A-Level Computer Science Revision Question Pack

(These are from the old spec but some effort has been made to ensure the questions are still relevant to the current exams.. If in doubt check the Specification!)

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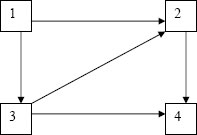
[Mark Schemes 426](#_Toc482104475)

The questions have been placed into topics… the question numbering is to allow for easier access to the mark scheme.. The number relates to the mark scheme number at the back.

The questions relate to A-Level only and are here to help you practice the topics you kow you are weak in.

# Programming concepts

**4.** The following diagram represents a directed graph.

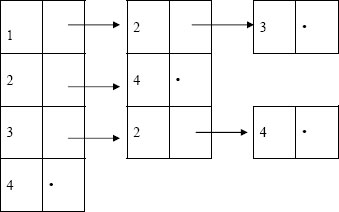


(a) By filling in the following diagram show how this digraph can be represented as an adjacency matrix.

|  |  |  |  |
| --- | --- | --- | --- |
| 1 2 3 4 | | | |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |

(3)

(b) This could also be represented as an adjacency list.



(i) Give **one** advantage of the adjacency list implementation.

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(1)

(ii) Give **one** advantage of the adjacency matrix implementation.

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(1)

(c) You are to use a graph for an application that has fixed nodes but requires regular addition and deletion of links between the nodes.

(i) Which implementation would you select?

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(1)

(ii) Explain why you chose this implementation.

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(2)

(Total 8 marks)

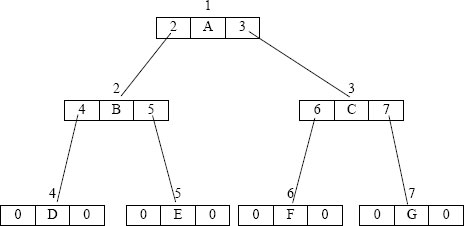
**9.** (a) Data may be stored as a binary tree. Show how the following data may be stored as a binary tree for subsequent processing in alphabetic order by drawing the tree in the space below. Assume that the first item is the root of the tree and the tree is created entering the data in the order given:

Manchester, Bradford, Halifax, Hull, Accrington, Dewsbury, Wakefield, York,

Wetherby, Sunderland

(5)

The nodes and branches in a binary tree may be visualised as follows:



(b) Explain with a sketch how the above representation could be stored in three one-dimensional arrays together with a variable that points to the root node. Your sketch should show each array and its contents.

(5)

(c) A procedure P, shown below, is used to output the data stored in the nodes of tree, T1, in ascending alphabetic order. The tree, T1, is shown in the figure below.



Procedure P (TreeNodePtr)

If LeftChild(TreeNodePtr) Exists

Then P(LeftChild(TreeNodePtr))

Output RootValue(TreeNodePtr)

If RightChild(TreeNodePtr) Exists

Then P(RightChild(TreeNodePtr))

EndProc

Trace by hand the procedure call P(1) for the given tree, T1, using the trace table shown in the table below.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Call | TreeNodePtr | Output in chronological order | | | | | | |
| No |  | First | Second | Third | Fourth | Fifth | Sixth | Seventh |
| 1 | 1 |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |
| 11 |  |  |  |  |  |  |  |  |

(11)

(d) What traversal does procedure P perform?

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(1)

(Total 22 marks)

**10.** (a) Explain briefly the main features of a recursive procedure from the programmer’s point of view. Explain what is required from the system in order to enable recursion to be used.

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(3)

(b) Nodes in a one way linked list consist of a data field and a pointer to the next node:

|  |  |
| --- | --- |
| Data | Ptr |

A variable called Start is a pointer to the first node of the list. The last node in the list stores the special value **Nil** as its pointer. This value points nowhere.



The function **X** is defined as follows:

Function X(Item)

If (Item.Ptr = Nil)

Then X  0

Else X  1 + X (Item.Ptr)

Access to each of the fields of a node is achieved by using the dot notation as follows:

Item.Data gives the value stored in the Data part of the node.

Item.Ptr gives the value stored in the Ptr part of the node.

Show the operation of function **X** when X(Start) is called using the linked list in the figure above:

(5)

(c) What is the purpose of this algorithm?

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(2)

(d) Write a recursive procedure in pseudo-code to print each of the data items in the list described in (b) in reverse order. Describe how to call your procedure.

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(5)

(e) Discuss the difficulties of a non-recursive solution to the problem given in (d). Explain the circumstances under which your recursive solution might fail. How could the data structure be modified in order to make a non-recursive solution comparatively simple?

*The quality of written communication will be assessed in your answer.*

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(5)

(Total 20 marks)

**12.** A binary search tree is used by software to store and then search for user names on a college network.

The following are the first seven user names to join the tree:

PollardJ, AtkinsP, RogersG, AbbottJ, SearleF, CollinsK, RuddleA

(a) Sketch the tree structure.

(2)

(b) The tree is to be searched for various user names.

(i) The task is to search for the user name **CollinsK**. List in order the nodes visited.

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(1)

(ii) A second search is done to find the user name **RuddleA**. How many comparisons does this require?

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(1)

(Total 4 marks)

**13.** A firm selling double glazing employs three sales staff. Each person is given a sales target for each of the four quarters of the year.

 Quarter 1 January – March

 Quarter 2 April – June

 Quarter 3 July – September

 Quarter 4 October – December

Based on all the sales made, the data in **Table 1** is produced showing whether or not each sales person achieved their target sales for each quarter. Each value is stored as a single character ‘Y’ (sales target met) or ‘N’ (sales target not met).

The columns represent each quarter, each row represents a salesperson.

**Table 1**



(a) What data structure could be used in a programming language for organising the data shown in **Table 1**?

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(1)

(b) One of the data values in **Table 1** has been emboldened. What does this value represent?

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(1)



(c) The following algorithm processes the data shown in **Table 1**. Trace the execution of the algorithm by completing **Table 2**.

For Quarter  1 To 4

Do NewArray [Quarter]  0

End For

For Person  1 To 3

Do

For Quarter  1 To 4

Do

If Target[Person, Quarter] = ’N’

Then NewArray [Quarter]  NewArray [Quarter] + 1

End If

End For

End For

**Table 2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Person | Quarter | Target[Person, Quarter] | NewArray  [1] [2] [3] [4] | | | |
|  | 1 |  | 0 |  |  |  |
|  | 2 |  |  | 0 |  |  |
|  | 3 |  |  |  | 0 |  |
|  | 4 |  |  |  |  | 0 |
| 1 | 1 | y |  |  |  |  |
|  | 2 | n |  | 1 |  |  |
|  | 3 | y |  |  |  |  |
|  | 4 | n |  |  |  | 1 |
| 2 | 1 | N | 1 |  |  |  |
|  | 2 | N |  | 2 |  |  |
|  | 3 | Y |  |  |  |  |
|  | 4 | y |  |  |  |  |
| 3 | 1 | N | 2 |  |  |  |
|  | 2 | N |  | 3 |  |  |
|  | 3 | N |  |  | 1 |  |
|  | 4 | n |  |  |  | 2 |

(6)

(d) Explain what numbers are being calculated and stored in the NewArray data structure.

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(2)

(Total 10 marks)

**17.** A library system uses three classes, **BookCopy**, **Borrower** and **Loan**. A BookCopy object represents a book, a Borrower object represents someone who borrows books and a Loan object represents the loan of a single BookCopy to a Borrower.

(a) Draw a class diagram to represent the relationships between these classes.

(3)

(b) The Borrower class has data fields Name and Address. The class definition for Borrower is

Borrower = Class

Public

Procedure AddNewBorrower

Procedure AmendBorrowerDetails

Procedure GetBorrowerDetails

Private

Name : String

Address : String

End

The BookCopy class has data fields Title, Author, OnLoan and ISBN. The class definition for BookCopy is

BookCopy = Class

Public

Procedure AddNewBookCopy

Procedure ChangeLoanStatus

Procedure GetBookDetails

Private

Title : String

Author : String

OnLoan : Boolean

ISBN : String

End

The Loan class needs operations (methods) to create a loan, delete a loan and get loan details. The data fields are the person, the book loaned, the date of the loan and the date of return.

Write the class definition for the Loan class.

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(4)

(c) The library has decided to introduce short-loan books in addition to standard-loan books. How would you modify the BookCopy class to allow for this change?

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(2)

(Total 9 marks)

**18.** A binary search tree has the following functions defined:

RootValue(T) Returns the value stored in the root node of the tree T

LeftChild(T) Returns the left child (subtree) of the root node of the tree T

RightChild(T) Returns the right child (subtree) of the root node of the tree T

A recursively-defined procedure P with a tree as a parameter is defined below.

Procedure P(T)

If RightChild(T) exists

Then P(RightChild(T))

Output RootValue(T)

If LeftChild(T) exists

Then P(LeftChild(T))

EndProc

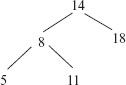
(a) What is meant by a recursively-defined procedure?

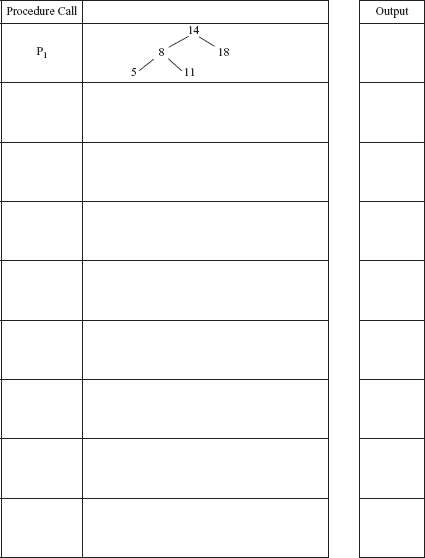
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(1)

(b) (i) Complete the table below by dry running the procedure call P(T) for the tree T given below.





(6)

(ii) What does the procedure P describe?

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(2)

(Total 9 marks)

**25.** A queue may be implemented by using either an array or a linked list.

(a) Give a disadvantage of

(i) an array implementation.

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(1)

(ii) a linked list implementation.

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(1)

(b) As items are added and removed in the array implementation the queue will gradually move along the array. How can the program deal with the situation when the end of the array is reached?

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(1)

(c) A queue is implemented with the following operations:

AddItem – add an item to the queue

RemoveItem – remove an item from the queue

FrontItem – obtain the item at the front of the queue

IsQueueEmpty – return true if the queue is empty, otherwise return false.

What additional operation is required if the queue is implemented using an array?

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(1)

(Total 4 marks)

**26.** An operating system implementing virtual memory for memory management uses 32-bit addresses that contain the following:



The page number is used to access the page table.

(a) Give **two** items of information that might be stored in a page table.

1. ................................................................................................................................

2. ................................................................................................................................

(2)

(b) Describe how a memory address is calculated using the virtual memory address and the page table.

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(3)

(c) State where the page table is likely to be stored in the computer system and explain why this location is chosen.

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(2)

(Total 7 marks)

**27.** A binary tree has the following functions defined

RootValue(T) Returns the contents of the root node of the tree T

LeftChild(T) Returns the left child of the root node of the tree T

RightChild(T) Returns the right child of the root node of the tree T

A recursively-defined procedure P with a tree as a parameter is defined below.

Procedure P(T)

If RightChild(T) Exists

Then P(RightChild(T))

Output RootValue(T)

If LeftChild(T) Exists

Then P(LeftChild(T))

EndProc

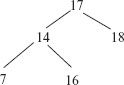
(a) What is meant by a recursively-defined procedure?

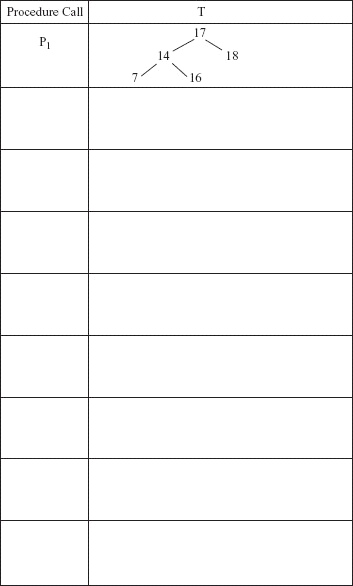
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(1)

(b) (i) Complete the table below by dry running the procedure call P(T) for the tree T given below





(7)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Output |  |  |  |  |  |

(ii) What does the procedure P describe?

..........................................................................................................................

(2)

(Total 10 marks)

**28.** For an object-oriented program to store and retrieve details of the boats moored in a marina, a **Boat** class is needed. Two subclasses have been identified: **MotorBoat** and **Yacht,** which have inheritance relationships with class **Boat.**

(a) Draw an inheritance diagram for these classes.

(2)

(b) The **Boat** class has data fields **Name, Length, Colour**.

The class definition for Boat is

Boat = Class

Public

Procedure SetBoatDetails

Function GetName

Function GetLength

Function GetColour

Private

Name : String

Length : Real

Colour : String

End

While preserving the private status of the Colour field, what modification would you make to this class definition in order to allow the colour of the boat to be changed?

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(2)

(c) The **Yacht** class has the following additional private data fields:

 **Masts** that represent the number of masts.

 **Engine** that represents whether the yacht has an engine or not.

Write the class definition for **Yacht.**

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(6)

(Total 10 marks)

**32.** **Figure 1** shows an area of 100 memory locations which are used to store string data values. This area of memory behaves as a queue. The Head and Tail values are used to control changes to the queue. **Figure 1** shows the state of the queue after three values have been added.

**Figure 1**

|  |  |
| --- | --- |
| Address | Memory contents |
| 99 |  |
| … |  |
| … |  |
| … |  |
| 7 |  |
| 6 |  |
| 5 |  |
| 4 |  |
| 3 |  |
| Tail 2 | ‘Frog’ | |
| 1 | ‘Dog’ | |
| Head 0 | ‘Cat’ | |

(a) What is the function of the Tail pointer?

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(1)

(b) Which item in the queue will be the first item to leave?

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(1)

**Figure 2**

|  |  |  |
| --- | --- | --- |
| Address | | Memory contents |
| 99 | |  |
| … | |  |
| … | |  |
| … | |  |
| 7 | |  |
| 6 | |  |
| 5 | |  |
| 4 | |  |
| 3 | |  |
| 2 | ‘Frog’ | | |
| 1 | ‘Dog’ | | |
| 0 | ‘Cat’ | | |

(c) Three new items join the queue in the order ‘Snake’, ‘Eel’ and ‘Shark’ and two items then leave.

Draw on **Figure 2** the new state of the queue, including the Head and Tail pointers.

(3)

(d) After extensive data changes the queue will become unusable. Explain why this is so.

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....................................................................................................................................

(2)

(Total 7 marks)

**39.**



(a) Assume a queue is implemented as a linked list using pointers as in the figure**.**

Give the **three** steps required to remove a node from the front of the queue and recover the memory space occupied by the node.

1 .................................................................................................................................

2 .................................................................................................................................

3 .................................................................................................................................

(3)

(b) A set of operations are defined to manipulate the contents of the queue. As well as *Remove* these include *FrontItem* and *IsQueueEmpty*.

Name another operation that would be essential to use this queue.

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(1)

(c) The queue could be implemented using an array instead of a linked list.

(i) What additional operation will be required if the queue is implemented using an array?

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(1)

(ii) Give **one** advantage of array implementation.

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(1)

(iii) Give **two** disadvantages of array implementation.

1 .......................................................................................................................

1 .......................................................................................................................

(2)

(Total 8 marks)

**40.** An integer array A contains the following items.

|  |  |
| --- | --- |
|  | A |
| [1] | 3 |
| [2] | 5 |
| [3] | 11 |
| [4] | 12 |
| [5] | 18 |
| [6] | 21 |
| [7] | 26 |
| [8] | 29 |
| [9] | 32 |

The operator DIV performs integer division. x DIV y calculates how many times y divides exactly into x. For example 7 DIV 3 = 2.

(a) Dry run the following algorithm by completing the trace table.

Number ← 12

Lower ← 1

Upper ← 9

While Lower<Upper

Current ← (Lower+Upper)DIV 2

If Number >= A [Current] Then Lower ← Current

If Number <= A [Current] Then Upper ← Current

EndWhile

Return Current

|  |  |  |  |
| --- | --- | --- | --- |
| Number | Lower | Upper | Current |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

|  |  |
| --- | --- |
| Value returned |  |

(8)

(b) What is the purpose of this algorithm?

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(1)

(Total 9 marks)

**41.** Many programs executed within a Graphical User Interface (GUI) environment are *object-oriented* and *event-driven.*

(a) Give an example of an event in this context.

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(1)

(b) Describe how event-driven programs differ from non event-driven programs.

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(2)

(c) List **two** features of an object.

1 .................................................................................................................................

2 .................................................................................................................................

(2)

(d) Name an object that might be part of a GUI.

...................................................................................................................................

(1)

(Total 6 marks)

**46.** A county has a number of local libraries in various towns. Books currently belong to each library and there is no system for the exchange of books between libraries.

New programs have to be written, as the decision has been made to have centralised records of library books.

The software house commissioned to write the new programs has obtained a complete list of titles held at each library. It found that a common system was used for the book codes. Some older books will not be retained and this is to be indicated by the ToBeRetained column in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| BookTitle | BookCode | YearFirstInStock | ToBeRetained |
| Hang-gliding made simple | T05320 | 1993 |  |
| Around the world in 80 days | T76542 | 2001 |  |
| My way | M11981 | 1990 |  |
| Starting with hypnotherapy | M79080 | 2005 |  |
| Kim Smith – the autobiography | M00876 | 1991 |  |
| XXX |  |  |  |

(a) Study the sample data shown in the table. This data will be accessed by program code. Name the most suitable **data type** which should be used for each data item. Each data type **must be different.**

(i) BookCode ........................................................................................................

(1)

(ii) YearFirstInStock ..............................................................................................

(1)

(iii) ToBeRetained ..................................................................................................

(1)

(b) The first application to be developed is a program to search the complete list of books and to calculate the data values for the ToBeRetained column; any books which were bought before 1992 will not be retained.

The incomplete pseudo-code which follows shows a first attempt at the algorithm. Data for each of the four attributes BookTitle, BookCode, YearFirstInStock, ToBeRetained are shown in the table above, and are to be stored in four arrays BookTitle, BookCode, YearFirstInStock and ToBeRetained.

Complete the pseudo-code in the **three** places indicated.

For Book  1 To TotalNoOfBooks

If YearFirstInStock[ (i) .................................... ] < 1992

Then ToBeRetained[Book] (ii) ....................................................

Else ToBeRetained[Book] (iii) ....................................................

EndIf

EndFor

(3)

(c) A second program is to be developed to allocate each book a new code number. The old book codes are to be abandoned. The first character of the old book code indicates the book’s location.

• This book location is to be retained and stored in an array Location.

• Each new book code will be a unique integer number that will be generated by the program. The first number will be 1.

Use will be made of a ‘built-in’ function StartString. It is defined in the help files as follows:

|  |
| --- |
| Function StartString(ThisString : String; NoOfCharactersToRetain : Integer) : String ;  The function is given the string ThisString and returns the number of characters specified by NoOfCharactersToRetain starting from the first character of ThisString. |

(i) What are the values of the **parameters** used in the following code?

NewString : = StartString(‘T76542’, 1)

1 ........................................................................................................................

2 ........................................................................................................................

(2)

(ii) What value is assigned to NewString when this code is executed?

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(1)

(iii) The pseudo-code for the algorithm to calculate the new book codes and the locations is shown below.

NextAvailableCode  1

Book  1

Repeat

If YearFirstInStock[Book] >=1992

Then

Begin

LocationLetter  StartString(BookCode[Book], 1)

If LocationLetter = ’T’

Then Location[Book]  ‘Torrington’

If LocationLetter = ‘M’

Then Location[Book]  ‘Morristown’

NewCode[Book]  NextAvailableCode

NextAvailableCode  NextAvailableCode + 1

End

Book  Book + 1

Until BookTitle[Book] = ’XXX’

Trace the execution of this algorithm by completing the trace table **Figure 2**; use the data shown in the table **Figure 1.**

Show also the final contents of the Location and NewCode arrays in **Figure 3** and **Figure 4.**

**Figure 1**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| BookTitle | |  | | BookCode |  | YearFirstInStock |
| [1] | Hang-gliding made simple | [1] | T05320 | | [1] | 1993 |
| [2] | Around the world in 80 days | [2] | T76542 | | [2] | 2001 |
| [3] | My way | [3] | M11981 | | [3] | 1990 |
| [4] | Starting with hypnotherapy | [4] | M79080 | | [4] | 2005 |
| [5] | Kim Smith – the autobiography | [5] | M00876 | | [5] | 1991 |
| [6] | XXX | [6] |  | | [6] |  |

**Figure 2**

|  |  |  |
| --- | --- | --- |
| NextAvailableCode | Book | LocationLetter |
| 1 | 1 | ‘T’ |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  | Figure 3 Location |  | Figure 4 New Code |
| [1] |  | [1] |  |
| [2] |  | [2] |  |
| [3] |  | [3] |  |
| [4] |  | [4] |  |
| [5] |  | [5] |  |

(6)

(Total 15 marks)

**47.** (a) State the principle of operation of a set of data values which behave as a stack.

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(1)

(b) Memory locations 600 to 605 are to be used as a stack area to store character data, and the first value added to the stack is to be stored at address 600.

**Figure 1** shows the initial empty state of the stack.

**Figure 1**

|  |  |
| --- | --- |
| 600 |  |
| 601 |  |
| 602 |  |
| 603 |  |
| 604 |  |
| 605 |  |

(i) Show on **Figure 2** the state of the stack after the characters ‘A’, ‘V’, ‘E’, ‘R’ and ‘Y’ join the stack.

**Figure 2**

|  |  |
| --- | --- |
| 600 |  |
| 601 |  |
| 602 |  |
| 603 |  |
| 604 |  |
| 605 |  |

(1)

(ii) Two items are removed from the stack. Show on **Figure 3** the state of the stack.

**Figure 3**

|  |  |
| --- | --- |
| 600 |  |
| 601 |  |
| 602 |  |
| 603 |  |
| 604 |  |
| 605 |  |

(1)

(iii) Two new characters ‘S’ and ‘P’ join the stack. Show on **Figure 4** the final state of the stack.

**Figure 4**

|  |  |
| --- | --- |
| 600 |  |
| 601 |  |
| 602 |  |
| 603 |  |
| 604 |  |
| 605 |  |

(1)

(c) The original items in this stack are to be reversed. This can be done using a second  
data structure which uses locations 700 to 705 respectively. The first item added to the  
stack was character ‘A’.

**Figure 5**



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 600 | ‘A’ | 700 |  |  | 600 |  |
| 601 | ‘V’ | 701 |  |  | 601 |  |
| 602 | ‘E’ | 702 |  |  | 602 |  |
| 603 | ‘R’ | 703 |  |  | 603 |  |
| 604 | ‘Y’ | 704 |  |  | 604 |  |
| 605 |  | 705 |  |  | 605 |  |

Stack Stack

(before the operation) (i) .......................... (after the operation)

(i) Name the second data structure. Label **Figure 5.**

(1)

(ii) Describe **Step 1** in **Figure 5.**

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(1)

(iii) Describe **Step 2** in **Figure 5.**

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(1)

(iv) Show on **Figure 5** the final contents of all the memory locations.

(2)

(Total 9 marks)

**52.** (a) In object-oriented programming, what is meant by aggregation?

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(1)

(b) An object-oriented program is required to handle details of items of furniture that are for sale. The furniture sold includes dining suites. A dining suite consists of a table and a number of chairs.

Some fields required for the suites are

TableType

ChairType

NumberOfChairs

A method required for the suites is

DisplayDetails

Some fields required for the tables are

TableType

Size

Colour

Some fields required for the chairs are

ChairType

Colour

(i) Draw **a class diagram** of these classes, Suite, Table and Chair.

(2)

(ii) Write class definitions for Chair, Table and Suite.

(8)

(Total 11 marks)

**53.** A *recursively-defined* procedure **ProcA** that takes two integers as parameters is defined below.

(a) What is meant by a recursively-defined procedure?

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(1)

(b) What is the role of the stack when a recursively-defined procedure is executed?

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(1)

(c) Dry run the procedure call **ProcA(11,1)** using the data in the array, **Items**, by completing the trace table below.

|  |  |  |
| --- | --- | --- |
|  |  | Items |
| Procedure ProcA (Number,Entry) | [1] | 4 |
| If Number <> Items[Entry] | [2] | 5 |
| Then ProcA (Number,Entry+1) | [3] | 8 |
| Else Output (Entry) | [4] | 11 |
| EndIf | [5] | 15 |
| EndProc | [6] | 19 |
|  | [7] | 21 |
|  | [8] | 28 |
|  | [9] | 33 |

|  |  |  |
| --- | --- | --- |
| Number | Entry | Output |
| 11 | 1 |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

(4)

(d) What is the purpose of this algorithm?

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(1)

(e) Give a situation where this algorithm will fail.

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(1)

(f) Suggest a modification to the algorithm that will prevent it from failing.

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(1)

(g) With an ordered array, Items, of many more entries, what more efficient algorithm could be used to achieve your expressed purpose in part (d)?

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(1)

(Total 10 marks)

**58.** The data shown below is a list of surnames of 20 motor car policyholders with the number of claims they have each made in the last five years.

|  |  |  |  |
| --- | --- | --- | --- |
|  | PolicyHolder |  | NoOfClaims |
| 1 | Wilcox | 1 | 1 |
| 2 | Adams | 2 | 0 |
| 3 | Pollard | 3 | 0 |
| 4 | Williams | 4 | 0 |
| 5 | Searle | 5 | 3 |
| 6 | Kelly | 6 | 0 |
| 7 | Lewis | 7 | 1 |
| 8 | Franks | 8 | 5 |
| 9 | Patel | 9 | 1 |
| 10 | Li Che | 10 | 0 |
| ... |  | ... | ... |
| ... |  | ... | ... |
| 19 | Wilkinson | 19 | 3 |
| 20 | Veale | 20 | 0 |

(a) (i) The user inputs a policyholder.  
If the surname is found, the program outputs the number of claims for that policyholder.

Read(SearchName)   
For P := 1 To 20 Do

If PolicyHolder[P] = SearchName

Then GoTo 200

GoTo 300

200 : Write(NoOfClaims[P])

300: End

Give **two** reasons why this is badly designed program code.

1 ......................................................................................................................

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2 ......................................................................................................................

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(2)

(ii) Write declaration statements (in a language with which you are familiar) for the PolicyHolder or NoOfClaims data structure above, and one other variable used in the code above.

The programming language I am using is ......................................................

1 ......................................................................................................................

2 ......................................................................................................................

(2)

(b) A new task is to design and write code to establish if there are any policyholders who have made five or more claims. The program will output a ‘yes’ or ‘no’ message only.

Write the code for this new task in a programming language with which you are familiar.

*(Hint: Use a loop structure to initiate the loop, and then end the loop when some condition is met.)*

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(5)

(Total 9 marks)

**62.** A stack may be implemented by using either an array or a linked list.

(a) Give a disadvantage of:

(i) an array implementation;

...........................................................................................................................

(1)

(ii) a linked list implementation.

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(1)

(b) Under what circumstances would it be more appropriate to use:

(i) an array;

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(1)

(ii) a linked list.

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(1)

(Total 4 marks)

**63.** A tree has the following functions defined:

RootValue(T) Returns the contents of the root node of the tree T   
LeftChild(T) Returns the left child of the root node of the tree T   
RightChild(T) Returns the right child of the root node of the tree T

A recursively-defined procedure P with a tree as a parameter is defined below.

Procedure P (T)  
 If LeftChild(T) exists   
 then P(LeftChild(T))   
 Output RootValue(T)   
 If RightChild(T) exists   
 then P(RightChild(T))   
EndProc

(a) What is meant by recursively-defined?

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(1)

(b) (i) Complete the table below by dry running the procedure call P(T) for the tree T given below.



|  |  |  |  |
| --- | --- | --- | --- |
| Procedure Call | T |  | Output |
| P1 |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
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|  |  |  |  |

(6)

(ii) What does procedure P describe?

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(2)

(Total 9 marks)

**64.** For an object-oriented program to store and retrieve details of a company’s vehicles, a Vehicle class is needed. **two** subclasses have been identified: **Car** and **Van**, which have inheritance relationships with class **Vehicle**.

(a) Draw an inheritance diagram for these classes.

(2)

(b) The Vehicle class has data fields RegistrationNumber, Make, Colour. The class definition for Vehicle is

Vehicle = Class  
 Public  
 Procedure SetVehicleDetails  
 Function GetRegistrationNumber  
 Function GetMake  
 Function GetColour   
 Private  
 RegistrationNumber : String  
 Make : String  
 Colour : String   
 End

While preserving the private status of the Colour field, what modification would you make to this class definition in order to allow the colour of the vehicle to be changed?

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(2)

(c) The Van class has additional private data fields:

• Capacity that represents the weight that can be carried in kilograms;

• TailLift that represents whether the van has a tail lift or not.

Write the class definition for **Van**.

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(6)

(Total 10 marks)

**68.** A retail store employs ten sales staff. Staff try to persuade customers to take out a store card with the company when they make a purchase. The store keeps a record of the number of new store cards issued by its sales staff over the first six months of the year.

**Table 1**

StoreCards

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | [1] | [2] | [3] | [4] | [5] | [6] |
| [1] | 12 | 12 | 6 | 8 | 3 | 2 |
| [2] | 12 | 17 | 7 | 4 | 5 | 6 |
| [3] | 2 | 12 | 0 | 12 |  |  |
| [4] | 4 | 10 | 7 | 4 |  |  |
| [5] | 5 | 0 | 0 | 0 | 0 | 0 |
| [6] | 6 | 1 | 4 | 6 | 7 | 8 |
| [7] | 12 | 19 | 12 | **16** | 17 | 6 |
| [8] | 13 | 9 | 7 | 3 | 4 | 5 |
| [9] | 12 | 8 | 4 | 4 | 5 | 4 |
| [10] | 14 | 11 | 12 | 4 | 5 | 6 |

The data is to be stored in a 2-dimensional array with identifier StoreCards as shown in the table above The first subscript of the array represents the row number (the salesperson number), and the second subscript the column number (the month).

(a) In the table the value 16 has been **emboldened**. Explain what this value represents.

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(2)

(b) Write a declaration statement for the array StoreCards.

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(2)

(c) Using the data given in the table abobe, write an assignment statement for the January sales for salesperson 8.

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(2)

(d) Study the pseudo-code below.

Input SalesPersonNumber  
PersonTotal ← 0  
For Month ← 1 to 6 Do  
 PersonTotal← PersonTotal + StoreCards[SalesPersonNumber, Month]  
End For   
Print PersonTotal

Explain what this algorithm is designed to do.

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(2)

(e) A number of programs are to be written for the store card application, and the following are some of the data values which will need to be stored and/or calculated.

State what data type the programmer would use for each data item below.

(i) Average overtime hours worked by each member of staff.

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(1)

(ii) Whether or not the staff are willing to work on Boxing Day.

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(1)

(iii) The number of customer complaints made about each member of staff.

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(1)

(Total 11 marks)

**76.** A *linear search* and a *binary search* are **two** different methods of searching an ordered list. A given list contains 271 items.

(a) (i) What is the maximum number of items accessed when searching for a particular item from the given list using a linear search?

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(1)

(ii) Explain your answer.

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(1)

(b) (i) What is the maximum number of items accessed when searching for a particular item from the given list using a binary search?

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(1)

(ii) Explain your answer.

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(1)

(c) An integer array A contains the following items.

A

|  |  |
| --- | --- |
| [1] | 23 |
| [2] | 45 |
| [3] | 16 |
| [4] | 12 |
| [5] | 31 |

(i) Dry run the following algorithm by completing the trace table.

For Count1 ← 1 To 4  
 For Count2 ← 1 To 4  
 If A[Count2] > A[Count2 + 1] Then  
 Temp ← A [ Count2]   
 A[Count2] ← A[Count2 + 1]  
 A[Count2 + 1] ← Temp   
 EndIf   
 EndFor   
EndFor

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Count 1 | Count2 | Temp | A | | | | |
|  |  |  | [1] | [2] | [3] | [4] | [5] |
| – | – | – | 23 | 45 | 16 | 12 | 31 |
| 1 | 1 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |  |

(5)

(ii) What is the purpose of this algorithm?

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(1)

(iii) Suggest **one** way the algorithm could be improved.

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(1)

(Total 11 marks)

**80.** (a) Dry run the following algorithm by completing the trace table.

x  5  
y  3  
Result  1  
REPEAT  
 Result  Result \* x  
 y  y – 1  
UNTIL y=0

|  |  |  |
| --- | --- | --- |
| **x** | **y** | **Result** |
| 5 | 3 | 1 |
|  |  |  |
|  |  |  |
|  |  |  |

(7)

(b) What is the purpose of this algorithm?

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(1)

(Total 8 marks)

**83.** Processes are rated in priority according to their expected running times. Processes with the shortest running times are given top priority. A process joining the list will be placed immediately after all other processes of equal or higher priority. The name of the process indicates the order in which it joined the list. Process6 joined the list before Process7.

The table below contains for each process its name, the memory address of its process control block, its expected running time and a pointer to the position in the table of the next process to be executed.

Processes are entered in the table wherever there is a free slot.

(i) Complete the pointer column after the following processes have been placed in the table:

HeadPointer = 6

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Position | Name | Running Time | Address | Pointer |
| 1 | Process6 | 7 | 01400 |  |
| 2 |  |  |  |  |
| 3 | Process7 | 17 | 01700 |  |
| 4 | Process2 | 17 | 02300 |  |
| 5 | Process9 | 45 | 04100 |  |
| 6 | Process5 | 2 | 01200 |  |
| 7 |  |  |  |  |
| 8 | Process19 | 5 | 01900 |  |

(3)

(ii) The scheduler program is written in a high level language. Name and describe a suitable data structure for this table.

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(2)

(iii) The Computer System Manager may wish to view the current order in which the runnable processes are predicted to run. Write an algorithm that will print the process names in runnable order.

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(4)

(iv) Name another list of processes that must be maintained by the operating system. Explain why the processes are in this list.

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(2)

(Total 11 marks)

**84.** (a) State **two** advantages of the object-oriented approach to program design over the structured approach to program design.

1 ..................................................................................................................................

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2 ..................................................................................................................................

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(2)

(b) A golf club keeps details of its members. Each member has a unique membership number, first name, surname and telephone number recorded. Three classes have been identified:

Member  
MidWeekMember  
FullMember

The classes *MidWeekMember* and *FullMember* are related, by single inheritance, to the class Member.

Draw an inheritance diagram for the given classes.

(2)

(c) Programs that use objects of the class *Member* need to add a new member’s details, amend a member’s details, and show a member’s details. No other form of access is to be allowed. Write a class definition for this class.

Member = Class

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End

(4)

(Total 8 marks)

**91.** (a) In the context of data structures what is meant by the terms:

(i) FIFO; .......................................................................................................................

(ii) LIFO? .......................................................................................................................

(2)

(b) Queue and stack are examples of data structures. Tick in the following table to indicate whether they are FIFO or LIFO data structures.

|  |  |  |
| --- | --- | --- |
|  | FIFO | LIFO |
| Queue |  |  |
| Stack |  |  |

(2)

(c) Describe **one** example of the use of a stack.

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(2)

(d) Describe **one** example of the use of a Binary Search Tree.

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(2)

(Total 8 marks)

**93.** The following algorithm uses an array Values that contains the integers 4,7,9.

(a) Dry run this algorithm by using the trace table below.

Last  3  
New  6  
Ptr  1  
WHILE(New > Values[Ptr])  
 Ptr  Ptr + 1  
ENDWHILE  
WHILE (Last >= Ptr)  
 Values[Last+1]  Values[Last]  
 Last  Last – 1  
ENDWHILE  
Values[Ptr]  New

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| New | | Last | | Ptr | | Values | | | | | |
|  | |  | |  | | [1] | [2] | [3] | [4] | [5] |
| 6 | | 3 | | 1 | | 4 | 7 | 9 |  |  |
|  | |  | |  | |  |  |  |  |  |
|  | |  | |  | |  |  |  |  |  |
|  | |  | |  | |  |  |  |  |  |
|  | |  | |  | |  |  |  |  |  |

(6)

(b) What is the purpose of this algorithm?

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(1)

(Total 7 marks)

**95.** Write down the comparisons needed to look up *Pascal* using a binary search on the following alphabetically sorted list:

Basic, Fortran, Java, Lisp, Pascal, Prolog, Smalltalk.

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(Total 3 marks)

**97.** (a) In object-oriented programming, what is meant by inheritance?

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(1)

**97.** (a) In object-oriented programming, what is meant by inheritance?

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(1)

(b) An object-oriented program is required to handle details of a lending library’s books and CDs.

Some fields required for the books are:  
Title,  
Author,  
ISBN,  
OnLoan,  
DateAcquired.

Some fields required for the CDs are:  
Title,  
Artist,  
PlayingTime,  
OnLoan,  
DateAcquired.

Some methods required are:  
SetLoan,  
DisplayDetails

This could be implemented by declaring two separate classes Book and CD. This would result in a lot of repetitive code. Making use of inheritance, **write** class definitions for one superclass **StockItem** and two subclasses **Book** and **CD**.

(7)

(Total 8 marks)

**98.** A *recursively-defined* procedure **Process**, which takes an integer as its single parameter, is defined below.

(a) What is meant by recursively-defined?

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(1)

(b) Describe how a stack is used in the execution of procedure **Process**?

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(2)

(c) Dry run the procedure call **Process(1)**, using the data in the table below, showing clearly the order the values are printed.

Procedure Process (P)  
 Print (P)  
 If Table[P].Left <> 0  
 Then Process (Table[P].Left)  
 EndIf  
 Print (Table[P].Data)  
 If Table[P].Right <> 0  
 Then Process (Table[P].Right)  
 EndIf  
EndProcedure

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Table** |  |
|  | **Data** | **Left** | **Right** |
| [1] | Jones | 3 | 2 |
| [2] | Smith | 0 | 0 |
| [3] | Bremner | 5 | 4 |
| [4] | Fortune | 0 | 0 |
| [5] | Bird | 0 | 0 |

Printed Output: ...........................................................................................................

.....................................................................................................................................

(6)

(d) What does procedure Process describe?

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(1)

(Total 10 marks)

**106.** A stack is a type of abstract data type (ADT) that is often known as a LIFO data type. A stack with a single element 27 may be drawn as follows:



(a) What is the meaning of the term LIFO?

.....................................................................................................................................

(1)

(b) A stack has two operations, **Push** and **Pop**. **Push n** adds item **n** to stack. **Pop** removes one item from the stack. A number of operations are performed, **in sequence**, on the stack drawn above. Using the stack diagrams below show the effect of this sequence of operations.

(i) Push 5 

(1)

(ii) Push 9 

(1)

(iii) Pop 

(1)

(iv) Push 6 

(1)

(c) Give **one** example of the use of a stack.

.....................................................................................................................................

(1)

(Total 6 marks)

**111.** A *recursively-defined* procedure B, which takes an integer as its single parameter, is defined below. The operators DIV and MOD perform integer arithmetic.  
x DIV y calculates how many times y divides exactly into x. For example 7 DIV 3 = 2  
x MOD y calculates the remainder that results. For example 7 MOD 3 = 1.

Procedure B (Number)   
 If (Number = 0) OR (Number = 1)  
 Then Print (Number)  
 Else  
 B (Number DIV 2)  
 Print (Number MOD 2)

EndIf  
EndProcedure

(a) What is meant by recursively-defined?

.....................................................................................................................................

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(1)

(b) Why is a stack necessary to execute procedure B recursively?

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(1)

(c) Dry run the procedure call *B(53)* showing clearly the values of the parameter and the printed output for the six calls of *B*.

|  |  |
| --- | --- |
| Call Number | Parameter |
| 1 | 53 |
| 2 | 26 |
| 3 | 13 |
| 4 |  |
| 5 |  |
| 6 |  |

Printed Output: ..........................................

(6)

(d) What process does procedure B describe? .................................................................

(1)

(Total 9 marks)

**112.** Write down the comparisons needed to look up *Newcastle* using a binary search on the following list:

Birmingham, Coventry, Liverpool, Manchester, Newcastle, Sheffield, York.

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(Total 3 marks)

**113.** (a) High level languages can be classified as: *imperative, declarative, event-driven*.  
What is meant by **each** of these terms? Give an example of each language.

(i) Imperative

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...........................................................................................................................

Example ............................................................................................................

(2)

(ii) Declarative

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...........................................................................................................................

Example ............................................................................................................

(2)

(iii) Event-driven

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Example ............................................................................................................

(2)

(b) (i) In object-oriented programming, what is meant by encapsulation?

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(1)

(ii) For an object-oriented program to store and display personal details of members of a golf club, a Member class needs to be declared with the properties Surname, First Name, Telephone Number, Handicap (must be a whole number).

Write a class definition for the class Member to allow the program to use objects of this class to add a new member’s details, amend a member’s details, display a member’s details. No other form of access is to be allowed.

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(4)

(Total 11 marks)

**117.** A binary search tree is a data structure where items of data are stored such that they can be searched for quickly and easily.

The following data items are to be entered into a binary search tree in the order given:

Louise, Peter, Robert, Christine, Alan, Leslie, Maria

(a) Draw a diagram to show how these values will be stored in the tree.

(4)

(b) Circle the root node in your diagram.

(1)

(c) If Maria is being searched for in this binary tree, list the data items which have to be accessed.

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(1)

(Total 6 marks)

**119.** The following algorithm uses an array **Values** containing four numbers.

|  |  |
| --- | --- |
|  | Values |
| 1 | 24 |
| 2 | 13 |
| 3 | 57 |
| 4 | 45 |

Result  0  
Index  0  
Repeat  
 Index  Index + 1  
 If Result < Values[Index]  
 Then Result  Values[Index]  
 EndIf  
Until Index = 4

(a) Dry run this algorithm by using the trace table below.

|  |  |
| --- | --- |
| **Result** | **Index** |
| 0 | 0 |
|  |  |
|  |  |
|  |  |
|  |  |

(5)

(b) What is the purpose of this algorithm?

.....................................................................................................................................

(1)

(Total 6 marks)

**122.** For an object-oriented program to store and calculate payroll details for an organisation, an Employee class is needed. A subclass has been identified: **HourlyPaidEmployee**, which has an inheritance relationship with class **Employee**.

(a) Draw an inheritance diagram for these classes.

(2)

(b) The **Employee** class has data fields *Name*, *National Insurance Number*, *Annual Pay*,  
*Gross Pay To Date*.

The class definition for **Employee** is

TEmployee = Class  
 Public  
 Procedure AddNewEmployee  
 Procedure AmendEmployeeDetails  
 Procedure PrintPaySlip  
 Procedure CalculatePay  
 Private  
 Name : String  
 NationalInsuranceNumber : String  
 Annual Pay : Currency  
 GrossPayToDate : Currency  
End

Monthly pay for an employee object of **TEmployee** class definition is calculated differently from the monthly pay for an employee object of **THourlyPaidEmployee** class definition.

In the case of an employee object of class definition

 **THourlyPaidEmployee**: monthly pay is calculated by multiplying number of hours worked in month by hourly pay rate.

 **TEmployee**: monthly pay is calculated by dividing the annual pay by 12.

An hourly paid employee object needs one additional operation, which collects the number of hours worked in a month.

Write the class definition **THourlyPaidEmployee:**

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(6)

(Total 8 marks)

**124.** A recursively-defined procedure X with three integer parameters is defined below.  
*x* DIV *y* calculates how many times *y* divides exactly into *x*. For example 7 DIV 3 = 2.

Procedure X (E,L,H)  
 If L > H  
 Then Print ‘False’  
 Else M  (L+H) DIV 2  
 If E = List[M]  
 Then Print ‘True’  
 Else  
 If E < List[M]  
 Then X (E,L,M–1)  
 Else X (E,M+1,H)  
 Endif  
 Endif  
 Endif  
EndProc

(a) What is meant by recursively-defined?

.....................................................................................................................................

(1)

(b) (i) Using the table below, dry-run the procedure call X (6502, 1, 11) applied to the integer array *List* containing the following elements:

|  |  |
| --- | --- |
| **Index** | **List** |
| 1 | 1234 |
| 2 | 1789 |
| 3 | 3125 |
| 4 | 4789 |
| 5 | 5006 |
| 6 | 5789 |
| 7 | 6502 |
| 8 | 7411 |
| 9 | 8407 |
| 10 | 8971 |
| 11 | 9053 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **E** | **L** | **H** | **M** | **List[M]** | **Printed Output** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

(7)

(ii) What process does procedure X describe?

...........................................................................................................................

(2)

(Total 10 marks)

**129.** The algorithm below re-arranges numbers stored in a one-dimensional array called **List**. **Ptr** is an integer variable used as an index (subscript) which identifies elements within **List**. **Temp** is a variable, which is used as a temporary store for numbers from **List**.

Ptr  I  
While Ptr < 10 Do  
 If List [Ptr] > List [Ptr+ 1] Then  
 Temp  List [Ptr]  
 List [Ptr]  List [Ptr+l]  
 List [Ptr+l]  Temp  
 Endif  
 Ptr  Ptr+ 1  
Endwhile  
.......

(a) Dry-run the algorithm by completing the table below,

It is only necessary to show those numbers which change at a particular step.



(7)

(b) What will happen when **Ptr**= 10?

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(1)

(c) If the whole algorithm is now applied to this rearranged list, what will be the values of:

(i) List[1] ...............................................................................................................

(ii) List[9] ...............................................................................................................

(iii) List[10]? ...........................................................................................................

(3)

(Total 11 marks)

**132.** (a) (i) The birds Pheasant, Teal, Widgeon, Partridge, Woodpigeon are entered, in the order given, into a linked list so that they may be processed alphabetically. Draw this linked list.

(2)

(ii) Redraw the list after two additional items, Grouse and Snipe, are added.

(2)

(b) This linked list is said to be a *dynamic structure.* What is meant by the term dynamic structure?

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(2)

(c) Explain how memory was allocated for the two additional data items.

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(2)

(Total 8 marks)

**133.** A *binary* search and a *linear* search are two different methods of searching a list.  
A given list contains 137 items.

(a) (i) What is the maximum number of items accessed when searching for a particular item from the given list using a binary search?

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(ii) Explain your answer.

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(b) (i) What is the maximum number of items accessed when searching for a particular item from the given list using a linear search?

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(ii) Explain your answer.

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(4)

(Total 4 marks)

**136.** (a) State **two** advantages of the object-oriented approach to program design over the structured approach to program design.

1 ..................................................................................................................................

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2 ..................................................................................................................................

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(2)

(b) A sailing club has both junior and senior members. Each member has a unique membership number, a name and an address recorded. Three classes have been identified:

Member

JuniorMember

SeniorMember

The classes JuniorMember and SeniorMember are related, by single inheritance, to the class Member.  
Draw an inheritance diagram for the given classes.

(2)

(c) Programs that use objects of the class Member need to add a new member’s details, amend a member’s details, and show a member’s details. No other form of access is to be allowed. Write a class definition for this class.

Member = **Class**

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**End;**

(4)

(Total 8 marks)

**143.** Describe how the elements in a non-empty queue are reversed with the aid of a stack.

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(Total 4 marks)

**144.** One of the concepts of Object Oriented Programming is *containment*.

Class TForm1 inherits from class TForm.

A form, Form1, of class Tform1, contains 2 buttons, Button1 and Button2, of class TButton.

Write the class definition for TForm1.

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(Total 3 marks)

**146.** The list **Days** contains the following representation of the days of the week.

[Sun, Mon, Tue, Wed, Thu, Fri, Sat]

The table below shows some functions which take a list as their single argument and return a result which is either an element of a list, another list, or a Boolean value.

|  |
| --- |
| **Head(list)** - returns the element at the head of **list** (e.g. Head(Days) Sun)  if **list** is non empty otherwise it reports an error. |
| **Tail(list)** - returns a new list containing all but the first element of the original list (e.g. Tail(Days)  [Mon, Tue, Wed, Thu, Fri, Sat]) if **list** is non-empty  otherwise it reports an error. |
| **Empty(list)** - returns True if **list** is the empty list or False otherwise. The empty list is denoted by[] |

(a) What result is returned when the following function calls are made?

(i) Head (Tail(Days)).............................................................................................

(1)

(ii) Tail ([(Head(Days)]).........................................................................................

(1)

(iii) Empty(Tail(Tail(Tail(Days)))).........................................................................

(1)

(b) Explain why it is faster to access these elements if the above data is stored as a one dimensional array.

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(2)

(Total 5 marks)

**147.** An algebraic expression is represented in a binary tree as follows.



(a) On the above diagram, circle and label the *root* of this tree, a *branch* and a *leaf node*.

(3)

(b) In the spaces below, draw the *left sub-tree* and the *right sub-tree* of this tree.



(2)

(c) What is the result if this tree is printed using in-order traversal?

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(3)

(Total 8 marks)

**158.** (a) In an object-oriented, computerised encyclopaedia, there is a class called *Creatures*. Two sub-classes of Creatures are *Spiders* and *Beetles*. Draw an inheritance diagram for this.

(2)

(b) For the sub-class Spiders suggest:

(i) **one** property;

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(ii) **one** method.

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(2)

(Total 4 marks)

**161.** The list Ports contains the following names:

[Southampton, Barcelona, Athens, Alexandria, Tunis, Lisbon]

The table below shows some functions which take a list as their single argument and return a result which is either an element of a list or a boolean value.

|  |
| --- |
| Head(list) – If the list is non-empty, it returns the element at the head of the list (e.g. Head (Ports)  Southampton) otherwise it reports an error |
| Tail(list) – If the list is non-empty it returns a new list containing all but the first element of the original list, otherwise it reports an error |
| Empty(list) – if the list is the empty list it returns True otherwise it returns False. The empty list is donated by [ ] |

(a) What result is returned when the following function calls are made?

(i) Tail(Ports) .......................................................................................................

..........................................................................................................................

(1)

(ii) Head(Tail(Tail(Ports))) ...................................................................................

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(2)

(iii) Empty(Tail(Tail(Tail(Tail(Tail(Tail(Ports))))))) ............................................

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(2)

A *recursively defined* procedure P, which takes a list as its single parameter, is defined below.

Define Procedure P(list)  
 If Not Empty(list)  
 Then  
 P(Tail(list))  
 Print Head(list)  
 EndIf  
EndDefine

(b) What is meant by recursively defined?

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(1)

(c) Explain why a stack is needed to execute procedure P recursively.

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(2)

(d) For the procedure call P(Ports) give the PRINTed output in the order in which it is produced.

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(4)

(e) Complete the table to show the list Ports as a linked list so that the ports can be accessed in alphabetical order.



(2)

(Total 14 marks)

**163.** The operators DIV and MOD perform integer arithmetic.  
x DIV y calculates how many times y divides into x, for example 7 DIV 3 = 2.  
x MOD y calculates the remainder that results after the division, for example 7 MOD 3 = 1.

(a) The following algorithm uses an array Result. Dry run this algorithm by completing the trace table below.



(6)

(b) What is the purpose of this algorithm?

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(1)

(Total 7 marks)

**169.** For the expression 3+x the binary tree stores + at the root, 3 at the left hand node and x at the right hand node. If the nodes of this tree are printed as the tree is traversed, what will be printed when the traversal is

(a) pre-order; ....................................................................................................................

(b) in-order; ......................................................................................................................

(c) post-order? ..................................................................................................................

(Total 3 marks)

**170.** A procedure to process an array of numbers is defined as follows.

Procedure P(Number)  
 Repeat  
 X  StartofArray  
 Flag  False  
 Repeat  
 If Number(X) > Number (X+ 1)  
 Then  
 Begin  
 Temp  Number(X)  
 Number (X)  Number (X+ 1)  
 Number(X+I)  Temp  
 Flag  True  
 End  
 X  X+l  
 Until EndofArray  
 Until Flag = False  
Endproc

The array number, containing 17, 11, 21, 9, 23, 15, is to be processed by this procedure.

(a) List the array after the outer Repeat loop has been executed once.

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(2)

(b) What algorithm does the procedure P describe?

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(1)

(c) What is the purpose of Flag in this procedure?

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.....................................................................................................................................

(1)

(Total 4 marks)

171. The following data is input to a program, in alphabetical order, and is stored.

Anne  
Bob  
Claire  
Dean

(a) Draw a diagram to show how this data is stored for:

(i) a stack;

(ii) a queue.

(4)

(b) One item is retrieved from these data structures for processing, and Eden is input.

Draw the diagrams of this new situation for:

(i) the stack;

(ii) the queue.

(3)

(c) Why are queues in computer systems usually implemented as circular queues?

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(2)

(Total 9 marks)

**172.** A supermarket has a section labelled ‘Bottled Water’. Bottled water comes as ‘still bottled water’ or ‘carbonated bottled water’.

In an object-oriented program, ‘bottled water’, ‘still bottled water’ and ‘carbonated bottled water’ are three defined *classes.* The classes ‘still bottled water’ and ‘carbonated bottled water’ are related, by single *inheritance,* to ‘bottled water’.

(a) What is meant here by

(i) class? ................................................................................................................

..........................................................................................................................

(ii) inheritance? ......................................................................................................

...........................................................................................................................

(2)

(b) Draw an inheritance diagram for the given classes.

(3)

(c) Give **three** advantages of the object-oriented approach to programming over a structured approach.

1 ..................................................................................................................................

.....................................................................................................................................

2 ..................................................................................................................................

.....................................................................................................................................

3 ..................................................................................................................................

.....................................................................................................................................

(3)

(Total 8 marks)

**186.** A binary search tree is a data structure where items of data are held such that they can be searched for quickly and easily.  
The following data items are to be entered into a binary search tree in the order given:

London, Paris, Rome, Berlin, Amsterdam, Lisbon, Madrid.

(a) Draw a diagram to show how these values will be stored.

(4)

(b) Circle the root node in your diagram.

(1)

(c) If Madrid is being searched for in this binary tree, list the data items which have to be accessed.

....................................................................................................................................

(1)

(Total 6 marks)

**190.** The memory of a computer holds an array of records, each of which includes name, address and other information.

(a) What condition is necessary for the binary search (binary chop) process to work correctly?

(2)

(b) Describe this process to find the position in the array of the record containing a given name.

(5)

(c) Why is this search method normally faster than a linear search?

(2)

(Total 9 marks)

**191.** The plan below shows the layout of the Mass Transit Railway (MTR) in Hong Kong. The maintenance depot is at Mong Kok.



All the trains operate the same cycle (sequence) of journeys, given by the algorithm below. The algorithm is intended to ensure that:

1. trains are serviced as soon as possible after covering 135 km, and

2. each train will have travelled in both directions along each track at least once in the cycle.

The algorithm relates to three arrays called *station*, *journey* and *km*. The contents of these arrays are shown below.

|  |  |
| --- | --- |
| Subscript | **Station** |
| 0 | Mong Kok depot (MK) |
| 1 | Tsuen Wan (TW) |
| 2 | Quarry Bay (QB) |
| 3 | Sheung Wan (SW) |
| 4 | Chai Wan (CW) |
| 5 | Hong Kong Central (HK) |

-

|  |  |
| --- | --- |
| Subscript | **Journey** |
| 0 | 3 |
| 1 | 4 |
| 2 | 3 |
| 3 | 1 |
| 4 | 5 |
| 5 | 2 |
| 6 | 3 |

The 6 × 6 two-dimensional array **km**, representing the distance between stations (in kilometres), contains



The proposed algorithm is:

org:=0  
last := 1  
dest:= 3  
maintain := FALSE  
start := station[org]  
finish := station[dest]  
totalkm := km [org, dest]  
org := dest

**while**(TRUE)  
**n** := 0  
**repeat**

n := n + 1  
**if** (maintain = TRUE) **then**

n := last  
 totalkm := 0  
 maintain := FALSE

**endif**

dest := journey [n]  
if (totalkm > 135) then

dest := 0  
last := n  
maintain := TRUE

**endif**

start := station[org]  
finish := station[dest]  
totalkm := totalkm + km[org, dest]  
org := dest

**until** n >= 6

**endwhile**

(a) What is the effect of the instructions **while**(TRUE) and **endwhile**?

(1)

(b) For each of the variables *maintain* and *n*, state with a reason what data type it should be.

(4)

(c) Copy and complete the trace table below, for one iteration of the outer (**while** .... **endwhile**) loop.



(8)

(d) An objective of the algorithm is that each train has travelled in both directions along every track at least once in the cycle. Using your trace table, state, with reasons, whether this objective has been achieved.

(2)

(Total 15 marks)

**192.** A bank is allowing its customers to use the Internet in order to manage their accounts from home.

(a) Give **three** security features that the bank can use against fraud.

(3)

(b) The bank is maintaining personal records and is subject to Data Protection legislation. Give **three** responsibilities that the bank has under this legislation.

(3)

(Total 6 marks)

**195.** Data is held in a linked list. The array animals contains records with the content shown.

|  |  |  |
| --- | --- | --- |
| Subscript | Data | Pointer |
| 1 | Elephant |  |
| 2 | Deer |  |
| 3 | Bear |  |
| 4 | Rabbit |  |
| 5 | Cow |  |
| 6 |  |  |

(a) Give the values that would be needed in the pointer field of each non-empty record to produce a list in alphabetical order. A pointer value of zero indicates the end of the list.

(2)

(b) The variables *Start* and *Freestorage* are used to point to the start of the list and the next free space, respectively. What values should they contain?

(2)

(c) Describe the steps needed to add “Monkey” to the list.

(5)

(Total 9 marks)

**196.** The algorithm below shows a procedure called sort.

/*/numbers is a global array of integers  
// max is a global integer holding the number of values to be sorted*

**procedure** sort

integer: cp, rp, temp, count  
rp := 1

**repeat**

rp := rp+1  
 cp := 1  
 **while** rp > cp **do**  
 **if** numbers[rp] > numbers[cp] **then**  
 temp := numbers[rp]  
 **for** count := rp **to** cp + 1 **step** – 1  
 numbers[count] := numbers[count – 1]  
 **endfor** numbers[cp] := temp  
 **endif**  
 cp := cp+1  
 **endwhile**  
**until** rp = max

**endproc**

(a) Using the column headings shown below, trace the algorithm for the procedure *sort* when the array *numbers* contains the values 13, 25, 24 and max = 3.



(10)

(b) Name the sort method used in the algorithm above.

(1)

(c) Why would this method be inefficient if the array *numbers* contained 500 values?

(2)

(Total 13 marks)

**215.** The following section of pseudo-code processes a one-dimensional integer array called *List.* The numbers in *List* are stored in ascending order, and x, *Low, High, Middle* are all integer variables. (The function Int returns the whole number part of its parameter.)

Proc Process(Low, High, x)

FoundFalse  
Repeat  
 MiddleInt((Low **+** High)/2)  
 If List(Middle) = x  
 Then FoundTrue  
 Else If List(Middle) **>** x  
 Then High Middle –1  
 Else Low Middle +1 {List(Middle) <x}  
Until Found = True

(a) Complete the following dry-run table for Process (1, 10, 19), given that the integers in the list are:

2,4, 6, 7, 11, 13, 19, 21, 27, 29

|  |  |  |  |
| --- | --- | --- | --- |
| **Low** | **High** | **Middle** | **Found** |
| 1 | 10 |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

(7)

(b) What type of routine does this pseudo-code define?

......................................................................................................................................

(1)

(Total 8 marks)

**216.** (a) Give **two** desirable properties of a hashing algorithm for a direct access file.

1 ............................................................................................................................

2 ............................................................................................................................

(2)

(b) A dynamic direct access file needs to be re-organised after a period of use. Briefly explain the need for re-organisation.

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(3)

(Total 5 marks)

**219.** A vehicle manufacturer of both cars and lorries has a computer system programmed in an object-oriented language. Three classes have been identified:

Vehicle  
Car  
Lorry

The classes Car and Lorry are related by single inheritance to the class Vehicle.

(a) In object-oriented programming what is meant by:

(i) a class;

(1)

(ii) inheritance?

(1)

(b) Draw an inheritance diagram for the given classes.

(3)

(Total 5 marks)

**220.** An algebraic expression is represented in a binary tree as follows:



(a) Using a copy of this tree, label its *root*, a *branch* and a *leaf node.*

(3)

(b) On the same copy, mark and label the *left sub-tree* and the *right sub-tree* of this tree.

(2)

A recursively-defined procedure T, which takes a tree structure, tree(x, y, z) as its single parameter, where x is the root, y is the left sub-tree and z is the right sub-tree, is defined below (<> means not equal to).

Procedure T (tree(x, y, z))

If y <> empty  
 Then  
 PRINT ‘)’  
 T(y)  
EndIf  
 PRINT x  
 If z <> empty  
 Then  
 T(z)  
 PRINT ‘)’  
 EndIf  
EndProc

(c) What is meant by *recursively-defined*?

(1)

(d) Explain why a stack is necessary in order to execute procedure T recursively.

(3)

(e) Dry run the following procedure call

T ( tree( ‘\*’, tree (‘+’, tree (‘A’, empty, empty), tree (‘B’, empty, empty) ),  
 tree (‘–’, tree (‘C’, empty, empty), tree (‘D’, empty, empty) )  
 )  
)

showing clearly the PRINTed output and the values of the parameter omitted from the table (rows 4, 5, 6, 7) for the **seven** calls of T.

|  |  |
| --- | --- |
| **Call Number** | **Parameter** |
| 1 | tree(‘\*’, tree(‘+’, tree(‘A’,empty,empty), tree(‘B’,empty,empty) ),  tree(‘–’, tree(‘C’,empty,empty), tree(‘D’,empty,empty) )  ) |
| 2 | tree(‘ +’, tree(‘A’,empty,empty), tree(‘B’,empty,empty) **)** |
| 3 | tree(‘A’,empty,empty) |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |

(10)

(f) What tree traversal algorithm does procedure T describe?

(1)

(Total 20 marks)

**221.** Electronic messages of various kinds are sent between machines as sequences of binary bits. Each character in a message is encoded as a particular sequence of bits. A tree can be used to encode and decode messages. The diagram below is a simple example, in which the codes for the letters **a, b, n** and **s** are given by looking at the routes taken to reach the letters. For example, the letter **b** is reached by going right at the top node and left at the next, which gives the code **10** (**1** for right and **0** for left) while the letter **a** is reached by going left at the top node giving the code 0.



A message is also decoded using the tree. The message **100** is decoded by following the route through the tree, moving right(**1**) then left(**0**) to give **b** and then starting again from top, moving left(**0**) to give **a.**

(a) Encode the message **banana.**

(1)

(b) Decode the message **100111110.**

(1)

(c) Suggest how the leaf nodes in the tree should be re-arranged, without altering the basic shape of the tree, to minimise the number of bits used to encode the message **banana.**

(2)

(d) The tree is extended, with each left branch being a leaf node, so that it can encode all the lower case letters of the alphabet and a space. What is the length of the longest code in bits?

(1)

(e) It is claimed that with this coding system fewer bits are required to transmit a plain text message than are required by alternative coding systems which use a fixed number of bits for each character.

(i) State the name of a coding system which represents each character by a fixed number of bits.

(1)

(ii) What information about the plain text would be needed and how would it be used to set up a coding tree as in part (d), to ensure the message was encoded in a minimum number of bits?

(2)

(iii) Under what conditions would the claim be true?

(2)

(f) Entities other than characters often need to be represented inside a computer. For each of the following, name and describe **one** coding system which is used to represent the entities.

(i) Signed integer numbers

(3)

(ii) Real numbers used for scientific calculations

(4)

(iii) A scanned picture

(3)

(Total 20 marks)

# Problem Solving

**2.** The big O notation is often used to describe the efficiency of an algorithm.

(a) Place the following algorithms in order of efficiency, the most efficient first.

Algorithm A that is O(n)

Algorithm B that is O(an)

Algorithm C that is O(n2)

1 .............................................................

2 .............................................................

3 .............................................................

(1)

(b) Describe a linear search and explain why it is O(n).

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(4)

(c) Describe a bubble sort and explain why it is O(n2).

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(4)

(Total 9 marks)

**7.** In a Turing machine numbers are encoded as shown in the table below.

|  |  |
| --- | --- |
| **Number** | **Tape** **Representation** |
| 0 | 1 |
| 1 | 11 |
| 2 | 111 |
| 3 | 1111 |
| etc | etc |

A Turing machine tape is infinitely long. The current cell of the tape under the machine’s read/write head is indicated with an arrow as shown in **Figure 1**. Arguments placed on the tape are each separated by a single occurrence of the symbol ‘0’. The number 3 is stored on the tape shown in **Figure 1**.



The Turing machine starts in state S0.

The given Turing machine uses the following four rules to perform its action:

|  |
| --- |
| (S0, 1, S0, ) means if in state S0 and the tape head reads a ‘1’ move the tape head right one cell.  (S0, 0, S1, 1) means if in state S0 and the tape head reads a ‘0’ move to state S1, write a ‘1’ to the current cell.  (S1, 1, S1, ) means if in state S1 and the tape head reads a ‘0’1 remain in state S1, move the tape head left one cell.  (S1, 0, S2, ) means if in state S1 and the tape head reads a ‘0’ move to state S2, move the tape head right one cell. |

**Figure 2** shows the finite state transition diagram for this machine. The Turing Machine starts in state S0 and finishes in state S2. In the S2 state the machine stops on a block of ‘1’s with the read/write head on the leftmost ‘1’



(a) (i) Show the position of the read/write head, using an arrow as in **Figure 1**, when state S1 is first reached.



(1)

(ii) What symbol will be in the cell that the read/write head is positioned over when state S1 is first entered and the rule has been applied?

(1)

(b) Change the tape shown below to the correct set of ‘0’ and ‘1’ symbols for state S2 and show the position of the read/write head using an arrow, as in **Figure 1**, when the Turing machine is in this state.



(3)

(c) What does this Turing machine calculate?

....................................................................................................................................

(1)

(Total 6 marks)

**8.** (a) Backus Naur Form (BNF) is used by compiler writers to express the syntax of a programming language. The syntax for a part of one such language is written in BNF as follows:

expression ::= integer | integer <operator expression

integer ::= 0  1  2  3  4  5  6  7  8  9

operator ::= +  -  \*  /

Do the following expressions conform to this grammar?

|  |  |  |
| --- | --- | --- |
|  | Expression | Yes/No |
| 1 | 4 \* 9 |  |
| 2 | 8 + 6 / 2 |  |
| 3 | -6 \* 2 |  |
| 4 | ( 4 + 5 ) \* 5 |  |

(4)

(b) (i) Express the infix expression

5 + 6 \* 2

in reverse polish notation.

..........................................................................................................................

(2)

(ii) Give **one** advantage of reverse polish notation.

..........................................................................................................................

(1)

(Total 7 marks)

# Real Numbers

**3.** A normalised floating point representation uses an 8-bit mantissa and a 4-bit exponent, both held using twos complement format.

(a) By completing the boxes show how the following denary values would be held.

(i) 31.25



(1)

(ii) -7.75



(1)

(iii) 0.125



(1)

(b) (i) What is the meant by the term *underflow?*

.........................................................................................................................

.........................................................................................................................

.........................................................................................................................

(2)

(ii) Give an example of a situation that will cause underflow.

.........................................................................................................................

.........................................................................................................................

(1)

(Total 6 marks)

**24.** The binary pattern 1001 1000 0100 can be interpreted in a number of different ways.

(a) Convert the binary pattern to hexadecimal.

....................................................................................................................................

(1)

(b) What is the decimal value if this binary pattern represents BCD?

....................................................................................................................................

(1)

(c) The above binary pattern represents a normalised two’s complement floating point number with an **eight** bit mantissa followed by a **four** bit exponent.

(i) State its value in **denary**.

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

(3)

(ii) Give **one** reason for storing floating point numbers in normalised form.

..........................................................................................................................

..........................................................................................................................

(1)

(iii) How does the above binary pattern indicate that the floating point number is normalised?

..........................................................................................................................

(1)

(iv) What is the largest positive denary number that can be stored using this representation?

..........................................................................................................................

..........................................................................................................................

(2)

(Total 9 marks)

**38.** The binary pattern 0100 0000 1110 can be interpreted in a number of different ways.

(a) State its hexadecimal representation. ........................................................................

(1)

(b) State its value as a decimal number if it represents a signed binary integer using two’s complement representation.

....................................................................................................................................

(1)

(c) State its value as a decimal number if it represents an unsigned fixed point number with four bits after the binary point.

....................................................................................................................................

(2)

(d) (i) State its value as a decimal number if it represents a two’s complement floating point number with an eight bit mantissa followed by a four bit exponent.



.........................................................................................................................

(3)

(ii) This floating point number is said to be*normalised*

How does the bit pattern indicate that this number is normalised?

.........................................................................................................................

.........................................................................................................................

(1)

(iii) What is the largest positive value that can be stored in this floating point representation?

.........................................................................................................................

(2)

(Total 10 marks)

**50.** The decimal number 57 is entered on a keyboard in the form of two ASCII characters ‘5’ and ‘7’. These are stored in the computer’s memory as

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |

(a) Express these binary values in hexadecimal.

....................................................................................................................................

(1)

(b) Express these binary values in denary.

....................................................................................................................................

(1)

(c) By completing **Table 1**, show how the decimal value 57 could be stored as a signed integer using two’s complement in 8 bits.

**Table 1**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |

(2)

(d) By completing **Table 2**, show how the decimal value 57.0 could be stored in normalised floating point form as an 8 bit mantissa followed by an 8 bit exponent. Both mantissa and exponent are to be stored as signed values using two’s complement.

**Table 2**



(2)

(e) Give **two** advantages of normalised floating point format over fixed point format.

1 ..................................................................................................................................

….................................................................................................................................

2 ..................................................................................................................................

….................................................................................................................................

(2)

(Total 8 marks)

**61.** The binary pattern 1001 0111 0100 can represent different numbers.

(a) State its hexadecimal representation.

.....................................................................................................................................

(1)

(b) State its value in denary if it represents an unsigned fixed point number with four bits after the binary point.

.....................................................................................................................................

(2)

(c) State its value in denary if it represents a two’s complement fixed point number with four bits after the binary point.

.....................................................................................................................................

.....................................................................................................................................

(2)

(d) (i) State its value in denary if it represents a normalised two’s complement floating point number with an eight bit mantissa followed by a four bit exponent.

...........................................................................................................................

...........................................................................................................................

...........................................................................................................................

(3)

(ii) Give a reason for storing floating point numbers in normalised form.

...........................................................................................................................

...........................................................................................................................

(1)

(Total 9 marks)

**85.** The binary pattern 1011 1110 0100 could be interpreted in a number of different ways.

(a) State its hexadecimal representation.

...............................................................................

(1)

(b) State its value in denary if it represents an unsigned fixed point number with four bits after the binary point. Use the space below to show your working.

.....................................................................................................................................

(3)

(c) State its value in denary if it represents a two’s complement integer.

.....................................................................................................................................

(2)

(d) The system stores floating point numbers in *normalised form* using 2’s complement, with an 8-bit mantissa and a 4-bit exponent as follows.

Mantissa Exponent



(i) State the value of 1011 1110 0100 in denary if it represents a two’s complement floating point number. Use the space below to show your working.

............................................................................................................................

(3)

(ii) This floating point number is said to be normalised.

How does the bit pattern indicate that this number is normalised?

............................................................................................................................

............................................................................................................................

(1)

(Total 10 marks)

**96.** The binary pattern 1000 1100 0100 can be interpreted in a number of different ways.

(a) State its value in **denary** if it represents an unsigned fixed point number with four bits after the binary point.

.....................................................................................................................................

(2)

(b) (i) State its value in **denary** if it represents a two’s complement floating point number with an eight bit mantissa followed by a four bit exponent.

...........................................................................................................................

(3)

(ii) The floating point number 1000 1100 0100 is said to be normalised.

How does the bit pattern indicate that this number is normalised?

...........................................................................................................................

...........................................................................................................................

(1)

(iii) Why should floating point numbers be stored in normalised form?

...........................................................................................................................

...........................................................................................................................

(1)

(Total 7 marks)

**110.** The binary pattern 1011 0111 0110 can be interpreted in a number of different ways.

(a) State its hexadecimal representation: .........................................................................

(1)

(b) State its value in denary if it represents an unsigned fixed point number with four bits after the binary point.

.....................................................................................................................................

(2)

(c) (i) State its value in denary if it represents a two’s complement floating point number with an eight bit mantissa followed by a four bit exponent.

...........................................................................................................................

...........................................................................................................................

...........................................................................................................................

(3)

(ii) This floating point number is said to be *normalised*.  
How does the bit pattern indicate that this number is normalised?

...........................................................................................................................

...........................................................................................................................

(1)

(iii) Why should floating point numbers be stored in normalised form?

...........................................................................................................................

...........................................................................................................................

(1)

**123.** (a) A system stores integers in **16 bits**. Using binary representation, show the steps of subtracting 6 from 18, using two’s complement.

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(4)

(b) The system stores floating point numbers in *normalised form* using 2’s complement with a 12-bit mantissa and a 4-bit exponent as follows.



(i) A floating point number is stored in main memory at symbolic address Num1. Complete the table below, showing the contents of the memory location using binary notation and the value in decimal.

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbolic Address** | **Hexadecimal Representation** | **Binary Representation** | **Decimal Value** |
| Num1 | A802 |  |  |

(4)

(ii) Why should floating point numbers be stored in normalised form?

...........................................................................................................................

...........................................................................................................................

(1)

(Total 9 marks)

**127.** Bit patterns can be interpreted in a number of different ways.

(a) A computer word contains the bit pattern 0001 0111.

What is its decimal value if it represents a pure binary integer

.....................................................................................................................................

(1)

(b) A computer system uses **odd** parity. The most significant bit (MSB) is used as a parity bit. The ASCII value for the character ‘!’is decimal number 33.

(i) What would be the 8-bit binary pattern to represent the character ‘!’?

MSB

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |

(2)

(ii) Asynchronous data transmission is used if one character is sent at a time. One start bit marks the beginning of a character and one stop bit marks the end of a character.

What would be the bit pattern if the character ‘!’ above is sent using asynchronous data transmission?

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |

(1)

(Total 4 marks)

**134.** (a) (i) Convert the hexadecimal number BD93 to binary.

...........................................................................................................................

(1)

(ii) The contents of register A is 1011 1010 0000 0011.  
These bits are a representation of a number in twos complement, with the leftmost 10 bits as the mantissa and the rightmost 6 bits as the exponent.

Convert this number into decimal. Use the space below to show your working.

...........................................................................................................................

(3)

(b) Give **two** reasons why floating point numbers are normalised.

1 ..................................................................................................................................

.....................................................................................................................................

2 ..................................................................................................................................

.....................................................................................................................................

(2)

(Total 6 marks)

**145.** (a) The number 0111 0010 1011 1101 is stored in twos complement notation in 16 bits with the most significant 10 bits representing the mantissa and the least significant 6 bits representing the exponent.

(i) Is this number positive or negative?..................................................................

(ii) Estimate the magnitude of this number. Circle the correct answer below.

|  |  |  |  |
| --- | --- | --- | --- |
| >2**32** | Between 216 and 232 | Between 22 and 2–2 | <2–2 |

(2)

(b) The number 0110 0001 0100 1000 is stored in the **same format**. Convert this number into denary.

(3)

(c) (i) Give **one** advantage of fixed point over floating point representation.

...........................................................................................................................

(ii) Under what circumstances would fixed point representation be used rather than floating point?

...........................................................................................................................

(2)

(Total 7 marks)

**160.** A two byte register holds numbers in floating point form with a 10 bit mantissa and a 6 bit exponent.

(a) Explain the terms:

(i) mantissa; ..........................................................................................................

..........................................................................................................................

(1)

(ii) exponent. .........................................................................................................

..........................................................................................................................

(1)

(b) Each of these holds data in two’s complement form. At one moment, this register holds the following bits.

0110101100000011

(i) Label the mantissa in this data.

(1)

(ii) How can you tell if the number is positive or negative?

..........................................................................................................................

..........................................................................................................................

(1)

(c) Explain, or show, how you would subtract 3 from 5 using two’s complement.

....................................................................................................................................

....................................................................................................................................

....................................................................................................................................

....................................................................................................................................

....................................................................................................................................

(2)

(d) Give **one** advantage of floating point notation over fixed point notation for storing real numbers.

....................................................................................................................................

....................................................................................................................................

(1)

(Total 8 marks)

# Databases

**5.** A person who collects coins has decided to record the details of his collection in a database. He has decided that the following details should be stored for each coin.

CoinID

Type (for example 10p)

Year

Condition (for example “very fine”)

Value

Date purchased

SupplierID

Supplier’s Name

Supplier’s Address

Supplier’s Telephone Number

Price paid

(a) The person decides that he will use one relation, Coin, as shown below:

Coin(CoinID, Type, Year, Condition, Value, DatePurchased, SupplierID, SupplierName, SupplierAddress, SupplierTelNo, PricePaid)

Why is this relation not in third normal form?

....................................................................................................................................

....................................................................................................................................

(1)

(b) When the data is stored in a normalised database, two relations **Coin, Supplier** are used. For each of these, complete the following Data Definition Language (DDL) statements to create the tables, including all key fields.

(i) CREATE TABLE Coin

(........................................................................................................................

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................)

(2)

(ii) CREATE TABLE Supplier

(.........................................................................................................................

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................)

(1)

(c) Complete the Entity-Relationship diagram in the figure below to show the degree of the relationships that exists between the given entities.

|  |  |  |
| --- | --- | --- |
| Supplier |  | Coin |

(1)

(d) Using the SQL commands SELECT, FROM, WHERE, ORDER BY and any others that you consider appropriate, write an SQL statement to query the database tables for the type, year, condition and price paid of all coins from a supplier with supplier’s name, Bloggs. The result of this query should be in ascending order of price paid.

....................................................................................................................................

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(3)

(Total 8 marks)

**15.** When people who own cats go on holiday, they can leave their cats in a cattery to be looked after. In one such cattery, each cat is assigned its own cage.

The cattery uses a relational database to manage the data about the cats which it looks after.

(a) What is a relational database?

...................................................................................................................................

(1)

**Cat**, **Booking** and **CatOwner** are three of the relations used for this database.

**Cat**(CatCode, CatName, *CatOwnerID*, Notes)

**Booking**(CatCode, DateIn, CageNumber, NumberOfNights)

**CatOwner**(CatOwnerID, Title, Forename, Surname, Address, PostCode, ContactNumber)

**CatCode** and **DateIn** form a composite primary key in the relation **Booking**.

(b) (i) What is a composite primary key?

..........................................................................................................................

(1)

(ii) Why is a composite primary key needed in the relation **Booking**?

..........................................................................................................................

(1)

(c) (i) Define the term foreign key.

..........................................................................................................................

(1)

(ii) Identify the foreign key in the relation **Cat**.

..........................................................................................................................

(1)

(d) The following shows parts of these three tables.

**Cat Table**

|  |  |  |  |
| --- | --- | --- | --- |
| **CatCode** | **CatName** | **CatOwnerID** | **Notes** |
| ... |  |  |  |
| C1789 | Ginger | O0987 | ... |
| C1790 | Jerry | O0987 | ... |
| C1791 | Prickles | O0988 | ... |
| C1792 | Tabitha | O0989 | ... |
| C1793 | Squidge | O0990 | ... |
| C1794 | Jerry | O0990 | ... |

**CatOwner Table**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CatOwnerID** | **Title** | **Forename** | **Surname** | **Address** | **PostCode** | **ContactNumber** |
|  |  |  |  |  | ... | ... |
| O0987 | Dr | James | Watson | ... | NP123GU | 0177654932 |
| O0988 | Rev | Phil | Clarke | ... | NP157DF | 01787254322 |
| O0989 | Mrs | Jenny | Murray | ... | NP171KL | 01797883345 |
| O0990 | Mr | Dai | Roberts | ... | NP171KL | 01797233433 |
|  |  |  |  | ... | ... | ... |

**Booking Table**

|  |  |  |  |
| --- | --- | --- | --- |
| **CatCode** | **DateIn** | **CageNumber** | **NumberOfNights** |
| ... |  |  |  |
| C1790 | 12/01/08 | 23 | 14 |
| C1792 | 12/01/08 | 12 | 7 |
| C1789 | 13/01/08 | 9 | 8 |
| C1791 | 15/01/08 | 37 | 15 |
| C1792 | 12/02/08 | 12 | 7 |
| ... |  |  |  |

The cat in cage 9 becomes sick, the vet is called and the staff are sufficiently concerned that they decide to contact the owner. Complete the QBE grid to find the name of the cat, its owner’s name and the contact telephone number.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute | CageNumber |  |  |  |  |
| Table | Booking |  |  |  |  |
| Criteria |  |  |  |  |  |

(4)

(Total 9 marks)

**19.** When teachers in a large school need stationery items such as pens or folders, they help themselves from the stationery cupboard and write in a charge book what they have taken and which department they are working for. At the end of each month the finance clerk, Fred, charges the cost of the items to the relevant department. Fred is responsible for re-ordering items. A computing student, Susan, has been given the task of designing a computerised system for this.

(a) For each of the fact-finding techniques below, describe specifically how Susan might use the technique to analyse the current system (make sure that you include relevant personnel and facts in your answer where appropriate).

(i) interview

..........................................................................................................................

..........................................................................................................................

(1)

(ii) survey

..........................................................................................................................

..........................................................................................................................

(1)

(iii) examination of existing paperwork

..........................................................................................................................

..........................................................................................................................

(1)

(iv) observation

..........................................................................................................................

..........................................................................................................................

(1)

(b) From Susan’s investigation, she found that when teachers **take a stationery item,** they enter the stationery’s **item description** into a **charge book,** together with the quantity taken, the **department code,** the **date taken** and the **teacher’s initials**. Every week, Fred checks the charge book to **adjust the stock levels** written in the **stock book**. If he notices that stock levels for any item are very low, he orders **replacement stock** for all those items that he thinks need restocking. Fred completes an order form with **item** **codes** and **quantities** and the **school’s address** and sends it to the **stationery supplier**. When he **completes the monthly charge forms** for the departments, he looks up the i**tem price** from the **price list**. He fills in the charge form for each department with all the **item descriptions,** **quantities, item prices** and the **total** to be charged to each department. This is given to the **head of department.**



Complete the entries A–G on the appropriate lines below:

(i) (A) .........................................................................................................

(ii) (B) .........................................................................................................

(iii) (C) .........................................................................................................

(iv) (D) .........................................................................................................

(v) (E) .........................................................................................................

(vi) (F) .........................................................................................................

(vii) (G) .........................................................................................................

(7)

(c) Susan decides that a relational database could be used to automate the adjustment of stock levels and the search for items that need replacing.

The entities **Department, Teacher, Stock** and **ItemTaken** have been identified. Assume a teacher works for only one department.

The following details are to be stored about the **Department, Teacher** and **Stock:**

Department Code (unique) Item Code

Department Name Item Description

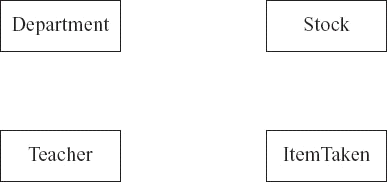
Head Of Department’s Initials Item Price

Teacher Initials (unique) Quantity In Stock

First Name Order Quantity

Surname Minimum Stock Level

Show the degree of **three** relationships which exist between the given entities:



(3)

(d) Details to be stored about the items taken will need to include the date when the item was taken.

Using the following format

**TableName (PrimaryKey, Non-keyAttribute1, Non-keyAttribute2, etc)**

describe tables that model the following entities and their relationships, stating **all** attributes and underlining the primary key in each case.

(i) Department ( ....................................................................................................

...................................................................................................)

(1)

(ii) Teacher ( ..........................................................................................................

..........................................................................................................)

(2)

(iii) Stock ( .............................................................................................................

.............................................................................................................

.............................................................................................................

............................................................................................................)

(1)

(iv) Item Taken ( ....................................................................................................

....................................................................................................

....................................................................................................

...................................................................................................)

(4)

(e) Using SQL commands SELECT, FROM, WHERE and ORDER BY, write an SQL statement to query the database tables for all items taken during December 2007. The answer table should display the item description, quantity and item price and the items should be in department code order.

....................................................................................................................................

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(6)

(f) By linking the database with a word-processing package, the charge forms for the departments could be generated automatically. What is this process called?

....................................................................................................................................

(1)

(Total 29 marks)

**23.** A local free recycling group has been set up in a small community. If Member A no longer needs an item, he can advertise it on the group’s website. If Member B needs an item, she can search for it on the site. The two members then get in contact and Member A gives the item to Member B.

Items are removed from the site when exchanged or after six weeks.

The scheme is based on a relational database, which includes the two tables, **Member** and **Item**.

(a) Complete the definition below.

A relational database is a collection of ........................................... in which relationships

are created through .........................................................................

(2)

(b) Each table below shows a small selection of the records.

Table **Member**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **MemberID** | **EmailAddress** | **KnownAs** | **Password** | **Date** **joined** | ........ |
| Flintstone | fred127@internetmail.abc | Fred | wonderland | 15/08/07 |  |
| Hollyberry | panbdy23@aqa.org.uk | Pam | schnuki2 | 02/09/07 |  |
| Sunnyboy | pssmith@localmail.fin | Peter | pwrrsmith | 10/10/07 |  |
| ContraryMary | mary.peters@webmail.wyz | May | thisismypassword | 15/11/07 |  |

Table **Item**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ItemNumber** | **Date** **Posted** | **MemberID** | **ItemOnOffer** | **Description** |
| 2435 | 12/12/07 | Flintstone | Paving slabs | 15 York stone paving slabs, 600 mm square, dirty but good condition. |
| 2436 | 12/12/07 | Flintstone | Lawn mower | Greengrass petrol driven lawnmower. Too heavy for me now! |
| 2438 | 14/12/07 | ContraryMary | Bunk beds | Wooden bunk beds, 150 cm x 100 cm, with mattresses. |
| 2439 | 14/12/07 | ContraryMary | Chair | Rocking chair. Wooden arms. Needs new upholstery. |
| 2442 | 15/12/07 | Hollyberry | Child’s bed | Child’s bunk bed with desk area underneath. Wooden. Slightly worn. |
| 2443 | 16/12/07 | We54rey | Chairs | 6 garden chairs, good as new. |
| 2445 | 19/12/07 | Dnukia69 | Bed | 5 ft double bed. Firm sprung mattress. |

(i) The primary key in table **Member** is the **MemberID**. What is the purpose of a primary key?

.........................................................................................................................

(1)

(ii) Why is **EmailAddress** not a good choice for use as a primary key?

.........................................................................................................................

(1)

(iii) Explain, in the context of this question, the advantage of indexing the **Item** table on the field **ItemOnOffer.**

.........................................................................................................................

.........................................................................................................................

(1)

(iv) Name the foreign key in the table **Item.**

.........................................................................................................................

(1)

(c) When searching a database, inexact matches can be achieved by using one or more wild card characters. For example, if Pam cannot remember if a member is called Peter or Pete, she can type Pete\* in the criterion field for **KnownAs.**

In fact, Pam is looking for any type of bed for her child. She has used the site before and is familiar with the way it works.

(i) Complete the QBE grid for her search, so that she can find out as much as possible about as many relevant advertised items as possible, and then can contact their owner.

|  |  |  |  |
| --- | --- | --- | --- |
| Field name | ItemOnOffer |  |  |
| Table |  |  |  |
| Criterion |  |  |  |

(3)

(ii) From the records shown in the **Item** table, how many records would be found from your search?

.........................................................................................................................

(1)

(Total 10 marks)

**29.** The council of a large city wants to reduce the number of cars owned by the city’s residents. The council is planning to introduce a car share club. The club will own cars, which will be parked in designated parking areas across the city when not hired out. The club members will be able to hire a car via the Internet, by e-mail or by phone. Members can book a car for one or more hours, or one or more days, up to a maximum of three weeks. Members pay a fixed monthly membership fee. They are also billed for the amount of time the car is hired plus a mileage charge. If a member returns a car late to the designated parking area, there will be a penalty charge for each additional hour.

Each car has a built-in computer with mobile phone technology to provide a communication link to the booking centre. Each member will receive a membership card which contains an RFID (Radio Frequency Identification) tag and the member is issued with a PIN (Personal ID Number).

(a) When a resident of the town wants to join the car share club, they are required to provide the following details:

– Credit card number

– Full Name and Address (as registered against their credit card)

– Driving Licence Number

– E-mail address

– Mobile telephone number

The monthly fee plus hire charges are automatically added to the member’s credit card.

A statement of charges is available for the member to download from the Internet.

(i) What other details are required to be stored about the member so that the member can only access their own statement of charges?

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(2)

The details held about each Parking Area are:

– A 3-character unique Location Code

– Name of Parking Area, such as “Station”

– Post Code of Parking Area

The details held about each car are:

– Car Registration Number

– Designated Parking Area

At the time of booking, the member will be asked to provide the following details:

– Member ID

– Pick-up point (from which parking area)

– Hire start date and time

– Hire end date and time

The booking centre allocates a car from the chosen parking area to the member and issues the member with a booking reference code.

Choosing suitable attribute identifiers, complete the relations making sure that the primary key attribute(s) are underlined.

(ii) Member ( .........................................................................................................

.........................................................................................................

........................................................................................................)

(1)

(iii) ParkingArea ( ..................................................................................................

................................................................................................)

(1)

(iv) Car ( ................................................................................................................

...............................................................................................................)

(1)

(v) Booking ( .......................................................................................................

......................................................................................................)

(3)

(b) Complete the entity-relationship diagram for the entities below:



(3)

(c) Using SQL commands SELECT, FROM, WHERE, ORDER BY, write an SQL statement to query the database tables to produce a list of bookings for the month of December 2007. The results of the query are to be in member ID order.

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(4)

(Total 15 marks)

**35.** The following are parts of three tables in a relational database for a book loan system.

Member

|  |  |  |  |
| --- | --- | --- | --- |
| MemberID | Surname | Forename | TelephoneNumber |
| ... | ... | ... | ... |
| IV270023 | Smith | Gerald | 01234 567890 |
| IV270024 | Smith | Wendy | 01234 567890 |
| IV280016 | Pope | Anne | 01234 465987 |
| IV280017 | Patel | Arwen | 01234 657980 |
| ... | ... |  | ... |

Book

|  |  |  |  |
| --- | --- | --- | --- |
| BookID | Title | Author | Value |
| ... | ... | ... | ... |
| 1457X | Travels with my Family | A M MacIntyre | £13.50 |
| 14582 | Travels with my Family | AM MacIntyre | £13.50 |
| 15635 | By Bicycle to Bangor | A M MacIntyre | £14.75 |
| 16370 | Walking in Wonderland | BG O’Connor | £15.99 |
| ... | ... | ... | ... |

Loan

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| BookID | MemberID | DateOut | DateIn | DateReturned |
| ... | ... | ... | ... | ... |
| 1457X | IV270023 | 07/12/06 | 28/12/06 | 22/12/06 |
| 16370 | IV270024 | 07/12/06 | 28/12/06 | 22/12/06 |
| 15635 | IV270024 | 07/12/06 | 28/12/06 | 22/12/06 |
| ... | ... |  | ... | ... |

(a) How are relationships between entities implemented with relational database software?

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(1)

(b) Give the primary key for the entity Loan.

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(2)

(c) The Book table has an index on the attribute Author. Why is indexing used?

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(1)

(d) The last digit of the BookID is used for validation. What type of validation control is this an example of?

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(1)

(Total 5 marks)

**43.** The network manager of a college has to ensure that all software on college computers is installed legally.

(a) Which law is the network manager following?

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(1)

Some software is bought with a site licence for use on any number of college computers whereas other software is bought with a multi-user licence for installation on a specified number of college computers. The network manager wants to set up a relational database to keep details of software licences and which college computers have which software installed. She has identified the following details she wants to store about each software package:

• Software name

• Version

• Software ID (ten alphanumeric characters), unique

• Supplier

• Date purchased

• Expiry date

• Number of computers licenced

When any software is installed on a college computer, she wants to store the following details:

• Computer ID of the computer on which the software is to be installed (six alphanumeric characters)

• Date of software installation

• Staff ID who requested the software (3 letters) for this computer

(b) The two entities **SoftwareLicence** and **SoftwareInstallation** have been identified.

Draw an Entity-Relationship diagram for the above entities.

(3)

(c) Complete the following Data Definition Language (DDL) statements to create the fully normalised tables necessary to implement the database, including all key fields.

(i) CREATE TABLE SoftwareLicence

( ........................................................................................................................

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(3)

(ii) CREATE TABLE SoftwareInstallation

( ........................................................................................................................

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(4)

(d) The network manager wants a list of each computer and what software is installed on it. Using the SQL commands SELECT, FROM, WHERE, ORDER BY and any others that you consider appropriate, write an SQL statement to query the database tables for a list of computers with software name and version installed.

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(4)

(Total 15 marks)

**55.** A chef keeps her recipes on a single-table database system**. Figure 1** shows the Recipe Table.

**Figure 1**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Recipe ID | Dish | Recipe Ingredients (including quantity) | Preparation Time | Cooking Time | Number of Servings | Cooking Instructions |
| 1 | Hummus | 250g chickpeas 6 cloves garlic 50ml lemon juice 340g tahini | 20 minutes | 2 hours | 8 | Cook chickpeas until soft. Puree in food processor. Add remainder of ingredients, mix well. |
| 2 | Feta Salad | 400g tomatoes 250g feta cheese 1 cucumber 50g olives 45ml vinaigrette | 15 minutes | none | 4 | Mix all salad ingredients together. Season with salt and pepper. Dress with vinaigrette. |
| 3 | Casserole | 500g chickpeas 400g tomatoes 450g potatoes | 10 minutes | 2 hours | 4 | Cook chickpeas until nearly soft. Add cubed potatoes and tomatoes. ....... |
| : | : | : | : | : | : | : |
| : | : | : | : | : | : | : |

The chef’s only supplier provides her with an on-line price list for her ingredients. **Figure 2** shows the PriceList Table.

**Figure 2**

|  |  |  |  |
| --- | --- | --- | --- |
| FoodItemID | FoodItemName | PackSize | Price |
| Tom001 | Tomatoes | 400g | £0.55 |
| Chi002 | Chickpeas | 250g | £0.75 |
| Cuc003 | Cucumber | single | £0.50 |
| : | : | : | : |

(a) (i) Which of the above two tables is **not** in First Normal Form? ..........................

(1)

(ii) Why? ................................................................................................................

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(1)

(b) The chef would like to be able to cost the ingredients for her dishes and is asking you to help her design a database which would allow the costing of dishes without retyping any of the pricelist details.

Database theory states that database tables should be *fully normalised*

(i) What does fully normalised mean?

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(2)

(ii) Why is it desirable that tables are fully normalised?

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(1)

(c) When the data in **Figure 1** and **Figure 2** are stored in a fully normalised relational database, three relations, **Recipe, FoodItem** and **RecipeIngredient** are needed. For each of these, complete the relations, making sure the primary key attribute(s) are underlined.

(i) Recipe( .............................................................................................................

.........................................................................................................................)

(1)

(ii) FoodItem( ........................................................................................................

.........................................................................................................................)

(1)

(iii) RecipeIngredient( ............................................................................................

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(4)

(d) Using the SQL commands SELECT, FROM, WHERE, ORDER BY and any others that you consider appropriate, write the SQL statement to list all the ingredients and their quantities required for Feta Salad. The results table should also show the pack size of the food item and the associated price. The list should be in alphabetical order of ingredient.

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(5)

(Total 16 marks)

**65.** A head of department in a school wishes to store data on her pupils’ module results for AS and A-level Computing. The data requirements are defined as follows:

• each pupil has their forename(s) and surname recorded;

• each pupil is assigned a unique candidate number;

• each module is identified by a module code;

• each module has a given maximum number of marks available;

• each module is available each year at a winter and/or summer session;

• each pupil’s module result is a number of marks between 0 and the maximum for that module;

• each pupil may resit a module several times, the best results being used to calculate the overall grade.

A single table, ResultsTable, was constructed initially in a relational database. **Figure 1** shows the structure of this table and a few entries.

**Figure 1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Pupil Forenames** | **Pupil Surname** | **Candidate Number** | **Module Code** | **Exam Session** | **Module Mark** | **Level** | **Total Mark** | **Grade** |
| Ali | Patel | 1234 | CPT1 | W04 | 54 | AS | 187 | C |
|  |  |  | CPT1 | S04 | 74 | A | 318 | D |
|  |  |  | CPT2 | S04 | 63 |  |  |  |
|  |  |  | CPT3 | S04 | 50 |  |  |  |
|  |  |  | CPT4 | W05 | 43 |  |  |  |
|  |  |  | CPT2 | S05 | 60 |  |  |  |
|  |  |  | CPT5 | S05 | 43 |  |  |  |
|  |  |  | CPT6 | S05 | 45 |  |  |  |
| Marie | Frost | 1357 | CPT1 | W04 | 97 | AS | 255 | A |
| Anne |  |  | CPT2 | S04 | 86 | A | 500 | A |
|  |  |  | CPT3 | S04 | 72 |  |  |  |
|  |  |  | CPT4 | W05 | 50 |  |  |  |
|  |  |  | CPT4 | S05 | 72 |  |  |  |
|  |  |  | CPT5 | S05 | 75 |  |  |  |
|  |  |  | CPT6 | S05 | 98 |  |  |  |
| John Mark | Smith | 2345 | CPT1 | W05 | 65 | AS | 169 | D |
|  |  |  | CPT1 | S05 | 60 |  |  |  |
|  |  |  | CPT2 | S05 | 72 |  |  |  |
|  |  |  | CPT3 | S05 | 32 |  |  |  |
| Ali : | Patel : | 7315 : | : : | : : | : : | : : | : : | : : |

(a) Which of the column heading(s) in ResultsTable would be suitable as a primary key?

.....................................................................................................................................

(1)

(b) What makes this table **not** in First Normal Form?

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.....................................................................................................................................

(1)

(c) When the data in Figure 1 is stored in a fully-normalised relational database, **three** relations, **Pupil**, **ModuleResult** and **PupilGrade** are used. For each of these, complete the relations making sure the primary key attribute(s) are underlined.

(i) Pupil (........................................................................................................................)

(2)

(ii) ModuleResult (...........................................................................................................

............................................................................................................)

(2)

(iii) PupilGrade (..............................................................................................................

............................................................................................................)

(2)

(d) Complete the partial Entity-Relationship diagram in **Figure 2** to show the degree of **two** relationships which exist between the given entities.

**Figure 2**



(2)

(e) Using the SQL commands SELECT, FROM, WHERE, ORDER BY and any others that you consider appropriate, write an SQL statement to query the database tables for the pupil forenames, surname and A-level grades in descending order of total mark.

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(5)

(Total 15 marks)

**73.** Sam starts work at a small business selling garden tools and equipment by mail order.   
Four of the employees in the business have their own stand-alone computers.

• Mary takes the order and enters it into her computer. She records the customer’s name and address, plus the item(s) ordered. She prints out a copy and gives it to Renie.

• Renie takes the items off the shelves and packs the order. She records, on her computer, the customer’s name and address, and the items despatched. She notes any item that is out of stock; these will have to follow in a later despatch. She prints off a copy of these details to give to Hassan.

• Hassan produces the invoice. He records, on his computer, the customer’s name and address and the items despatched with prices. He adds a handling charge and puts the invoice into an envelope ready for posting to the customer. He gives a copy invoice to James.

• James is the accountant. He records, on his computer, the customer’s name and address, the invoice amount and whether it has been paid or not.

(a) This system has disadvantages. Explain **two** of these.

1 ..................................................................................................................................

.....................................................................................................................................

2 ..................................................................................................................................

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(4)

(b) Sam suggests that if the computers were networked, they could share files. If the computers were networked, why is it unlikely that they could share files as they are set up currently?

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(2)

(c) The company decide to start again and create a relational database. Sam starts talking about *attributes, primary keys* and *foreign keys.*

(i) Define an attribute.

...........................................................................................................................

(1)

(ii) Define a primary key.

...........................................................................................................................

(1)

(iii) Define a foreign key.

...........................................................................................................................

(1)

(d) Initially Sam thinks that four tables are needed

1. Customer table

2. Stock table containing details of each item of stock

3. Order table containing general details of each order

4. OrderLine table containing details of each item ordered for a particular order

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table: | Customer |  | Stock |  | Order |  | OrderLine |
| To include these fields | Surname  Firstname  Address 1  Town  PostCode  Telephone Number  CustomerID |  | PartNumber  Description  UnitPrice  NumberInStock |  | OrderNumber  DateOfOrder  CustomerID |  | OrderNumber  OrderLineNumber  PartNumber  Quantity |

(i) What would be the most suitable primary key for the table Customer?

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(1)

(ii) What would be the most suitable primary key for the table OrderLine?

...........................................................................................................................

(1)

(iii) Name a foreign key in the table OrderLine.

...........................................................................................................................

(1)

(iv) Mr Jeremiah Smith telephoned Mary. He said that he had mislaid his copy of his latest order and asked her to remind him what he had ordered. Mary asked him if he could remember the date he made the order, and he told her it had been 23rd April 2006. If Mary were using a relational database, set up to include the tables as described above, she could run a query to list the items. Complete the QBE grid required to produce this list.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Field | Surname | FirstName | DateOfOrder |  |  |
| Table |  |  |  |  |  |
| Show |  |  |  |  |  |
| Criteria |  |  |  |  |  |

(6)

(Total 18 marks)

**77.** A computer technician in a school is asked to keep up-to-date details of the hardware equipment the school owns (known as an inventory). The school management require the following details to be stored for each item of hardware:

• description

• make

• model

• inventory reference number (20 alphanumeric characters)

• date of purchase

• purchase price

• room where item is kept.

If an item is loaned, the following details must be stored:

• location details of where the item will be located

• the initials of the person responsible for its return

• the dates of removal and return.

(a) The **two** entities **HardwareItem** and **EquipmentLoan** have been identified.

(i) Complete the diagram below.



A ........................................................................................................................

B ........................................................................................................................

C ........................................................................................................................

(2)

(ii) Name this type of diagram.

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(1)

(b) Complete the following Data Definition Language (DDL) statements to create the fully normalised tables necessary to implement the database.

CREATE TABLE HardwareItem

( ....................................................................................................................................

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..................................................................................................................................... )

CREATE TABLE EquipmentLoan

( ....................................................................................................................................

......................................................................................................................................

......................................................................................................................................

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..................................................................................................................................... )

(6)

(c) Using the SQL commands SELECT, FROM, WHERE, ORDER BY and any others that you consider appropriate, write an SQL statement to query the database tables for the description, inventory reference number and date of removal of those items of equipment that have been loaned since a given date. The results of this query should be displayed in such a way as to make it easy to see how many times each item was loaned.

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(6)

(Total 15 marks)

**88.** A teacher of Advanced Level Computing uses a relational database to record details of

 Students

 Work done by students on their Advanced level project

 Marks awarded for the system life cycle phases of a student’s project

 Description and maximum mark for each system life cycle.

The teacher assigns

 A unique student identifier to each student

 A unique identifier to each system life cycle phase.

Work done by a student on a project is carried out

 On more than one date

 On different system life cycle phases on different dates

 On no more than one system life cycle phase on any particular date

 In only one time period on any particular date.

Students submit their work for assessment after completing each phase of the system life cycle.

The relational database uses four tables:

**Student**(StudentID, FirstName, Surname, DateOfBirth)

**WorkDone**(Date, StudentID, StartTime, LifeCyclePhaseID, DescriptionOfWorkDone, TimeSpent)

**MarkAwarded**(StudentID, LifeCyclePhaseID, DateSubmitted, Mark, DateMarked,  
 TeachersComments)

**LifeCyclePhase**(LifeCyclePhaseID, LifeCycleName, Maximum)

(a) Draw an Entity-Relationship (E-R) diagram for the tables:

(i) Student and WorkDone

(1)

(ii) Student and MarkAwarded

(1)

(iii) LifeCyclePhase and MarkAwarded

(1)

(b) Using the SQL commands SELECT, FROM, WHERE and any others considered appropriate, write an SQL statement to query the database tables for each of the following

(i) The first name and surname of every student;

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............................................................................................................................

............................................................................................................................

(1)

(ii) The first name and surname of every student together with the mark awarded for the phase of the system life cycle with LifeCyclePhaseID = 1, presented in ascending order of student surname.

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(5)

(Total 9 marks)

**94.** A *relational database* is used to record details for an online database of hotels, attractions and other places of interest in a popular holiday resort. The database will be accessible from work stations in tourist information offices across the resort. There are also town plans for the towns in the resort on which hotels and other sites are identified by a unique number for ease of use.

(a) (i) What is a relational database?

................................................................................................................................

(1)

(ii) How are relationships implemented in a relational database?

................................................................................................................................

(1)

(b) Two of the relations (tables) used for this database are:

**Town(TownName, Population, Attractions)**

**Hotel(HotelName, TownName, NumberOnPlan, Stars, RoomRate,  
NoOfBedrooms, Restaurant, SwimmingPool)**

TownName is the primary key in the Town relation.

NumberOnPlan is the primary key in the Hotel relation.

(i) Why might HotelName **not** be suitable as the primary key for the Hotel relation?

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(1)

(ii) Name the attribute that is the foreign key in the Hotel relation.

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(1)

(iii) Indexes are created on the fields HotelName and TownName in the Hotel relation.

Why is an index used?

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(1)

(iv) Explain **one** disadvantage of having multiple indexes.

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..........................................................................................................................

(2)

(c) A user interface for such a system would have certain requirements, such as a means of making a selection, and clear on-screen instructions.

(i) The work stations are placed in busy tourist information offices to be used, unsupervised, by tourists. Suggest a suitable input method for the tourist to make a selection in this system.

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(1)

(ii) The system provides information about hotels and places of interest, plus pictures and maps of the resort. What feature might be built into the software to enable all this information to be accessed on screen in a manageable way?

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(1)

(iii) Suggest **two** distinct requirements of the user interface to make the system more accessible to the many users.

1 .......................................................................................................................

2 .......................................................................................................................

(2)

(Total 11 marks)

**100.** (a) The storage schema is one level of the three level Database Management System (DBMS) architecture. Name the **two** other levels.

1 ..................................................................................................................................

2 ...................................................................................................................................

(2)

(b) Give one data definition language (DDL) command that could be found in a script used to construct a relational database.

.....................................................................................................................................

(1)

(c) *Object-oriented databases* are set to replace *relational databases* in the future.

What is

(i) a relational database;

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...........................................................................................................................

(1)

(ii) an object-oriented database?

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(1)

(Total 5 marks)

**101.** An Examination Board records total entries by centre and subject for its examinations for June 2005 in an un-normalised relational database table as shown in the figure below. The data equirements specify that

 a subject offered for examination by the Examination Board has at most one Examination Board Subject Officer;

 an Examination Board Subject Officer may be a subject officer for more than one subject offered for examination by the Examination Board;

 Centre Number and SubjectID are unique.



The relation for this table is as follows

**ExamBoardEntryNumbers**(CentreNo. CentreName, CentreAddress, SubjectID, SubjectName,  
 ExamBoardSubjectOfficerName, NumberOfCandidatesEntered)

(a) What makes this table un-normalised?

.....................................................................................................................................

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(1)

(b) When the data in the figure above is stored in a fully-normalised relational database three relations Centre, **CentreEntryNumber and Subject are used. For each of these** complete the relations making sure that the primary key attribute(s) are underlined.

(i) Centre ( .............................................................................................................)

(2)

(ii) CentreEntryNumber (.........................................................................................)

(2)

(iii) Subject (.............................................................................................................)

(2)

(c) (i) Complete the entity-relationship diagram for the entities **Centre** and **CentreEntryNumber.**

|  |  |  |
| --- | --- | --- |
| Centre |  | CentreEntry Number |

(1)

(ii) Complete the entity-relationship diagram for the entities **Centre** and **Subject**.

|  |  |  |
| --- | --- | --- |
| Centre |  | Subject |

(1)

(d) Problems with particular entries are also logged in the relational database. These problems are reported in e-mails sent to the Examination Board by the Examination Officer responsible for a centre’s examination entries. The Examination Board may communicate a response via e-mail. The relational database includes two extra fully-normalised relations **ExaminationOfficer** and **Problem** for this purpose.

**ExaminationOfficer**(CentreNo, ExamOfficerSurname, Title, EMailAddress)

**Problem**(ProblemId, DateReported, ProblemDescription, CentreNo, ReplySent)

Using the SQL commands

SELECT, FROM, WHERE, ORDER BY

and any other commands which are considered appropriate, write an SQL statement to query the database tables for the surname and centre number of all Examination Officers who have reported a problem before 1st March 2005 and the corresponding description of the problem.  
The result of the query is to be ordered in ascending order of CentreNo.

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(5)

(e) Name the type of package which would be most suitable to use with the database or on its own for creating a mail merge operation to send personalised letter attachments with each e-mail.

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(1)

(Total 15 marks)

**107.** A file in a library has 100 records with the following record structure.

ISBN, Title, Author, Keywords

The system uses 8 bit ASCII to code characters. All fields in these records are fixed length strings.

ISBN is a 10 digit code. Title is 30 bytes long. Author is 25 bytes and Keywords is 200 bytes long.

What should be the primary key for these records? ............................................................

Justify your choice.

...............................................................................................................................................

(Total 2 marks)

**109.** A local Adult Education Centre uses a relational database to manage its day and evening classes. Two relations(tables) are used.

**Class** (ClassID, Subject, Level, Day, Time, LecturerID)

**Lecturer** (LecturerID, Subject1, Subject2, Name, Address, PhoneNumber)

(a) (i) What is a primary key?

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(1)

(ii) Suggest a suitable primary key for the relation Lecturer.

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(1)

(b) (i) What is meant by a foreign key?

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(1)

(ii) Name the attribute which is the foreign key in the relation Class.

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(1)

(Total 4 marks)

**115.** A department of local government responsible for recreation and the environment has printed leaflets of scenic walking routes in its area. The tablebelow shows details which are recorded in an un-normalised relational database table. The data requirements specify that

 A leaflet references one or more routes.  
 A route is referenced in at most one leaflet.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **LeafletID** | **Leaflet Name** | **Leaflet Cost** | **Quantity In Stock** | **RouteID** | **Route Name** | **Route Area** | **Route Description** |
| 1 | Wendover Hills | £1.10 | 1000 | 1 2 3 | Chequers Monument Clock Tower | Ellesborough Ellesborough Wendover | Relatively hilly Flat Flat |
| 2 | Halton Woods | £1.20 | 2000 | 4 5 6 | East Halton West Halton Middle Halton | Halton Halton Halton | Hilly Relatively flat Flat |
| 3 | Penn | £1.00 | 1500 | 7 8 | Penn Woods Penn Village | Penn Penn | Relatively hilly Flat |
| 4 | Bierton | £1.00 | 800 | 9 10 | Canal Bierton Village | Bierton Bierton | Flat but muddy Flat |
|      |  |  |  |  |  |  |  |
| 56 | Chesham Bois | £1.00 | 900 | 141  142 | East Woods  West Woods | Chesham  Chesham | Hilly and muddy  Hilly and muddy |

The relation for this table is as follows

**LeafletRoutes**(LeafletId, LeafletName, LeafletCost, QuantityInStock,

RouteID, RouteName, RouteArea, RouteDescription)

(a) What makes this table un-normalised?

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(1)

(b) When the data in the table aboveis stored in a fully-normalised relational database, two relations **Leaflet** and **Route** are used. For **each** of these, complete the relations making sure that the primary key attribute(s) are underlined.

(i) **Leaflet**(.............................................................................................................

............................................................................................................)

(2)

(ii) **Route** (.............................................................................................................

.............................................................................................................)

(3)

(c) Complete the entity-relationship diagram for the entities **Leaflet** and **Route**.



(1)

(d) Problems with particular routes are logged in the relational database. These problems are reported in e-mails sent by people walking the routes for which leaflets are available. The relational database includes two extra fully-normalised relations **Person** and **Problem** for this purpose.

**Person**(PersonId, Surname, Title, EMailAddress)

**Problem**(ProblemId, DateReported, ProblemDescription, RouteId, PersonId, ReplySent)

Using the SQL commands

SELECT, FROM, WHERE, ORDER BY

and any others which are considered appropriate, write an SQL statement to query the database tables for all surnames and e-mail addresses of people who have reported a problem before 1st January 2004 and the corresponding RouteIds. The result of the query is to be ordered in ascending order of RouteId.

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(6)

(e) Name the **type** of package which would be most suitable to use with the database or on its own for creating:

(i) a mail merge operation to send personalised letter attachments with each e-mail;

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(1)

(ii) the design of the leaflets in a printer-ready form;

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(1)

(iii) a simple accounting record of leaflet sales.

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(1)

(Total 16 marks)

**120.** (a) When setting up a relational database, entities, *attributes* and relations must be determined. A relational database is to be set up to hold details about sailing holidays.

(i) A relational database is more than a collection of tables. How are relationships implemented in a relational database?

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(2)

(ii) What is an attribute?

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(1)

(b) (i) What is the purpose of data validation?

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(1)

(ii) Give **one** example of a typical built-in validation control that might be applied to a sailing holiday database.

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(1)

(Total 5 marks)

**125.**   


The script in the figure above creates a restricted view, **BorrowersWithFines**, of the **Borrower** table.

(i) Which attribute(field) names of BorrowersWithFines will be visible to a user granted access to this view?

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(1)

(ii) Briefly explain what data this view will give a user access to.

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(1)

(Total 2 marks)

**126.** A swimming club organises swimming gala competitions.

A gala consists of

 more than one race

 races of different swimming strokes, e.g. breast stroke, front crawl

 races at more than one distance for a given stroke

 races with more than one swimmer.

A race has a

 specified swimming stroke

 set distance

 more than one swimmer.

A swimmer may

 swim in more than one race

 swim one swimming stroke in one race and a different stroke in another race

 swim in races of different distances.

A swimming club uses a relational database to record details of

 swimmers

 swimming galas

 swimmers entered for a race in a gala

 swimming strokes swum by swimmers.

The swimming club assigns a

 unique swimmer number to each swimmer

 unique number to each gala

 number to each race in a gala which is unique **only** within the particular gala, e.g. 100 metres breast stroke race is assigned the number 1

 unique number to each swimming stroke that swimmers may swim in a race, e.g. breast stroke is assigned the number 1.

The relational database uses five tables:

**Swimmer**(SwimmerNo, FirstName, Surname, DateOfBirth)

**Gala**(GalaNo, GalaDescription, DateOfGala, Venue)

**GalaRace**(GalaNo, RaceNo, StrokeNo, Distance, SwimmerNoOfWinner, WinningTime)

**GalaRaceSwimmer**(GalaNo, RaceNo, SwimmerNo, EntryFeePaid, TimeRecordedForRace)

**Stroke**(StrokeNo, StrokeDescription)

(a) Draw an Entity-Relationship diagram for the tables:

(i) Gala and GalaRace

(1)

(ii) GalaRace and GalaRaceSwimmer

(1)

(iii) Stroke and GalaRace

(1)

(iv) Gala and Swimmer

(1)

(b) Using the SQL commands SELECT, FROM, WHERE and any others considered appropriate, write an SQL statement to query the database tables for each of the following.

(i) The surname of the swimmer with SwimmerNo = 6.

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(1)

(ii) The SwimmerNo for each swimmer in race with RaceNo = 5 and gala with  
GalaNo = 2, presented in ascending order of TimeRecordedForRace.

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(3)

(iii) The surname of the winner of each race in gala with GalaNo = 4.

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(3)

(Total 11 marks)

**131.** A publisher of a daily newspaper uses a computer system consisting of:

 Reporters’ workstations.  
 Sub-editors’ workstations.  
 A page make-up workstation.  
 An image processing workstation.  
 A central file store.

Each article is word-processed and stored centrally in a separate file.

(a) What type of operating system - real, interactive, batch or network must be run at each of the workstations so that

(i) access to the central file store is possible?

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(1)

(ii) reporters can word-process articles?

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(1)

(b) The editor in charge of an edition enters the layouts of each page at the page make-up workstation. A page is divided into a number of blocks. There is one article per block.

A relational database is used to record details of the page layouts for each edition of the newspaper.

Two relations (tables) **NewspaperEdition** and **PageLayout** are used for this database:

**NewspaperEdition** (Editionld, Date, NoOfPages, EditorInChargeOfEdition)

**PageLayout** (EditionId, PageNo, BlockNo, PositionOfBlockOnPage,  
 WidthOfBlock, LengthOfBlock, FilePathName)

Each newspaper edition is assigned a unique EditionId. There is only one edition per day. FilePathName is used to locate the word-processed article assigned to a block.

(i) State a suitable primary key for the NewspaperEdition relation.

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(1)

(ii) State a suitable secondary key for the NewspaperEdition relation.

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(1)

(iii) Name the attribute which is the foreign key in the relation PageLayout.

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(1)

(iv) State a suitable primary key for the relation PageLayout. Justify your choice.

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(3)

(c) A block of space on a page may also contain an image.  
State **two** image processing operations that an image processing workstation might apply to images.

1 ..................................................................................................................................

.....................................................................................................................................

2 ..................................................................................................................................

.....................................................................................................................................

(2)

(Total 10 marks)

**138.** A hospital stores details of its wards, patients and their medical condition in a database ina way that will allow information about these details to be extracted.  
The data requirements are defined as follows.

 Each patient is assigned a patient number (unique), surname, forename, address, date of birth and gender.

 Each ward has a number of beds.

 Each ward is assigned a ward name (unique), name of the nurse in charge and the number of beds it possesses.

 Each medical condition that the hospital can treat is recorded.

 Each medical condition is assigned a medical condition number (unique), name and the recommended standard treatment.

 Each patient may suffer from one or more medical conditions.

 A particular medical condition may be attributed to more than one patient.

 The medical conditions of each patient are recorded.

 Each ward has zero or more patients.

 A patient can be assigned to only one ward at any one time.

 Each ward may have patients with different medical conditions.

Four entities for the hospital database are

**Ward, Patient, MedicalCondition, PatientMedicalCondition**

(a) Using the partially complete entity relationship diagram shown in the figure below, as an aid, show the degree of **three** more relationships which exist between the given entities.



(3)

(b) Using the following format

**TableName(PrimaryKey, Non-keyAttributel, Non-keyAttribute2, etc)**

describe tables, stating all attributes, for the following entities underlining the primary key in each case.

(i) Ward .................................................................................................................

(1)

(ii) Patient ...............................................................................................................

...........................................................................................................................

(2*)*

(iii) MedicalCondition .............................................................................................

(1)

(iv) PatientMedicalCondition ..................................................................................

(2)

(c) Using the SQL commands **SELECT, FROM, WHERE,** write an SQL statement to query the database tables for the forename, surname and medical condition number of all patients in Victoria ward.

(3)

(Total 12 marks)

**141.** A multi-storey car park is controlled by a computer system as follows.

For a vehicle arriving at the barrier-controlled *entrance*:

 the computer system generates an integer number at random from a set of unused  
 numbers which identifies the vehicle to the system  
 the vehicle’s driver collects a ticket containing this number from a machine at the barrier  
 after a short interval a barrier is raised to enable the car to enter the car park  
 the computer system remembers the current date, the arrival time and the randomly  
 generated number.

If the car park is full a sign is lit to indicate the situation and no vehicle is allowed to enter the car park.

For a vehicle arriving at the barrier-controlled *exit*:

 the ticket is presented to a machine which reads the number on the ticket  
 the computer system determines the length of time the vehicle has been parked in the  
 car park and calculates the amount to pay  
 the amount to pay is displayed on the machine  
 the driver inserts the correct money into the machine  
 the computer system records the length of time in minutes and the amount to pay in  
 pence  
 after a short interval the barrier is raised to enable the vehicle to exit.

(a) Taking account of the technology that could be used for ticket production at the entrance barrier, describe **two** different ways for the number assigned to the ticket to be submitted to the computer system at the exit barrier. Your answer should include a reference to the relevant input/output hardware used.

1...................................................................................................................................

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.....................................................................................................................................

2...................................................................................................................................

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(4)

(b) Using the table below, construct an appropriate record structure for the computer system to use to record the relevant car parking details for one vehicle. Data types should be given that would be available in a third generation programming language.

|  |  |
| --- | --- |
| **Field Name** | **Data Type** |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

(5)

(Total 9 marks)

**142.** Mobile phone systems rely upon a *smart card* called a Subscriber Identity Module or SIM in **a** mobile phone to identify a subscriber to the mobile phone network. Each SIM is allocated a unique number that is stored in the SIM and which is continually sent to the nearest base station in the mobile phone network whilst the mobile phone is switched on. Each base station is able to access a central relational database consisting of several relations (tables) two of which **LocationRegister** and **CallRegister** are constructed as follows

**LocationRegister** (SIMCardNo, MobileTelephoneNo, MobilePhoneSerialNo,  
 ActivationDate, ServiceType, CurrentBaseStationID)

**CallRegister** (CallID, SIMCardNo, Date, Time, Duration, CalledTelephoneNo, Charge)

Each mobile telephone call is assigned a unique CallId.

(a) What is a smart card?

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.....................................................................................................................................

(1)

(b) State a suitable primary key for the **CallRegister** relation.

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(1)

(c) (i) Explain what is meant by foreign key.

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...........................................................................................................................

(1)

(ii) Name the attribute which is the foreign key in the relation **CallRegister.**

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(1)

(d) Relation **LocationRegister** is *updated in real time* whereas relation **CallRegister** is updated in a *batch* *processing* system which uses records collected from the network’s base stations every 24 hours.

What is meant by:

(i) Updated in real time?

...........................................................................................................................

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(1)

(ii) Batch processing?

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(1)

(iii) Give **one** reason why relation **LocationRegister** should be updated in real time.

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(1)

(e) Indexes are created on **CallID** and **SIMCardNo** attributes in relation **CallRegister.**

(i) Why is an index used?

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(1)

(ii) Which of the two attribute indexes is a secondary index?

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(1)

The tables belowshow a sample of the **CallRegister** table **(1A)** and a sample of the  
**LocationRegister** table **(1B)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CallID** | **SIMCardNo** | **Date** | **Time** | **Duration** | **Called Telephone No** | **Charge** |
| :  : | :  : | :  : | :  : | :  : | :  : | :  : |
| 1204200227 | 310-68-4451003 | 12/04/2002 | 8:01:00 | 360 | 07713411927 | 300 |
| 1204200228 | 310-68-4451005 | 12/04/2002 | 8:02:00 | 420 | 01296552341 | 210 |
| 1204200229 | 310-68-4451003 | 12/04/2002 | 8:08:10 | 120 | 07713631281 | 100 |
| 1204200230 | 310-68-4451008 | 12/04/2002 | 8:02:20 | 240 | 0793433016 | 80 |
| 1204201200 | 310-68-4451003 | 13/04/2002 | 9:32:35 | 120 | 0793433016 | 40 |
| 1204201201 | 310-68-4451008 | 13/04/2002 | 9:35:35 | 240 | 0235670023 | 160 |
| :  : | :  : | :  : | :  : | :  : | :  : | :  : |

**Figure 1A: CallRegister table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SIMCardNo** | **Mobile TelephoneNo** | **Mobile Phone SerialNo** | **Activation Date** | **Service Type** | **Current BaseStationID** |
| 310-68-4451000 | 07713631281 | 4990600 | 10/02/2001 | A | 10211 |
| 310-68-4451001 | 07713421224 | 4990613 | 07/10/2001 | A | 20231 |
| 310-68-4451002 | 07713411927 | 4990628 | 13/07/2001 | B | 11367 |
| 310-68-4451003 | 07718491221 | 4990632 | 12/09/2001 | B | - |
| 310-68-4451004 | 07714621289 | 4990644 | 23/11/2001 | A | - |
| 310-68-4451005 | 07713421123 | 4990656 | 24/12/2001 | C | 34111 |
| 310-68-4451006 | 07713482414 | 4990661 | 01/02/2002 | C | 32178 |
| 310-68-4451007 | 07713421582 | 4990673 | 10/03/2002 | C | 22987 |
| 310-68-4451008 | 07715621276 | 4990689 | 29/04/2002 | D | 10345 |

**Figure 1B: LocationRegister table**

(f) The following shows a Query By Example (QBE) applied to the **LocationRegister** and **CallRegister** tables.

|  |  |  |
| --- | --- | --- |
| **MobileTelephoneNo** | **Date** | **Time** |
| 07718491221 | 12/04/2002 | > 8:00:00 |

**QBE**

(i) What will be the minimum number of records returned by this QBE?

...........................................................................................................................

(1)

(ii) Complete the following QBE to extract the **SIMCardNo** and **ServiceType** of all mobile phone accounts activated before 01/03/2002.

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |

(3)

(g) The last digit of the **MobilePhoneSerialNo** is a check digit.

(i) What is a check digit?

...........................................................................................................................

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(1)

(ii) What is its purpose?

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(1)

(Total 15 marks)

**149.** A lending library uses a relational database to record details of books, book loans and borrowers.

 A unique International Standard Book Number (ISBN) is assigned to each book title such as “The Art of Passing Computing Examinations”.

 The library assigns a unique Accession Number to each copy of a book in the library.

 The library assigns a unique Borrower Number to each borrower.

The relational database uses four tables **Book, Book Copy, BookLoan** and **Borrower** with attributes (primary key is underlined) as follows:

**Book**(ISBN, AuthorName, Title, NumberOfCopies)

**BookCopy**(AccessionNumber, ISBN, DateAcquired, ReplacementCost)

**BookLoan**(AccessionNumber, BorrowerNumber, DateDueBack)

**Borrower**(BorrowerNumber, Surname, Initials, Address)

(a) Draw an entity relationship diagram for the tables:

(i) Borrower and BookLoan

(1)

(ii) Book and Borrower

(1)

(b) Using the SQL commands **SELECT, FROM, WHERE,** and any others considered appropriate, write an SQL statement to query the database tables for each of the following:

(i) The title of the book with ISBN “1-57820-082-2”.

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(2)

(ii) The name of the author and ISBN of a book with the AccessionNumber 1234.

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(4)

(c) By linking the database with a word-processing package, overdue book reminder letters can be generated when copies of books on loan to borrowers are overdue. What is this process called?

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(1)

(Total 9 marks)

**156.** A book lending library lends books to borrowers. Each borrower is assigned a unique borrower code. This code is encoded magnetically on to an identity card issued to each borrower when they join the library. The code is read from the identity card by swiping it through a machine connected to the library’s computer system. The code is also printed on the card in human-readable form.



**Figure 1**

(a) Name the type of machine used to read the borrower code from the card.

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(1)

(b) Each borrower code includes a check digit. What is a check digit and why is it used?

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(2)

(c) State **one** reason for having the human-readable form of the borrower code printed on the card.

Reason: .......................................................................................................................

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(1)

Each book is allocated a unique book code. The book code together with other details as shown in **Figure 2** are pasted on to the inside cover of the book. When a borrower borrows a book the book code is scanned into the computer system so that the loan can be recorded.



**Figure 2**

(d) Name the device used to scan the book code into the computer system.

.....................................................................................................................................

(1)

(e) Each loan is recorded in a separate record. All loan records are stored in a Loans file.

The loan record includes the following fields:

BookCode  
BorrowerCode  
DateBookToBeReturnedBy

(i) What is meant by primary key?

..........................................................................................................................

(1)

(ii) Which of the above fields should be chosen as the primary key?

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(1)

(iii) Each new loan can only be recorded at the end of the Loans file. What type of file organisation does the Loans file use?

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(1)

(f) At the end of each day the information stored in the Loans file is transferred to the Books file using sequential file access. The Books file contains a separate record for each copy of a book that the library stocks.  
 The book record includes the following fields:

BookCode  
BorrowerCode  
LoanStatus  
DateBookToBeReturnedBy

The Books file is organised sequentially. The field LoanStatus is used to record whether or not a book is currently on loan.

(i) Suggest a suitable field on which the Books file would be sorted.

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(1)

(ii) Why should the Loans file be sorted and in what order, before the Books file is updated?

Reason: ............................................................................................................

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..........................................................................................................................

Order: ...............................................................................................................

(2)

(g) At the end of each day overdue books are identified. State the processing steps that need to be executed in the library’s computer system to extract the loan details of books that have not been returned by the date recorded in the Books file and to record these details in a separate OverDueBooks file. State clearly the data that will be extracted.

Steps: ..........................................................................................................................

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(4)

Data: ...........................................................................................................................

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(3)

(Total 18 marks)

**157.** A sporting federation that organises races uses a relational database to keep track of the racing division in which each competitor races and the points accumulated in that division. The twenty racing divisions are uniquely coded “Cat20”, “Cat19”, ...., “Cat2”, “Cat1”. On reaching the maximum points allowed the competitor withdraws from further competition in that division and starts again from zero points in the division above, if it exists.

Two relations (tables) are used for this database

**Competitor** and **RacingDivision**

**Competitor** (CompetitorId, Name, Address, PointsAccumulated, RacingDivisionId)

**RacingDivision** (RacingDivisionId, MaximumPointsAllowed)

Each competitor is assigned a unique CompetitorId.

(a) What is a relational database?

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(1)

(b) (i) Select a suitable primary key for the relation Competitor. Justify your choice.

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(2)

(ii) Select a suitable primary key for the relation RacingDivision.

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(1)

(c) (i) Explain what is meant by the term foreign key.

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(2)

(ii) Name the attribute which is the foreign key in the relation Competitor.

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(1)

(d) Indexes are created on **CompetitorId** and **RacingDivisionId** attributes for the relation Competitor.

(i) Why is an index used?

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(1)

(ii) Which of the two attribute indexes is a secondary index?

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(1)

(e)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CompetitorId** | **Name** | **Address** | **PointsAccumulated** | **RacingDivision1d** |
| :  : | :  : | :  : |  | :  : |
| 567 | Jones | ....... | 55 | Cat2 |
| 868 | Smith | ....... | 412 | Cat1 |
| 919 | Adams | ....... | 23 | Cat2 |
| 920 | Gregory | ....... | 534 | Cat1 |
| :  : | :  : | :  : |  | :  : |

**Competitor table**

|  |  |
| --- | --- |
| **DivisionId** | **MaximumPointsAllowed** |
| Cat1 | 1000 |
| Cat2 | 900 |
| Cat3 | 850 |
| Cat4 | 800 |
| Cat5 | 750 |
| :  : | :  : |
| Cat19 | 50 |
| Cat20 | 25 |

**RacingDivision table**

Using the template, show the QBE for the query to find the CompetitorId, Name, Points Accumulated of those competitors in racing division Cat1 who have more than 300 points?

|  |  |  |  |
| --- | --- | --- | --- |
| **CompetitorId** | **Name** | **PointsAccumulated** | **RacingDivisionId** |
|  |  |  |  |

**QBE**

(2)

(Total 11 marks)

**166.** A **file** of 80 records has the following record structure.

**ProductID, ProductDescription, QuantityInStock**

ProductID is a four-byte integer, ProductDescription is a fifty-six byte fixed length string, QuantityInStock is a four-byte integer.

Suggest a suitable primary key for this file. Justify your choice.

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(Total 2 marks)

**168.** A publisher uses a relational database to record details of articles it publishes in a monthly magazine.

Two relations (tables) **MagazineEdition** and **MagazineArticle** are used for this database.

**MagazineEdition** (MagazineEditionId, Month, Year)

**MagazineArticle** (ArticleId, ArticleType, ArticleTitle, Content, AuthorName, MagazineEditionId)

Each Article is assigned a unique ArticleId.

(a) What is a relational database?

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(1)

(b) State a suitable primary key for the MagazineEdition relation. Justify your choice.

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(2)

(c) (i) Explain what is meant by foreign key.

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(2)

(ii) Name the attribute which is the foreign key in the relation MagazineArticle.

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(1)

(d) Indexes are created on **ArticleId** and **AuthorName** attributes.

(i) Why is an index used?

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(1)

(ii) Which of the two attribute indexes is a secondary index?

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(1)

(e) The following shows a sample of the MagazineEdition table and a sample of the MagazineArticle table.

**MagazineEdition table**

|  |  |  |
| --- | --- | --- |
| **MagazineEditionId** | **Month** | **Year** |
| : : | : : | : : |
| 240 | December | 1999 |
| 241 | January | 2000 |
| 242 | February | 2000 |
| 243 | March | 2000 |
| : : | : : | : : |

**MagazineArticle table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ArticleId** | **ArticleType** | **ArticleTitle** | **Content** | **AuthorName** | **Magazine EditionId** |
| 1 | Business | ........ | ........ | Bloggs | 89 |
| 2 | Management | ........ | ........ | Smith | 89 |
| 3 | Business | ........ | ........ | Bloggs | 89 |
| 4 | Quality Control | ........ | ........ | Jones | 89 |
| 5 | Investments | ........ | ........ | Bloggs | 90 |
| : : | : : | : : | : : | : : | : : |
| 1201 | Recruitment | ........ | ........ | Jones | 253 |
| 1202 | Accounting | ........ | ........ | Smith | 254 |
| : : | : : | : : | : : | : : | : : |

The following shows a Query By Example (QBE) applied to the MagazineEdition and MagazineArticle tables.

|  |  |  |
| --- | --- | --- |
| MagazineEditionId | AuthorName | ArticleType |
|  | Bloggs | Business |

**QBE**

(i) What will be the minimum number of records returned by this QBE?

..........................................................................................................................

(1)

(ii) Complete the following QBE to extract the author names and article titles of all articles of the article type “Management” appearing in magazines published in the year 1999 **or** before.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  |  |  |

(4)

(Total 13 marks)

**174.** Customers placing orders with ABC Ltd for ABC’s products have their orders recorded by ABC in a database.

The data requirements for the database system are defined as follows:

 Each product is assigned a unique product code, ProductId and has a product description.

 The quantity in stock of a particular product is recorded.

 Each customer is assigned a unique customer code, CustomerId and has their name, address and telephone number recorded.

 An order placed by a customer will be for one or more products.

 ABC Ltd assigns a unique code to each customer order, ABCOrderNo.

 A customer placing an order must supply a code, CustomerorderNo, which the customer uses to identify the particular order.

 A customer may place one or more orders.

 Each new order from a particular customer will have a different customer order code but two different customers may use, independently, the same values of customer order code.

 Whether an order has been despatched or not will be recorded.

 A particular order will contain one or more lines.

 Each line is numbered, the first is one, the second is two, and so on.

 Each line will reference a specific product and specify the quantity ordered.

 A specific product reference will appear only once in any particular order placed with ABC Ltd.

After normalisation the database contains four tables based on the entities:

**Customer, Product, Order, OrderLine**

(a) **Figure 1** below is a partially complete entity-relationship diagram. Show the degree of **three** more relationships which exist between the given entities.



**Figure 1**

(3)

(b) Using the following format:

**TableName(Primary Key, Non-key Attribute1, Non-key Attribute2, etc)**

describe tables, stating all attributes, for the following entities underlining the primary key in each case.

(i) Product .............................................................................................................

..........................................................................................................................

(2)

(ii) Customer ..........................................................................................................

..........................................................................................................................

(2)

(iii) Order ................................................................................................................

..........................................................................................................................

(3)

(iv) OrderLine ........................................................................................................

..........................................................................................................................

(4)

(c) Using the SQL commands SELECT, FROM, WHERE, ORDER BY, write an SQL statement to query the database tables for all customer names where the orders have been despatched. The result of the query is to be ordered in ascending order of ABCOrderNo.

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(6)

(Total 20 marks)

**182.** A charity uses a relational database to keep track of donors and their donations. Donations are given weekly, monthly and annually (donation type).

Two relations (tables) are used for this database.

**Donors** and **Donations**

**Donor** (DonorId, Name, Address, DonationType)

**Donation** (DonationId, AmountGiven, DateDonationGiven, DonorId)

Each donation is assigned a unique DonationId.

(a) What is a relational database?

.....................................................................................................................................

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(1)

(b) Select a suitable primary key for the Donor relation. Justify your choice.

.....................................................................................................................................

.....................................................................................................................................

(2)

(c) (i) Explain what is meant by the term foreign key.

...........................................................................................................................

...........................................................................................................................

(2)

(ii) Name the attribute which is the foreign key in the relation Donation.

...........................................................................................................................

(1)

(iii) Select a suitable primary key for the relation Donation.

...........................................................................................................................

(1)

(d) Indexes are created on **Donorld** and **Donation Type** attributes.

(i) Why is an index used?

...........................................................................................................................

(1)

(ii) Which of the two attribute indexes is a secondary index?

...........................................................................................................................

(1)

(e) The following are samples of the Donor table and the Donation table.

|  |  |  |  |
| --- | --- | --- | --- |
| **Donorld** | **Name** | **Address** | **DonationType** |
| **: :** | **: :** | **: :** | **: :** |
| 567 | Jones | .................. | Weekly |
| 868 | Smith | .................. | Monthly |
| 919 | Adams | .................. | Weekly |
| 920 | Gregory | .................. | Annually |
| **: :** | **: :** | **: :** | **: :** |

**Donor Table**

-

|  |  |  |  |
| --- | --- | --- | --- |
| **Donationld** | **Amount Given** | **DateDonation Given** | **Donorld** |
| 1 | 5 | 10/7/2000 | 567 |
| 2 | 7 | 10/7/2000 | 919 |
| 3 | 200 | 17/7/2000 | 920 |
| 4 | 7 | 17/7/2000 | 919 |
| 5 | 5 | 17/7/2000 | 567 |
| :  : | :  : | :  : | :  : |
| 12021 | 20 | 10/7/2001 | 868 |
| 12022 | 200 | 17/7/2001 | 920 |

**Donation Table**

The following shows a Query By Example (QBE) applied to the Donor and Donation tables.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Donorld** | **Name** | **Amount Given** | **DonationType** | **DateDonation Given** |
|  |  |  | Weekly | 10/7/2000 |

**QBE**

(i) How many records will be returned by this QBE?

...........................................................................................................................

(1)

(ii) Using the result of the QBE, calculate the total amount given.

...........................................................................................................................

(1)

(Total 11 marks)

**187.**(a) Describe **two** methods that could be used to ensure the integrity of data stored in a database.

1................................................................................................................................

.................................................................................................................................

.................................................................................................................................

2...............................................................................................................................

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.................................................................................................................................

(2)

(b) Name the legislation that applies to personal data stored in a database.

.................................................................................................................................

(1)

(Total 3 marks)

**189.** A newspaper publisher uses a relational database to record details of advertisements placed by businesses and members of the general public.

Two relations (tables) **Customer** and **Advertisement** are used for this database.

**Customer**  (CustomerId, Name, Address, CustomerType)

**Advertisement** (AdvertId, Content, DateAdvertPlaced, NoOfNights, Classification, Customerld)

Each advertisement is assigned a unique ~AdvertId.

(a) What is a relational database?

.................................................................................................................................

.................................................................................................................................

(1)

(b) State a suitable primary key for the Customer relation. Justify your choice.

.................................................................................................................................

.................................................................................................................................

(2)

(c) (i) Explain what is meant by foreign key.

.................................................................................................................

.................................................................................................................

(2)

(ii) Name the attribute which is the foreign key in the relation Advertisement.

..........................................................................................................................

(1)

(iii) State a suitable primary key for the relation Advertisement.

..........................................................................................................................

(1)

(d) Indexes are created on **CustomerId** and **Name** attributes.

(i) Why is an index used?

..........................................................................................................................

..........................................................................................................................

(1)

(ii) Which of the two attribute indexes is a secondary index?

..........................................................................................................................

(1)

(e) The following shows a sample of the Customer table and of the Advertisement table

|  |  |  |  |
| --- | --- | --- | --- |
| **Customer Id** | **Name** | **Address** | **Customer Type** |
| : : | : : | : : | : : |
| 920 | Jones | ...... | Business |
| 868 | Smith | ...... | Non-Business |
| 919 | Adams | ...... | Non-Business |
| 655 | Gregory | ...... | Business |
| : : | : : | : : | : : |

**Customer table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Adert ID** | **Content** | **DateAdvertPlaced** | **No Of Nights** | **Classification** | **Customer Id** |
| 1 | Lawn Mower for sale | 10/7/2000 | 3 | General sales | 567 |
| 2 | Child’s Bicycle | 10/7/2000 | 2 | General sales | 868 |
| 3 | Ford Mondeo T Reg | 11/7/2000 | 5 | Cars for sale | 920 |
| 4 | Ford Fiesta M reg | 12/7/2000 | 5 | Cars for sale | 655 |
| 5 | Electrician, no job too small | 12/7/2000 | 10 | Electricians | 800 |
| : : | : : | : : | : : | : : | : : |
| 12021 | Fiat Uno, P reg | 1/12/2000 | 3 | Cars for sale | 868 |
| 12022 | Study desk for sale | 1/12/2000 | 2 | General Sales | 919 |

**Advertisement table**

The following shows a Query By Example **(QBE)** applied to the Customer and Advertisement tables.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Customer Id** | **Name** | **Customer Type** | **Classification** | **Date Advert Placed** |
|  |  | Business | Cars for Sale |  |

**QBE**

(i) What will be the minimum number of records returned by this QBE?

..........................................................................................................................

(1)

(ii) Complete the following **QBE** to extract the names and addresses of all non business customers placing an advert after 12/7/2000.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  |  |  |

(4)

(Total 14 marks)

**193.** A car showroom uses a computer system to record the purchase and sale of second-hand cars. The system has a customer file that contains details of the customers and a car file that contains details of the cars.

(a) Give a suitable key field for

(i) a customer record,

(1)

(ii) a car record.

(1)

(b) Give **six** additional fields that would be included in a customer record.

(3)

(c) Give **six** additional fields that would be included in a car record.

(3)

(d) Explain how links could be established between the two files.

(2)

(Total 10 marks)

**194.** A particular computer language is described as declarative.

(a) What is meant by a declarative language?

(1)

(b) Give a situation where a declarative language should be used.

(1)

(Total 2 marks)

**205.** A theatrical agency finds theatrical work for its clients - actors and actresses - in theatre, television and film productions. The data requirements for a database for a theatrical agency are defined below.

 Each client is assigned to one agent  
 An agent is responsible for many clients.  
 Each agent within the agency is assigned an identification number and has their name  
 recorded.  
 Each client is assigned an identification number and has their name recorded.  
 Audition appointments are arranged between clients and producers.  
 Each producer is assigned an identification number and has their name recorded.  
 Auditions take place at venues that are hired by producers around the country.

 A particular venue may be hired by more than one producer and a producer may hire  
 more than one venue.  
 Each venue is assigned an identification number and has its name and address  
 recorded.  
 A producer never holds more than one audition per day.  
 A client never attends more than one audition per day.  
 A venue may not be hired more than once per day.  
 The date and the time of a client’s appointment for an audition are recorded.

Six entities for the theatrical agency database are:

**Client, Agent, Producer, Venue, ClientAuditionAppointment, VenueHired**

(a) Using a copy of the partially complete entity-relationship diagram as an aid, show the degree of **four** more relationships which exist between the given entities.



(4)

(b) A relational database is to be used to record the data. The table corresponding to the entity **Agent** is

**Agent(AgentId, AgentName)**

Using the following format

**TableName(PrimaryKey, Non-KeyAttribute1, Non-KeyAttribute2, etc)**

describe tables, stating all attributes, for the following entities. Underline the primary key in each case.

(i) Producer

(1)

(ii) Venue

(1)

(iii) Client

(2)

(iv) VenueHired

(3)

(v) ClientAuditionAppointment

(3)

(c) The contents of a result table with the column structure shown below are to be produced.

|  |  |  |  |
| --- | --- | --- | --- |
| **ClientId** | **ClientName** | **AgentId** | **AgentName** |
| --  --  --- | --  --  --- | --  --  --- | --  --  --- |

Using a structured query language (SQL) of the type **Select** ... **From** ... **Where** ..., show how the relevant data may be extracted from the tables in part (b) to produce the contents of this result table.

(6)

(Total 20 marks)

**213.** A bookshop uses a relational database to store details of its stock on a computer system. Two entities associated with this database are book and publisher. The key field (identifier) for the publisher entity is the publisher’s name and for the book entity is the ISBN (International Standard Book Number).

(a) What is meant by a relational database?

(2)

(b) State **four** attributes in addition to the ISBN and title associated with a book.

(4)

(c) Draw a diagram showing the relationship between the book entity and the publisher entity.

(2)

(d) State another entity that could be related to either of these entities. State the relationship involved and the key field (identifier) for the entity.

(3)

(Total 11 marks)

**222.** A club, AQA Wanderers, wishes to computerise the records of matches played by its first team so that it can generate statistics on its players. The data requirements are defined below.

In a season, the club’s first team plays against all opposition clubs’ first teams from the same division of the league twice, once at home and once away from home. The date of each match, the start time, opposition team’s name, whether home or away, goals for and goals against are recorded. Each AQA Wanderers’ player has a player identification number and their surname, forenames, date of birth, contact telephone number are recorded.

For each match, fourteen players from a pool of twenty are selected as match players including three substitutes. The player identification numbers of the selected players are to be recorded for each match together with the identification number sewn on the shirt worn (range one to fourteen) so that a player’s first team appearances may be analysed. The goal scorers of AQA Wanderers, if any, in each match must also be recorded together with the number of goals scored by each against the opposition. Players one to eleven start a match but may be substituted by players twelve to fourteen during the match. For any substitution of an AQA Wanderers’ player by another during a match the player identification numbers of both are to be recorded.

Five entities for AQA Wanderers are

**Player, MatchPlayer, Match, GoalScorer, Substitution**

(a) Using a copy of the partially complete entity relationship diagram shown below as an aid show the degree of **five** more relationships which exist between the given entities.



(5)

(b) A relational database is to be used to record the data for one season so that statistics on individual players can be produced at the end of the season. Using the following format

**TableName(PrimaryKey, Non-KeyAttributel, Non-KeyAttribute2, etc)**

describe tables, stating all attributes, for the following entities underlining the primary key in each case.

(i) Player

(2)

(ii) Match

(2)

(iii) GoalScorer

(4)

(iv) MatchPlayer

(3)

(v) Substitution

(4)

(Total 20 marks)

# Communications and Networking

**1.** Using electronic e-mail over the Internet is an example of a **client–server system**.

(a) Explain the term client-server.

....................................................................................................................................

....................................................................................................................................

....................................................................................................................................

(3)

(b) The sending and receiving of e-mails uses various protocols.

(i) Explain the term **protocol**.

.........................................................................................................................

(1)

(ii) Bob is a student travelling in his gap year. His sister Alice e-mails a greeting to him on his birthday, not knowing where he will be on that date. Explain, including the main protocols involved, how Bob is able to pick up Alice’s message.

.........................................................................................................................

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.........................................................................................................................

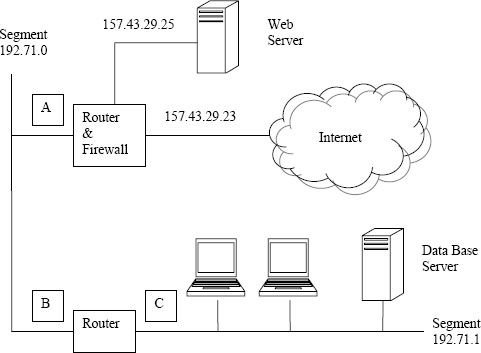
.........................................................................................................................

.........................................................................................................................

(5)

(Total 9 marks)

**6.** A network has the following topology.



(a) Suggest suitable IP addresses for the routers to replace the labels A, B and C.

A................................................................................................................................

B.................................................................................................................................

C.................................................................................................................................

(3)

(b) Explain why a firewall would be used in the above network. Your explanation should cover the role of ports and include at least two functions performed by the firewall.

*The quality of written communication will be assessed in your answer.*

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(5)

(c) When data is sent through the Internet it may be *encrypted*. What is encryption and explain why it is used.

*The quality of written communication will be assessed in your answer.*

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(4)

(d) A digital certificate consists of a public key and a private key. Person A and person B want to communicate via e-mail. Each has their own digital certificate and B has previously sent a digitally signed message to A. A wants to send B a message that only B can understand.

(i) Which key should A use to encrypt this message?

..........................................................................................................................

(1)

(ii) Which keys should B use to decrypt the message?

..........................................................................................................................

(1)

(Total 14 marks)

**11.** (a) State what is meant by **serial transmission** of data.

...................................................................................................................................

...................................................................................................................................



(1)

(b) (i) The figure above shows a port on the back of a PC which is used for the **parallel** **transmission** of data; typically between the PC and a printer.

More than eight of the port lines are used during a data transfer.

State **two different** uses for the lines.

1 .......................................................................................................................

2 .......................................................................................................................

(2)

(ii) When would it be **inappropriate** to use parallel data transmission, even when the communicating device has a parallel port?

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..........................................................................................................................

(1)

(c) Define **asynchronous data transmission**.

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(1)

(Total 5 marks)

**20.** Describe the principles of operation of a packet-switching network.

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(Total 3 marks)

**21.** **Figure 1** shows two of the ports on the back of a student’s home computer. The parallel port is connected to a laser printer.

**Figure 1**



The parallel port has 24 lines.

 Lines 1 to 7 are used for transfer of the data bits, with the byte’s most significant bit transferred on line 1.

 Line 8 is used to transfer the parity bit when used.

(a) Give **one** use for any of the other lines (9 to 24) for the parallel port connection.

....................................................................................................................................

(1)

(i) Use the ASCII code table shown in the table below to write the **7-bit ASCII binary** code for character ‘j’.

..........................................................................................................................

(1)

ASCII Code Table (part only)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Character** | **Decimal** | **Character** | **Decimal** | **Character** | **Decimal** | **Character** | **Decimal** |
| <Space> | 32 | 9 | 57 | j | 106 | t | 116 |
| 0 | 48 | a | 97 | k | 107 | u | 117 |
| 1 | 49 | b | 98 | l | 108 | v | 118 |
| 2 | 50 | c | 99 | m | 109 | w | 119 |
| 3 | 51 | d | 100 | n | 110 | x | 120 |
| 4 | 52 | e | 101 | o | 111 | y | 121 |
| 5 | 53 | f | 102 | p | 112 | z | 122 |
| 6 | 54 | g | 103 | q | 113 | ( | 40 |
| 7 | 55 | h | 104 | r | 114 | ) | 41 |
| 8 | 56 | i | 105 | s | 115 | : | 58 |

(ii) Characters are transmitted as an 8-bit code which includes a **parity bit** (in the most significant bit position of the byte) using **even parity**.

Give the 8-bit binary code for the character ‘j’.

..........................................................................................................................

(1)

(iii) The character ‘j’ is sent to the laser printer.

Write on **Figure 1** the pattern of bits when this character is transmitted using even parity.

(3)

(c) The parallel port uses a protocol called handshaking for the transfer of data.

(i) What is meant by the term *protocol*?

..........................................................................................................................

..........................................................................................................................

(1)

(ii) What is meant by the term *handshaking*?

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

(2)

(d) The USB port is connected to a card reader for a flash memory card which the student regularly uses to transfer files from the school’s computer system to the student’s home computer.

**Figure 2**



The **USB** **connection** uses 4 lines (wires).

 Line 1 is used to transfer data from the card reader to the home computer.

 Line 2 is used to transfer data from the home computer to the card reader.

 The most significant data bit is always transferred first.

(i) What does USB stand for? ...............................................................................

(1)

(ii) The USB port is currently in use transferring a spreadsheet file from the memory card to the PC.

Write on **Figure 2** the pattern of bits showing the transfer of the character ‘j’.

(2)

(iii) Define the term bit rate.

..........................................................................................................................

..........................................................................................................................

(1)

(Total 13 marks)

**22.** The figure below shows the address bar of a web browser.

(a) This is used to access various websites.



(i) What does 212.219.90.65 represent?

..........................................................................................................................

(1)

(ii) Another way to access a website is to key a **URL** into the address bar.

What does URL stand for?

..........................................................................................................................

(1)

(b) Name and describe **two** features you would expect to find on the browser’s menu or toolbar which are specific to browser software.

1. Feature: ..................................................................................................................

Description: ...............................................................................................................

2. Feature: ..................................................................................................................

Description: ...............................................................................................................

(2)

(c) AQA Wanderers are a local soccer club which has a website. The club’s players and members frequently access this website using the URL:

http://www.footyhosting.co.uk/aqawanderers/home.asp

The club pay an annual subscription to the company Footy Hosting Ltd to host the club’s site. The company also hosts the sites for hundreds of other soccer clubs.

(i) What is the **domain name** of the website being accessed?

..........................................................................................................................

(1)

(ii) Explain from the URL shown, how the company may have organised the storage of the pages for all the clubs it manages on its web server.

..........................................................................................................................

(1)

(d) The soccer club’s own computer is used to manage and upload the page content for AQA Wanderers and is done using a broadband connection.

Select from the list below **the most probable value** for the **transfer rate** of the data using the broadband connection. Put a circle around your answer.

20 MB 1.6 GHz 200 bps (bits/sec) 2 Mbps 128 Kbps

(1)

(e) The website for a single soccer club takes up approximately 5GB of storage space.

Footy Hosting Ltd currently has 500 clubs as customers and hopes to double this by the end of 2009.

(i) What type of secondary storage is used for a web server?

..........................................................................................................................

(1)

(ii) Select from the list below **one** value for the minimum size of web server required to host the sites for all clubs (including the proposed expansion in business). Put a circle around your answer.

50 MB 500 MB 20 GB 100 GB 8000 GB

(1)

(Total 9 marks)

**30.** SSL (Secure Socket Layer) is a protocol used by Internet browsers to transmit information securely. It uses a combination of *Symmetric Key and Public Key encryption.*

(a) Explain the difference between Symmetric Key and Public Key encryption.

............................................................................................................................................

............................................................................................................................................

............................................................................................................................................

(3)

(b) Amy uses her computer for online banking. When she logs on to her bank’s website, her computer (computer A) and the bank’s server (computer B) start a secure session using SSL. Computer B sends a symmetric key to computer A to encrypt all the personal data that is passed between the computers. This symmetric key is discarded at the end of the session.

(i) When and how is the Public Key encryption used in this session?

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

(3)

(ii) Why is the symmetric key encryption on its own not enough to protect the personal data during transmission between computer A and computer B?

..........................................................................................................................

..........................................................................................................................

(1)

(Total 7 marks)

**31.** Give **one** data definition language (DDL) command that could be found in a script used to construct a relational database table.

..............................................................................................................................................

(Total 1 mark)

**33.** **Figure 1** shows an area of main memory storing a text file which is about to be sent to a printer.

**Figure 1**

|  |  |
| --- | --- |
| Address | Contents |
| 0 |  |
| 1 |  |
| ... |  |
| ... |  |
| 150 | 0100 0101 |
| 151 | 0101 1000 |
| 152 | 0100 0001 |
| 153 | 0100 1101 |

**Table 1**

ASCII Code Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Character | Decimal | Character | Decimal | Character | Decimal |
| <Space> | 32 | I | 73 | R | 82 |
| A | 65 | J | 74 | S | 83 |
| B | 66 | K | 75 | T | 84 |
| C | 67 | L | 76 | U | 85 |
| D | 68 | M | 77 | V | 86 |
| E | 69 | N | 78 | W | 87 |
| F | 70 | O | 79 | X | 88 |
| G | 71 | P | 80 | Y | 89 |
| H | 72 | Q | 81 | Z | 90 |

(a) Assuming the first character to be printed is held at address 150, show the **first four** characters to be printed on the page. Use **Table 1.**

....................................................................................................................................

(3)

(b) **Figure 2** shows there are two printers available on the PC and they are connected to the computer. One is connected to port A, the other to port B.

**Figure 2**



The cable which connects to port A has 4 wires and connects to a USB printer.

The cable which connects to port B has 25 wires of which eight are used for sending data bits.

(i) What does USB stand for?

..........................................................................................................................

(1)

(ii) What type of data transmission occurs using Port B?

..........................................................................................................................

(1)

(iii) The computer communicates with the printer connected to port B using a **handshaking protocol.** Explain this term.

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

(2)

(iv) The port B cable uses 8 wires for data bits. Using a handshaking protocol, the other wires are used to send various signals. Name **one** signal.

..........................................................................................................................

(1)

(v) **Figure 1** shows the first four bytes of the text file to be printed. Name **two** necessary items of software resident in main memory at the time the printout is produced.

1........................................................................................................................

2........................................................................................................................

(2)

(Total 10 marks)

**34.** For **each** of the following activities, state which **one** of **batch operation**, **interactive operation, real time operation,** or **network operation** would be most appropriate.

(a) Developing a computer program.

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(1)

(b) An automatic train control system for driverless trains.

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(1)

(c) Sending a document to print on another work station.

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(1)

(Total 3 marks)

**44.** E-mail may be more easily intercepted and altered than paper mail without the knowledge of either the sender or the recipient.

In symmetric encryption, the same key is used to encrypt and decrypt a message. In asymmetric encryption, one key is used to encrypt a message and another key is used to decrypt the message.

(a) Why is symmetric encryption not used for encrypting e-mail messages?

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(1)

(b) In asymmetric encryption, one key is made publicly available (the public key) and the other key is kept secret by its owner (the private key).

Jack and Jill want to communicate with each other confidentially, and they each have a private and a public key.

(i) Which key should Jack use to encrypt a message to send to Jill, which only Jill can read?

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(1)

(ii) Which key can Jill use to decrypt the message sent by Jack?

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(1)

(c) A digital signature authenticates the message, that is, it verifies that the message came from the given sender and that it has not been tampered with.

(i) How is a digital signature produced?

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(3)

(ii) If Jack digitally signs the message sent to Jill, how can Jill verify Jack’s digital signature?

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(4)

(Total 10 marks)

**45.** A county has a number of local libraries in various towns. Books currently belong to each library and there is no system for the exchange of books between libraries.

Each library has a local area network (LAN) for lending and enquiries shown in the figure below.

(a) (i) Describe what is meant by a local area network.

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(2)



(ii) What type of local area network topology is shown in the figure above?

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(1)

(iii) Does the network cable for this type of network use serial or parallel transmission of data?

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(1)

(iv) Name **one** other type of local area network topology.

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(1)

(v) Name **two** other devices which could be added to the network each of which  
would be a resource shared by users (administrators and/or borrowers) of the  
network.

1 .......................................................................................................................

2 .......................................................................................................................

(2)

(b) There is currently an Internet connection from one of the PCs, and staff use this to contact a book supplier by keying the following into the address bar of the browser software.

http://www.bargainbooks-r-us.co.uk/index.htm

(i) What is the **domain name** of the supplier?

.........................................................................................................................

(1)

(ii) What is **index.htm**?

..........................................................................................................................

(1)

(iii) Sometimes when the browser is used the software displays the error message

‘Page Not Found’.

Give **one** possible reason for this, other than a misspelling of the URL.

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(1)

(c) The decision has been made to connect each library to a wide area network.

(i) Explain what is meant by a wide area network (WAN).

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(2)

(ii) Describe **two** benefits of connecting all the libraries to a WAN**. One** should be a benefit for a library administrator, and **one** a benefit for a borrower.

1 Administrator ................................................................................................

..........................................................................................................................

2 Borrower .......................................................................................................

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(2)

(Total 14 marks)

**48.** A company stores all its data in an on-line information retrieval system. Some of this data is personal data about the employees; some of it is confidential data about the business. All staff have authorised access to those parts of the system which they need to carry out their job role.

(a) (i) Describe **two** distinct steps that should be taken to minimise unauthorised access by staff to those parts of the system they have no need to access in order to carry out their job role.

1 ........................................................................................................................

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2 ........................................................................................................................

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(4)

(ii) How could such unauthorised access be detected?

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(1)

(b) What safeguards should be used to keep the data protected from loss or corruption due to:

(i) Hackers

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(1)

(ii) Viruses

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(1)

(iii) A system failure caused, for example, by a power cut?

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(1)

(c) Describe **one** further safeguard which needs to be in place to enable the company to get back into operation swiftly and effectively after a serious problem causing a complete system failure.

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…….............................................................................................................................

(1)

(Total 9 marks)

**54.** Tom’s family has asked you for some advice about networking. They have just moved to a new house, currently without any communication links. They want Internet access for the family desktop computer.

(a) Describe the **differentiating** features of *dial-up*, *cable-modem* and *ADSL* connections.

(i) dial-up ..............................................................................................................

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(ii) cable-modem ....................................................................................................

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…......................................................................................................................

(iii) ADSL ..............................................................................................................

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…......................................................................................................................

(6)

(b) Tom’s parents both use laptop computers at work and would like to be able to use these at home to access the Internet and to access personal files left on the family desktop computer.

(i) Explain how this could be achieved by setting up a peer-to-peer network.

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(3)

(ii) Explain how this could be achieved by setting up a client-server network.

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…......................................................................................................................

…......................................................................................................................

(3)

(c) Tom’s mother’s laptop computer is set up with an IP address of 192.168.28.175 and Tom’s father’s laptop computer uses IP address 192.168.15.12.

(i) What would be a sensible IP network ID? .......................................................

(1)

(ii) What is the range of IP addresses available for the family desktop computer?

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(2)

(iii) What would be the subnet mask for this network?

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(1)

(d) Tom’s parents are worried about the possible risks of viruses and data security threats through the Internet connection.

Explain what measures they should take to minimise the risk of:

(i) virus attack.

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(1)

(ii) unauthorised access to data held on the laptop computers.

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(1)

(e) The family’s computers could be linked using cable or wireless connections.

(i) What type of cable would be required for the cabled connection?

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(1)

(ii) What hardware would be required for the wireless connection?

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(2)

(iii) Give **one** advantage of wireless over cabled connection.

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(1)

(iv) Give **one** disadvantage of wireless over cabled connection.

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(1)

(Total 23 marks)

**56.** A firm of solicitors is based in a city centre office occupying **two** floors. The firm has 15   
stand-alone PCs.

The majority of the work involves the word processing of customer documents and contracts. One PC has a connection to the Internet and is used for access to various professional bodies’ web sites and the on-line ordering of goods.

The decision has been taken to network the existing PCs.

(a) Give **two** reasons why each PC will need a network adapter card.

1 ................................................................................................................................

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2 ................................................................................................................................

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(2)

(b) Describe **three** benefits which the network will bring to the company.

1 ................................................................................................................................

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2 ................................................................................................................................

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3 .................................................................................................................................

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(3)

(Total 5 marks)

**57.** A home computer is used to transfer picture files from a camera-phone to the hard disk of a computer using communications software and a Universal Serial Bus (USB) cable.

(a) What is meant by serial data communication?

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...................................................................................................................................

(1)

(b) The picture files on the camera are each 768 by 1024 pixels. The pictures are encoded as 256-colour images.

(i) How many bytes are needed to store one pixel?

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(1)

(ii) How many kilobytes are needed to store five pictures?

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(1)

(c) The camera-phone also plays MP3 sound files. These sound files are produced from music CDs using software on the user’s PC. The software has the option to encode the MP3 files at either 64kbps or 128kbps. The MP3 files are then uploaded from the PC to a memory card in the camera-phone.

Give **one** advantage and **one** disadvantage to the user of producing the files at the higher bit rate.

Advantage

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Disadvantage

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...................................................................................................................................

(2)

(Total 5 marks)

**59.** Why is data often encrypted when transmitted over a network? Give **two** reasons.

1 ..........................................................................................................................................

2 ..........................................................................................................................................

(Total 2 marks)

**60.** When a member of staff logs onto a computer in a particular organisation, they enter their User\_name and password. The password has to be at least 8 characters long and must include both letters and numbers.

(a) Why do organisations set rules for acceptable user passwords?

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(1)

The file **Password** is used by the computer system to authenticate (check) the identity and password typed at a keyboard when a user logs onto the system. The password is input to the logon program as an alphanumeric string and converted to a two-byte integer using a hashing function or algorithm before being sent across a network for authentication (checking).

(b) Outline **three** major steps that a typical hashing function / algorithm would use to convert an alphanumeric string into a two-byte integer.

1 ...................................................................................................................................

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2 ..................................................................................................................................

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3 ..................................................................................................................................

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(3)

(Total 4 marks)

**66.** A small organisation, Acme Consultants, with four stand-alone computers in an office, want to set up a peer-to-peer network in order to share the printer connected to one of the computers.

(a) What is peer-to-peer networking?

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(1)

(b) If an Ethernet switch is used to set up the network, draw a labelled diagram of the physical layout of the network.

(2)

(c) It is decided to set the IP addresses for each computer manually and use a subnet mask of 255.255.255.0.

(i) The following IP addresses were used for the computers:

Computer A: 192.168.5.2   
Computer B: 192.168.5.3   
Computer C: 192.168.4.4   
Computer D: 192.168.5.5

Why is this not satisfactory?

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(1)

(ii) What should be the network ID of this network?

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(1)

(iii) What possible values could the host IDs take?

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(1)

(d) Acme Consultants now want to connect their network to the Internet using an ADSL line. A router is used to connect the network switch to the ADSL modem.

(i) What is the purpose of the router?

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(1)

(ii) The IP addresses 192.168.5.1 and 222.125.105.15 are assigned to the router.

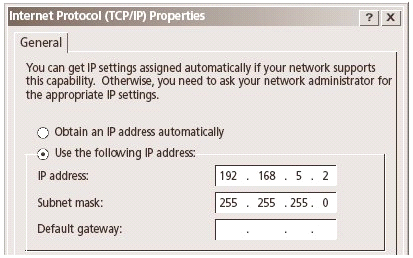
Which of the IP addresses needs to be registered with the Internet registrar and why?

IP address: .........................................................................................................

Reason ................................................................................................................

...........................................................................................................................

(2)



(iii) The diagramabove shows part of the TCP/IP configuration window displayed on the monitor of computer A. What IP address should be entered for the Default gateway?

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(1)

(Total 10 marks)

**67.** When data is sent between **two** computer systems - the sender and the receiver - it is sometimes necessary to *encrypt* the data.

(a) What is encryption?

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(1)

(b) A digital certificate consists of a public key and a private key. Anyone can know the public key but the private key should never be disclosed by its owner, the holder of the digital certificate.

Person A and Person B want to communicate via e-mail. Each has their own digital certificate and B has previously sent a digitally signed message to A. A wants to send B a message that only B can understand.

(i) Which key should A use to encrypt this message?

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(1)

(ii) Which key does B have to use to decrypt the message?

...........................................................................................................................

(1)

(c) B wants to send a reply to A.

A digital signature can be used to authenticate a message, that is, to show that it really has been sent by B and that it has not been tampered with.

B adds a digital signature to her message,

(i) List the steps needed to generate the digital signature for B’s message.

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(3)

(ii) What are the steps needed to check that B’s message is authentic?

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(4)

(Total 10 marks)

**69.** A company sets up a server-based network with ten terminals. Each terminal is a PC with its own secondary storage.

(a) The network was recently created from an existing set of stand-alone computers, and is used by a team of programmers. Describe **two** advantages that networking the computers has brought to the programming team.

1 ..................................................................................................................................

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2 ..................................................................................................................................

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(2)

(b) The network manager has the choice of:

Option 1: Installing all the applications software on the server.

Option 2: Installing the applications software on the hard drive of each PC.

(i) Describe **one** advantage to the network manager of Option 1.

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(1)

(ii) Describe **one** advantage to a terminal user of Option 2.

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(1)

(c) Each terminal communicates with a printer using a *handshaking protocol.*

(i) Explain the term protocol.

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...........................................................................................................................

(1)

(ii) Explain the term handshaking.

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(2)

(d) Clients who use the company’s website input

http://www.smk-solutions.co.uk/index.htm

into the address bar of their browser.

What is the domain name for the company?

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(1)

(Total 8 marks)

**70.** Different operating systems have been developed with different operational characteristics.   
One of the operational characteristics of a real-time operating system is to produce output fast enough to affect the next input.

(a) Give **two** further operational characteristics of a real-time operating system.

1 ..................................................................................................................................

2 ..................................................................................................................................

(2)

(b) Some real-time operating systems have to respond extremely quickly. Give **one** example of such a system and **one** example of a system where an extremely quick response is not essential.

Extremely quick: a system to ....................................................................................

(1)

Not extremely quick: a system to .............................................................................

(1)

(Total 4 marks)

**71.** What could you do to ensure that your e-mails are not read by unauthorised people?

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(Total 1 mark)

**74.** (a) Using an example, outline the principles of Client-Server operation.

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(3)

(b) Operating systems are often described as *event driven.*

(i) Explain what is meant by the term event driven.

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(2)

(ii) Give an example of an event.

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(1)

(Total 6 marks)

**78.** A school has classrooms and offices in several buildings on a single site. Data held about the pupils is stored on a database and administered by a database administrator. The school now wants to connect all its office and classroom computers to share information and services and introduce an electronic registration system.

(a) Which network type is most appropriate, wide area (WAN) or local area (LAN)?   
Justify your choice.

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(2)

(b) Explain **one** way in which the school network can benefit each of the following.   
Each must be different.

(i) A pupil

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(1)

(ii) A teacher

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(1)

(iii) A head of year or personal tutor

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(1)

(iv) The head or principal of the school

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(1)

(c) The computers in each room are to be connected using an Ethernet-based hub.  
In one of the buildings **three** offices are next to each other, each with five computers.   
Draw a diagram of the physical topology of this network.

(3)

(d) When the network installation is complete, pupils and staff complain that the network is very slow during peak periods.

(i) It is suggested that the hubs should be replaced by switches. What is the difference between a switch and a hub?

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(2)

(ii) Why does this improve the speed of the transmissions on the network?

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(1)

(e) Why is a firewall needed if the school wants to connect to the Internet?

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(2)

(Total 14 marks)

**79.** (a) A small organisation has several computers in an office physically wired together to form a local area network (LAN) as shown below.



What is the name of this network topology?

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(1)

(b) The network could instead be physically wired together where the centrally located computer is a server as shown below.



What is the name of this network topology?

.....................................................................................................................................

(1)

(c) (i) State **one** advantage of network (a) compared with network (b) above, and give a reason.

Advantage .........................................................................................................

Reason ...............................................................................................................

............................................................................................................................

(2)

(ii) State one advantage of network (b) compared with network (a) above, and give a reason.

Advantage...........................................................................................................

Reason ...............................................................................................................

............................................................................................................................

(2)

(Total 6 marks)

**81.** (a) Data can be transmitted using parallel or serial transmission. Give **two** reasons why data is normally transmitted over long distances using serial transmission.

1. .................................................................................................................................

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2. .................................................................................................................................

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(2)

(b) In the context of serial data transmission describe what is meant by

(i) Baud Rate;

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............................................................................................................................

(1)

(ii) Bit Rate;

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............................................................................................................................

(1)

(iii) Bandwidth?

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(1)

(c) What is the relationship between bit rate and bandwidth?

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(1)

(Total 6 marks)

**86.** What is meant by

(a) Baseband network operation;

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(1)

(b) Broadband network operation;

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(1)

(c) Synchronous data transmission?

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(1)

(Total 3 marks)

**87.** A software company, ABC Ltd, proposes that in the future customers who buy ABC Ltd’s software will buy only the rights to store and execute this software on ABC Ltd’s servers. ABC Ltd will operate an on-line service to its customers to allow its software products to be centrally managed and shared.  
A customer at a workstation located anywhere in the world will send commands and data for processing to ABC Ltd’s servers which will then return the results of processing to the customer’s workstation.

(a) Which type of network, Wide Area Network (WAN) or Local Area Network (LAN), will connect customers to ABC Ltd’s on-line service?

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(1)

(b) Developing software purely as an on-line service eliminates the need to distribute software on CD-ROM. Describe **three** other benefits to ABC Ltd **or** its customers from this on-line service.

1 ..................................................................................................................................

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2 ..................................................................................................................................

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3 ..................................................................................................................................

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(3)

(Total 4 marks)

**89.** The figure below shows the TCP/IP *protocol* stack applied to a LAN (Local Area Network).



(a) What is a protocol?

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.....................................................................................................................................

(1)

(b) What is the topology of this local area network?

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(1)

(c) State a suitable type of network cable for the physical connections of this LAN.

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(1)

The IP protocol layer uses IP addressing to route packets.

(d) Give **two** examples of an IP address that could belong to the same LAN.

1 ..................................................................................................................................

2 ..................................................................................................................................

(2)

(e) Which part of your IP addresses identifies

(i) the LAN;

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(1)

(ii) the host on this LAN?

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(1)

(f) The Ethernet protocol layer uses Ethernet MAC (Media Access Control) addressing to route Ethernet frames. What is an Ethernet MAC address?

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(1)

(g) Describe **two** tasks performed by the TCP protocol layer

1 ...................................................................................................................................

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2 ...................................................................................................................................

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(2)

(h) Give **one** example of another type of application found in the Application layer.

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(1)

(i) If two local area networks are connected through the Internet each must have a registered public IP address.  
Name the **type** of organisation responsible for recording the allocation of public IP addresses.

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(1)

(Total 12 marks)

**90.**



(a) The figureaboverepresents asynchronous data being transmitted using odd parity in the direction of the arrow. Give the name and the purpose of **each** of the following bits.

(i) bit A

Name ................................................................................................................

Purpose..............................................................................................................

...........................................................................................................................

(2)

(ii) bit B

Name ................................................................................................................

Purpose..............................................................................................................

...........................................................................................................................

(2)

(iii) bit C

Name ................................................................................................................

Purpose..............................................................................................................

...........................................................................................................................

(2)

(b) What is meant by:

(i) baud rate; ..........................................................................................................

...........................................................................................................................

(1)

(ii) bit rate; .............................................................................................................

...........................................................................................................................

(1)

(iii) bandwidth? .......................................................................................................

...........................................................................................................................

(1)

(c) The baud rate and the bit rate of a communication channel may be different.   
Explain how this can occur.

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(2)

(Total 11 marks)

**92.** (a) What is meant by **each** of the following?

(i) Internet

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...........................................................................................................................

(1)

(ii) World Wide Web

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...........................................................................................................................

(1)

(iii) Local Area Network

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(1)

(iv) Wide Area Network

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(1)

(v) Intranet

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(1)

(b) Give an example of:

(i) a domain name;

...........................................................................................................................

(1)

(ii) an IP address.

...........................................................................................................................

(1)

(Total 7 marks)

**102.** A company specialising in networking training courses offers the following courses:

 Wide Area Networks

 Asynchronous Transmission Mode (ATM) networking

 Time-division multiplexing.

(a) What is

(i) a Wide Area Network (WAN)?

...........................................................................................................................

...........................................................................................................................

(1)

(ii) Asynchronous Transmission Mode (ATM) networking?

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(1)

(iii) time-division multiplexing?

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(1)

The figure below shows the local area network(LAN) of the company.  
It consists of three Ethernet bus segments with IP addresses 192.80.0.x, 192.80.1.x and 192.80.2.x connected together by routers.  
IP addresses that begin with 192 are private addresses.  
The business hosts its own web site on a Web server with public IP address 213.97.56.21.  
The Web server and the local area network are connected to the Internet through a router and firewall.  
The local area network is a server-based network.  
There is one file server and domain controller, and one database and application server.



(b) Draw a diagram to show how segment 192.80.2.x would be wired using a hub.

(2)

(c) Why must the router-firewall and the Web server have public IP addresses?

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(1)

(d) The computer with IP address 192.80.2.4 uses the TCP/IP protocol to send a web page to the Web server. Describe how the TCP/IP protocol is used to route the web page to the Web server. Your description should cover the role of the two routers and network card addresses.

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(5)

(e) State **one** purpose of the firewall in this local network.

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(1)

(f) The local area network is a *server-based network*. What is a server-based network?

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(2)

(g) What is a database server?

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(1)

(Total 15 marks)

**3.** (a) Two of the components of a computer system are a processor and main memory which are connected together by three buses. Name **each** of these buses and explain their purpose.

1 Name ................................................................................................................

Purpose .............................................................................................................

...........................................................................................................................

2 Name ................................................................................................................

Purpose .............................................................................................................

...........................................................................................................................

3 Name ................................................................................................................

Purpose .............................................................................................................

...........................................................................................................................

(6)

(b) In order to connect the computer system to a local area network (LAN) an additional piece of hardware is required. Name this piece of hardware and explain its purpose.

Name ..........................................................................................................................

Purpose .......................................................................................................................

.....................................................................................................................................

(2)

(c) A printer is connected to the computer system using parallel transmission. Give **one** reason why parallel transmission may be more appropriate than serial transmission.

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(1)

(d) Give **one** reason why serial transmission is more appropriate for the local area network.

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(1)

(Total 10 marks)

**104.** On the diagrams below draw the connections between the computers if the following Local Area Network (LAN) topologies are used. In **each** case show the direction of data transfer.

(a) Star  


(2)

(b) Bus  


(2)

(Total 4 marks)

**105.** In the context of communication and networking, what is meant by **each** of the following?

(a) Internet

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.....................................................................................................................................

(1)

(b) Domain name

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.....................................................................................................................................

(1)

(c) Intranet

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.....................................................................................................................................

(1)

(d) URL

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.....................................................................................................................................

(1)

(e) IP address

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.....................................................................................................................................

(1)

(Total 5 marks)

**103.** (a) Two of the components of a computer system are a processor and main memory which are connected together by three buses. Name **each** of these buses and explain their purpose.

1 Name ................................................................................................................

Purpose .............................................................................................................

...........................................................................................................................

2 Name ................................................................................................................

Purpose .............................................................................................................

...........................................................................................................................

3 Name ................................................................................................................

Purpose .............................................................................................................

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(6)

(b) In order to connect the computer system to a local area network (LAN) an additional piece of hardware is required. Name this piece of hardware and explain its purpose.

Name ..........................................................................................................................

Purpose .......................................................................................................................

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(2)

(c) A printer is connected to the computer system using parallel transmission. Give **one** reason why parallel transmission may be more appropriate than serial transmission.

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(1)

(d) Give **one** reason why serial transmission is more appropriate for the local area network.

.....................................................................................................................................

(1)

(Total 10 marks)

**104.** On the diagrams below draw the connections between the computers if the following Local Area Network (LAN) topologies are used. In **each** case show the direction of data transfer.

(a) Star  


(2)

(b) Bus  


(2)

(Total 4 marks)

**105.** In the context of communication and networking, what is meant by **each** of the following?

(a) Internet

.....................................................................................................................................

.....................................................................................................................................

(1)

(b) Domain name

.....................................................................................................................................

.....................................................................................................................................

(1)

(c) Intranet

.....................................................................................................................................

.....................................................................................................................................

(1)

(d) URL

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(1)

(e) IP address

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.....................................................................................................................................

(1)

(Total 5 marks)

**116.** The branches of a large supermarket chain and their suppliers use EDI (Electronic Data Inter-change) over a *wide area network* (WAN).

(a) What would EDI be used for in this application?

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(1)

(b) What is a wide area network (WAN)?

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(1)

(c) The supermarket chain faced a choice between using its own private WAN or one operated by a VAN (value-added network) provider for its EDI.

(i) Give **one** advantage of using a private WAN operated by a VAN provider over using its own private WAN.

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(1)

(ii) Give **one** advantage of using a private WAN rather than a public network such as the Internet for EDI.

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(1)

The diagram below shows the local area network (LAN) of the supermarket chain’s head office.  
It consists of three Ethernet bus segments with IP addresses 192.80.0, 192.80.1 and 192.80.2 connected together by routers.  
IP addresses that begin with 192 are private addresses.  
The head office hosts an on-line ordering service for customers on a Web server with public IP address 213.97.56.21.  
The Web server and the local area network are connected to the Internet through a router and firewall.  
The local area network is a server-based network.  
There is one file server and domain controller and one print server.



(d) Draw a diagram to show how segment 192.80.1 would be wired using a hub.

(2)

(e) Why must the router-firewall and the Web server have public IP addresses?

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(1)

(f) The computer with IP address 192.80.1.3 uses the TCP/IP protocol to send a document to be printed to the print server. Describe how the TCP/IP protocol is used to route the document to its destination. Your description should cover the role of the two routers and network card addresses.

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(5)

(g) State **one** purpose of the firewall in this local network.

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(1)

(h) The local area network is a *server-based network*. What is meant by a server-based network?

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(2)

(Total 15 marks)

**118.** (a) In the context of networks, give the full name of each of the following:

(i) LAN;

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(1)

(ii) WAN.

...........................................................................................................................

(1)

(b) Give an example of the use of a:

(i) LAN;

...........................................................................................................................

(1)

(ii) WAN.

...........................................................................................................................

(1)

(c) What is meant by **each** of the following terms?

(i) protocol;

...........................................................................................................................

...........................................................................................................................

(1)

(ii) BAUD rate;

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...........................................................................................................................

(1)

(iii) bit rate;

...........................................................................................................................

...........................................................................................................................

(1)

(iv) Bandwidth.

...........................................................................................................................

...........................................................................................................................

(1)

(d) What is the relationship between bandwidth and bit rate?

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(1)

(e) (i) Define serial transmission.

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(1)

(ii) Define parallel transmission.

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(1)

(iii) Give **one** advantage of serial transmission over parallel transmission.

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(1)

(iv) Give **one** advantage of parallel transmission over serial transmission.

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(1)

(Total 13 marks)

**128.** Acme Design, a small graphic design firm, has several stand-alone computers which staff use for their design work. They would like to use a LAN (Local Area Network) to share printers, scanners and plotters.

(a) What extra hardware is needed for each stand-alone computer to be connected to a LAN via cables?

.....................................................................................................................................

(1)

(b) Computers could be connected in one of the topologies shown below.



(i) Name these network topologies.

A ..................................................... B .........................................................

(2)

(ii) Give **one** advantage of topology A over topology B.

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(1)

(iii) Give **one** advantage of topology B over topology A.

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(1)

(c) (i) What is a protocol?

...........................................................................................................................

...........................................................................................................................

(1)

(ii) Why is a protocol needed?

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(1)

(Total 7 marks)

**137.** E-mail may be more easily intercepted and altered than paper mail without the knowledge of either the sender or the recipient.

(a) Give **one** reason that supports **this** statement.

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(1)

(b) A single shared key system to encrypt and decrypt messages is not generally used for encrypted mail sent across the Internet. Instead, a two key system is used consisting of:

 A *public* key, which is made publicly available.

 A *private* key which is held only by its owner and should never be publicly enclosed.

(i) How is this two-key system used to encrypt and decrypt e-mails?

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(2)

(ii) Holders of a digital certificate can digitally sign an e-mail to prove its origin and authenticity. How is this two-key public/private key system used to digitally sign an e-mail?

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(2)

(Total 5 marks)

**139.** **Figure 1** below shows the physical layout of a small local area network consisting of three workstations and one file server interconnected via a hub. The network is Ethernet-based.



**Figure 1**

(a) The network in **Figure 1** behaves as a bus network. Draw a carefully labelled diagram of the bus equivalent of the hub-based network of **Figure 1.**

(2)

(b) (i) Three more workstations – D, E, F – and another file server - File Server 2 – are added but network users complain that the performance of the network is now very slow. In terms of the operation of this network what is the most likely cause for the slowing of the network, assuming no hardware faults?

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(2)

(ii) To overcome this problem the network is split into two segments and bridged by a bridge with two ports, Port 1 and Port 2. Draw a carefully labelled diagram of the physical configuration of this new network.

(2)

(c) **Figure 2** shows another way that the computers in the local area network can be connected. The network uses switched Ethernet.



**Figure 2**

(i) Explain how the operation of switched Ethernet differs from that of hub-based Ethernet.

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(2)

(ii) What is the advantage of the switched-based network in **Figure 2** compared with the hub-based network in **Figure 1** for the same number of computers?

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(1)

(Total 9 marks)

**140.** (a) The Internet is an example of a Wide Area Network (WAN). Describe a WAN.

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(2)

(b) (i) What hardware is required to connect a stand-alone computer system to the Internet?

...........................................................................................................................

(1)

(ii) What type of application software is required to access a web site?

...........................................................................................................................

(1)

(c) Communication on the Internet is through *serial data transmission*.  
What is meant by serial data transmission?

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.....................................................................................................................................

(1)

(d) *Baud rate* and *bit rate* are often confused. What is meant by:

(i) baud rate?..........................................................................................................

.....................................................................................................................................

(ii) bit rate?..............................................................................................................

.....................................................................................................................................

(2)

(Total 7 marks)

**148.** The United Kingdom’s National Health Service was created to provide health care to the nation through:

 hospitals

 health centres/GPs’ (doctors’) surgeries

 pharmacies (chemists).

The UK government is proposing to computerise and network the entire National Health Service (NHS) so that it will be possible to have on-line *access to the system at a level of security relevant to their status* for anyone who

 works for the NHS

 uses its services

 works at a branch of government responsible for the NHS.

Patient records will be stored in multi-user distributed relational databases managed by *Database Management* *Systems* (DBMS).

 Every person in the UK is assigned a unique numeric key, *the patient reference number*, and is assigned for primary health care to a doctor in a health centre or a GPs (General Practitioner’s or doctor’s) surgery located in a single building.

 A person’s doctor may, if necessary, arrange for the person to see a specialist doctor in a hospital.

 Drugs prescribed for a person by the person’s GP for the treatment of an illness are obtained from a pharmacy.

 Every computer in the service of the NHS will be interconnected in *local area networks* (LANS) and the *local area networks* will be interconnected by a *wide area network* (WAN).

Which network type is most appropriate, WAN or LAN, **within** a health centre or GPs (doctor’s) surgery? Justify your choice.

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(Total 2 marks)

**150.** **Figure 1** below shows part of the logical layout of an Ethernet-based local area network consisting of several desktop PCs connected using a bus topology. The network is split into two *segments* linked by a bridge.



**Figure 1**

(a) (i) Why is it necessary sometimes to split local area networks based on a bus topology into two or more segments?

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(1)

(ii) Describe the involvement of the bridge in **Figure 1** in traffic management on the Ethernet segments.

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(2)

(iii) The network in **Figure 1** is physically realised using two hubs, a bridge and twisted-pair **cabling** to interconnect the desktop PCs. Draw a labelled diagram **of** the layout of the network that uses these components.

(2)

(iv) The network in **Figure 1** is operated as a peer-to-peer network. Explain peer-to- peer networking.

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(1)

(b) **Figure 2** below shows how three desktop PCs may share via an Ethernet switch and router an ADSL line connection to the Internet.



**Figure 2**

(i) What is the role of an Internet Service Provider (ISP)?

...........................................................................................................................

...........................................................................................................................

(1)

(ii) What is a router?

...........................................................................................................................

...........................................................................................................................

(1)



**Figure 3**

(iii) **Figure 3** above shows part of the TCP/IP configuration window displayed on the VDU of Desktop PC 1. What IP address should be entered for the Default Gateway?

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(1)

(Total 9 marks)

**151.** A stand-alone computer system is set up with *parallel data transmission* to a printer.

(a) What is parallel data transmission?

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....................................................................................................................................

(1)

(b) What is meant by handshaking in this context?

....................................................................................................................................

....................................................................................................................................

(2)

(Total 3 marks)

**152.** A small company has several stand-alone computers which staff use for word-processing letters and accessing the products catalogue, stored in a database, to answer telephone enquiries from customers. A copy of the database is stored on each machine.

(a) The company has been advised that networking the computers would be beneficial.

(i) State **two** advantages for the business of a local area network (LAN):

1 ........................................................................................................................

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...........................................................................................................................

2 ........................................................................................................................

...........................................................................................................................

...........................................................................................................................

(2)

(ii) What extra hardware is needed on each stand-alone computer to connect it to a LAN via cables?

...........................................................................................................................

(1)

(b) Computers could be connected in a topology such as a star network or a bus network.

(i) State **one** advantage of a star network over a bus network.

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...........................................................................................................................

(1)

(ii) State **one** advantage of a bus network over a star network.

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...........................................................................................................................

(1)

(c) The company director is also interested in trading via the internet, and is advised to get a *domain name*.

(i) What is a domain name?

...........................................................................................................................

...........................................................................................................................

(1)

(ii) Give an example of a domain name.

...........................................................................................................................

(1)

(d) A staff newsletter is published regularly and a copy pinned to the notice board for staff to read. One member of staff suggests it would be easier for colleagues to read the newsletter if it were published on the company *intranet*.

What is an intranet?

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(2)

(Total 9 marks)

**153.** (a) The series of characters J, F, H, U, S, X, T are to be entered into a binary search tree in the order given. Draw a diagram to show how these values will be stored.

(4)

(b) The following data are held in arrays Data, L and R:



Using the arrays above, dry-run the following pseudo-code by completing the trace table opposite:

Item  ‘T’  
Ptr  1  
WHILE Data[Ptr] < > Item DO  
 PRINT Data[Ptr]  
 IF Data[Ptr] > Item  
 THEN Ptr  L[Ptr]  
 ELSE Ptr  R[Ptr]  
 ENDIF  
ENDWHILE  
PRINT Data[Ptr]

Trace Table:

|  |  |  |
| --- | --- | --- |
| **Item** | **Ptr** | **Printed Output** |
| ‘T’ | 1 | ‘J’ |
|  |  |  |
|  |  |  |
|  |  |  |

(6)

(Total 10 marks)

**159.** (a) Define a client-server system.

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(2)

(b) Give **three** benefits of a client-server system.

1 ................................................................................................................................

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2 ................................................................................................................................

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3 ................................................................................................................................

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(3)

(Total 5 marks)

**162.** A small organisation has several computers in an office connected to form a network as shown below.



(a) What is the name of this network topology? .............................................................

(1)

(b) The network could instead be connected as a star topology.

(i) Draw the connections between the computers in a star topology in the diagram below.



(1)

(ii) State **one** advantage of a star network compared with the network you have named in (a) above, and give a reason.

Advantage ........................................................................................................

Reason .............................................................................................................

..........................................................................................................................

(2)

(Total 4 marks)

**164.** One method of sending data to a printer is by using *parallel transmission*.

(a) What is meant by parallel data transmission?

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.....................................................................................................................................

(1)

(b) Parallel transmission should **not** be used over long distances.

(i) Why not?

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..........................................................................................................................

(1)

(ii) How should data be transmitted over long distances?

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(1)

(Total 3 marks)

**165.** (a) The ASCII coding system uses 7 bits to code a character. The eighth bit is used as a parity bit. Explain how a parity bit is used when transmitting ASCII codes using even parity.

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(3)

(b) What is the relationship between bit rate and bandwidth?

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(1)

(Total 4 marks)

**173.** (a) Explain the modes of network operation:

(i) Baseband ..........................................................................................................

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...........................................................................................................................

(2)

(ii) Broadband .........................................................................................................

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...........................................................................................................................

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(2)

(b) Bus local area networks such as Ethernet operate in baseband mode. Wide area networks operate in broadband mode.

(i) Give **two** reasons why wide area networks are operated in broadband mode.

1 ........................................................................................................................

...........................................................................................................................

2 ........................................................................................................................

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(2)

(ii) Explain why the performance of a bus local area network such as Ethernet degrades with increase in network traffic.

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(2)

(iii) Explain how switched Ethernet overcomes this problem.

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(2)

(Total 10 marks)

**175.** (a) Some of the components of a computer system are:

Memory:  
main memory ............................. 1

Peripherals:  
keyboard ..................................... 2  
monitor ....................................... 3  
hard disk drive ............................ 4

I/O Ports:  
keyboard controller .................... 5  
disk controller ............................ 6  
VDU controller .......................... 7

In the diagram, name the components by writing the number into the appropriate box.



(4)

(b) The above computer system uses the *stored program concept.* Explain this term.

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(2)

(c) Many computer systems and printers have both serial and parallel ports. Data can be sent to a printer from either port. What is meant by:

(i) serial transmission of data; ..............................................................................

...........................................................................................................................

(1)

(ii) parallel transmission of data. ...........................................................................

...........................................................................................................................

(1)

(d) (i) When could parallel data transmission be used?

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(1)

(ii) Justify the answer you have given in (d) (i). ...................................................

...........................................................................................................................

(1)

(e) Asynchronous data transmission is a method of data transmission in which a character is sent as soon as it becomes available, for example when a key is pressed on the keyboard. In this situation, what is the reason in having the start and stop bits?

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(2)

(Total 12 marks)

***176.***(a) A college uses a LAN (Local Area Network) to share software and printers between its students. Describe a LAN.

.....................................................................................................................................

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(2)

(b) The diagram below shows the current topology.



(i)Name this topology.

...........................................................................................................................

(1)

(ii) Give **one** advantage of this topology.

...........................................................................................................................

...........................................................................................................................

(1)

(iii) Give **one** disadvantage of this topology.

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(1)

(c) The college decides to link to a WAN (Wide Area Network). When accessing a website, the connection can be made through either leased line networking or dial-up networking. What is meant by:

(i) leased line networking; ....................................................................................

...........................................................................................................................

(1)

(ii) dial-up networking? .........................................................................................

...........................................................................................................................

(1)

(d) Give **one** reason for the college selecting leased line networking.

.....................................................................................................................................

(1)

(e) Give **one** reason for the college selecting dial-up networking.

.....................................................................................................................................

(1)

(Total 9 marks)

**184.** (a) Data communication involves sending and receiving data. This can be either serial or parallel transmission. What is meant by:

(i) serial transmission of data;...............................................................................

..........................................................................................................................

(1)

(ii) parallel transmission of data?............................................................................

...........................................................................................................................

(1)

(b) Explain the term *baud rate* in the context of data transmission.

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....................................................................................................................................

(1)

(c) A computer system uses even parity. The most significant bit is used as a parity bit. The ASCII code of the character '&' is decimal number 38.

(i) What would be the 8-bit binary pattern transmitted if the character '&'is sent?

..........................................................................................................................

(2)

(ii) Asynchronous data transmission is used if one character is sent at a time. One start bit marks the beginning of a character and two stop bits mark the end of a character.  
What would be the bit pattern if the character '&'is sent using asynchronous data transmission?

..........................................................................................................................

(1)

(Total 6 marks)

# Operating Systems

**14.** (a) Identify each of these types of operating system from their description.

(i) The user and the system are in two-way communication; the user supplies commands and data to the system during processing.

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(1)

(ii) This type of operating system responds to events within a maximum specified time, and so is suitable for controlling time critical systems.

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(1)

(iii) This type of operating system enables users sitting at a number of computers to share resources.

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(1)

(b) For **each** of these applications, select which **one** type of operating system is the most suitable.

(i) Running a monthly payroll application for a large company.

..........................................................................................................................

(1)

(ii) An educational game for young children.

..........................................................................................................................

(1)

(iii) Controlling an industrial process that involves regulating the temperature of a furnace.

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(1)

(Total 6 marks)

**16.** The scheduler of an operating system that supports both *interactive* and *batch processing* maintains a list of runnable processes. When the scheduler requires a process to run it selects an interactive process from the list of runnable processes in preference to a batch process.

(a) Describe **two** distinct situations that would lead to the scheduler suspending a running process.

1 .................................................................................................................................

2 .................................................................................................................................

(2)

(b) Name an appropriate data structure for storing the list of runnable processes.

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(1)

(Total 3 marks)

**49.** (a) (i) One of the roles of an operating system is the management of hardware resources. Explain what *management* means in this context.

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……..................................................................................................................

……..................................................................................................................

(2)

(ii) Give **three** distinct types of hardware resource that would be managed by an operating system for a stand-alone PC.

1 ........................................................................................................................

2 ........................................................................................................................

3 ........................................................................................................................

(3)

(b) A second role of an operating system is the provision of a **virtual machine**. What does this mean?

……............................................................................................................................

……............................................................................................................................

(2)

(c) (i) Give **one** example of a task that could be carried out under batch processing.

……..................................................................................................................

(1)

(ii) Give **two** operational characteristics of **batch processing**.

1 .......................................................................................................................

……..................................................................................................................

2 .......................................................................................................................

……..................................................................................................................

(2)

(d) Give **two** operational characteristics of a batch **operating system.**

1 .................................................................................................................................

....................................................................................................................................

2 .................................................................................................................................

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(2)

(Total 12 marks)

**51.** In order to operate a new mouse attached to a computer system a device driver is required.

(i) What is the purpose of a device driver?

….................................................................................................................................

….................................................................................................................................

(2)

(ii) Why is it not always provided as part of the operating system?

….................................................................................................................................

….................................................................................................................................

(2)

(iii) What type of programming language is normally used to write device drivers?

….................................................................................................................................

(1)

(iv) Give **two** reasons for your choice of language type.

1 ..................................................................................................................................

….................................................................................................................................

2 ..................................................................................................................................

….................................................................................................................................

(2)

(Total 7 marks)

**72.** (a) One of the roles of an operating system is **Resource Management**. Give **three** resource management tasks for an operating system for a stand-alone computer.

1 ..................................................................................................................................

2 ..................................................................................................................................

3 ..................................................................................................................................

(3)

(b) A second role of an operating system is the provision of a **virtual machine**.   
What does this mean?

.....................................................................................................................................

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(1)

(c) Give **three** tasks that an operating system for a computer connected to a computer network will have in addition to the tasks of an operating system for a stand-alone computer.

1 ..................................................................................................................................

2 ..................................................................................................................................

3 ..................................................................................................................................

(3)

(Total 7 marks)

**75.** One of the roles of an Operating System is to manage memory.

(a) Explain what is meant by the memory management technique known as virtual memory.

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.....................................................................................................................................

.....................................................................................................................................

(3)

(b) Explain what is meant by the memory management technique known as paging.

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(2)

(c) Explain what is meant by the heap and how it is used by the operating system.

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(2)

(Total 7 marks)

**82.** Different operating systems have been developed with different operating requirements. For example, two operating requirements of batch operating systems are

 batch operating systems support programs which are sequential in nature;

 programs running under batch operating systems run from start to finish without user intervention.

(a) Give **three** operating requirements of a real time operating system.

1 ..................................................................................................................................

.....................................................................................................................................

2 ..................................................................................................................................

.....................................................................................................................................

3 ..................................................................................................................................

.....................................................................................................................................

(3)

(b) Give an example of a type of application for which a real time operating system is necessary.

.....................................................................................................................................

.....................................................................................................................................

(1)

(Total 4 marks)

**99.** Single user operating systems may use virtual memory.

(i) Where is virtual memory located?

.....................................................................................................................................

(1)

(ii) Why is virtual memory used?

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

(2)

(iii) How is virtual memory used?

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

(2)

(Total 5 marks)

**114.** Single user operating systems can be *multi-tasking* operating systems and use *virtual memory*.

(a) (i) What is multi-tasking?

...........................................................................................................................

...........................................................................................................................

...........................................................................................................................

...........................................................................................................................

(2)

(ii) What is meant by virtual memory?

...........................................................................................................................

...........................................................................................................................

...........................................................................................................................

(2)

(iii) How does virtual memory work?

...........................................................................................................................

...........................................................................................................................

...........................................................................................................................

...........................................................................................................................

(2)

(b) A multi-tasking operating system may use *multi-threading*.

(i) What is a thread?

...........................................................................................................................

...........................................................................................................................

(2)

(ii) Give **one** advantage of using multi-threading over separate processes.

...........................................................................................................................

...........................................................................................................................

(1)

(Total 9 marks)

**121.** One of the roles of an operating system is the *management* of hardware resources.

(a) (i) What does ‘management’ mean in this context?

...........................................................................................................................

...........................................................................................................................

(2)

(ii) List **two** distinct types of resource that would be managed by a typical stand-alone computer operating system.

1 ........................................................................................................................

2 ........................................................................................................................

(2)

(b) Explain **one** other role of an operating system.

.....................................................................................................................................

.....................................................................................................................................

(2)

(c) Give **two** tasks that an operating system for a computer network will have in addition to the tasks of an operating system for a stand-alone computer.

1 ..................................................................................................................................

2 ..................................................................................................................................

(2)

(Total 8 marks)

**130.** The role of an operating system is often said to be twofold:

1. To provide a virtual machine.

2. To manage the resources of the computer.

(a) What is meant by “to provide a virtual machine”?

.....................................................................................................................................

.....................................................................................................................................

(1)

(b) Name **three** types of resource managed by the operating system.

1 ..................................................................................................................................

2 ..................................................................................................................................

3 ..................................................................................................................................

(3)

(Total 4 marks)

**131.** A publisher of a daily newspaper uses a computer system consisting of:

 Reporters’ workstations.  
 Sub-editors’ workstations.  
 A page make-up workstation.  
 An image processing workstation.  
 A central file store.

Each article is word-processed and stored centrally in a separate file.

(a) What type of operating system - real, interactive, batch or network must be run at each of the workstations so that

(i) access to the central file store is possible?

...........................................................................................................................

(1)

(ii) reporters can word-process articles?

...........................................................................................................................

(1)

(b) The editor in charge of an edition enters the layouts of each page at the page make-up workstation. A page is divided into a number of blocks. There is one article per block.

A relational database is used to record details of the page layouts for each edition of the newspaper.

Two relations (tables) **NewspaperEdition** and **PageLayout** are used for this database:

**NewspaperEdition** (Editionld, Date, NoOfPages, EditorInChargeOfEdition)

**PageLayout** (EditionId, PageNo, BlockNo, PositionOfBlockOnPage,  
 WidthOfBlock, LengthOfBlock, FilePathName)

Each newspaper edition is assigned a unique EditionId. There is only one edition per day. FilePathName is used to locate the word-processed article assigned to a block.

(i) State a suitable primary key for the NewspaperEdition relation.

...........................................................................................................................

...........................................................................................................................

(1)

(ii) State a suitable secondary key for the NewspaperEdition relation.

...........................................................................................................................

(1)

(iii) Name the attribute which is the foreign key in the relation PageLayout.

...........................................................................................................................

(1)

(iv) State a suitable primary key for the relation PageLayout. Justify your choice.

...........................................................................................................................

...........................................................................................................................

...........................................................................................................................

(3)

(c) A block of space on a page may also contain an image.  
State **two** image processing operations that an image processing workstation might apply to images.

1 ..................................................................................................................................

.....................................................................................................................................

2 ..................................................................................................................................

.....................................................................................................................................

(2)

(Total 10 marks)

**135.** (a) How could an operating system allow two files with the same filename to be stored on the same floppy disk?

.....................................................................................................................................

.....................................................................................................................................

(1)

(b) Immediately after formatting a new 1.44 Mb floppy disk, the following message appears on the screen:

Bytes free = 1,457,664

On checking the properties, the capacity is said to be 1.38 Mb. Give **two** reasons why all of the disk capacity is not available to the user.

1 ..................................................................................................................................

.....................................................................................................................................

2 ..................................................................................................................................

.....................................................................................................................................

(2)

(c) The *file management sub-system* and the *memory management sub-system* are called when a command is entered to load an executable file from disc. Describe the role of each of these sub-systems in this operation, and state **one** error that **each** might have to deal with.

(i) The file management sub-system

...........................................................................................................................

...........................................................................................................................

...........................................................................................................................

Error ..................................................................................................................

(3)

(ii) The memory management sub-system

...........................................................................................................................

...........................................................................................................................

...........................................................................................................................

Error ..................................................................................................................

(4)

(Total 10 marks)

**154.** (a) What is meant by real time processing?

....................................................................................................................................

....................................................................................................................................

(1)

(b) State the most suitable method of processing for:

A computer system dedicated to controlling the anti-lock braking system of a racing car.

....................................................................................................................................

(1)

(Total 2 marks)

**167.** For each of the following name a suitable type of operating system. Give one reason for your choice.

(a) A computer system consisting of several desktop PCs sharing each other’s files.

Name: .........................................................................................................................

Reason: .......................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

(2)

(b) A computer system dedicated to controlling the flow of chemicals in a chemical processing plant.

Name: .........................................................................................................................

Reason: .......................................................................................................................

.....................................................................................................................................

.....................................................................................................................................

(2)

(Total 4 marks)

**177.** (a) What is meant by interactive operating system?

.....................................................................................................................................

(1)

(b) State a suitable type of operating system for:

A computer system dedicated to controlling the guidance system of a cruise missile.

.....................................................................................................................................

(1)

(Total 2 marks)

**185.** Newspapers and magazines are advertising many different specifications of personal computer systems. Such advertisements feature monitor, disk drives, processor, main memory and operating system.

(a) What is the purpose of an operating system?

....................................................................................................................................

....................................................................................................................................

(1)

(b) What is the function of:

(i) the processor;

..........................................................................................................................

(1)

(ii) main memory (Immediate Access Store)?

..........................................................................................................................

..........................................................................................................................

(1)

(c) The system bus in a computer system is made up of three buses. Name each bus and give **one** example of its use.

1 Name.........................................................................................................................

(1)

Example.......................................................................................................................

.....................................................................................................................................

(1)

2 Name........................................................................................................................

(1)

Example......................................................................................................................

....................................................................................................................................

(1)

3 Name.......................................................................................................................

(1)

Example.....................................................................................................................

....................................................................................................................................

(1)

(Total 9 marks)

**188.** For each of the following name a suitable type of operating system. Give **one** reason for your choice.

(a) A computer system consisting of several desktop PCs and a printer shared on-line.

Name.......................................................................................................................

Reason.....................................................................................................................

.................................................................................................................................

.................................................................................................................................

(2)

(b) A computer system dedicated to controlling the temperature and humidity level in a pottery kiln.

Name.......................................................................................................................

Reason.....................................................................................................................

.................................................................................................................................

.................................................................................................................................

(2)

(c) A computer system dedicated to processing OMR forms returned at the end of each day.

Name.......................................................................................................................

Reason.....................................................................................................................

.................................................................................................................................

.................................................................................................................................

(2)

(Total 6 marks)

**207.** Describe **each** of the following modes of operation and in each case give a suitable example of a situation where it might be used.

(a) transaction,

(3)

(b) real-time.

(3)

(Total 6 marks)

# Mark Schemes

**1.** (a) Client workstation computers ;

are provided with a service from some central server ;

all processing required is done by the server ;

the processing results are then returned to the client ; Max 3

(b) (i) Set of rules about the way two devices communicate ; 1

(ii) Alice uses SMTP to send her message;

to the e-mail server of her ISP;

The ISP looks at the Domain Name to find the servers accepting  
messages for that domain ;

The Domain Name is (the second) part of the destination address;

The message is delivered to the mail box of the user;

Bob logs on through the Internet to his ISP;

and collects his message using POP3; Max 5

**4-5 marks** Candidate has provided a detailed explanation of how Alice’s  
 message can be picked up with reference to the main protocols  
 involved demonstrating a clear understanding of this subject area.

Text is legible.

There are few, if any, errors of spelling, punctuation and grammar.

Meaning is clear.

The candidate has selected and used a form and style of writing  
appropriate to purpose and has expressed ideas clearly and fluently.

Sentences and paragraphs follow on from one another clearly and  
coherently.

Appropriate, specialist vocabulary has been used.

**2-3 marks** Candidate has provided a limited explanation of how Alice’s message  
 can be picked up with reference to some of the main protocols involved,  
 demonstrating some understanding of this subject area.

Text is legible.

There may be occasional errors of spelling, punctuation and grammar.

Meaning is clear.

The candidate has, in the main, used a form and style of writing which  
is appropriate for its purpose, with occasional lapses.

The candidate has expressed ideas clearly and reasonably fluently.  
Candidate has used well-linked sentences and paragraphs. Information  
or arguments are generally relevant and well structured.

**1 mark** Candidate has provided a weak explanation which does not demonstrate  
 a clear understanding of the main protocols involved. Information may  
 sometimes stray from the point or information be weakly presented and  
 not be fluent.

There may be some errors of spelling, punctuation and grammar.

The candidate has used a form and style of writing which has many  
deficiencies.

Sentences and paragraphs may not always be well-connected.

[9]

**2.** (a) 1. A

2. C

3. B 1

(b) Start at first item; and examine each succeeding item in turn;

Until item is found; or the end of the list reached;

**A** algorithm max 3

O(n) as up to n items searched;

All items may be searched; max 1

(c) For each succeeding pair of items;

if they are out of sequence they are swapped;

the process is repeated;

up to n-1 times; or until no more swaps are made;

max 3

All n items are compared up to n-1 times;

1

[9]

**3.** (a) (i)



1

(ii)



1

(iii)



1

(b) (i) A calculation; results in a value that is too near 0 to be stored;

**R** too small without clarification 2

(ii) A small number is divided by a very large number//

Two small numbers are multiplied together//

Or by example; 1

[6]

**4.** (a)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |  |
| 1 | 0 | 1 | 1 | 0 | ; |
| 2 | 0 | 0 | 0 | 1 | ; |
| 3 | 0 | 1 | 0 | 1 | ; |
| 4 | 0 | 0 | 0 | 0 | ; |

or

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |
| 1 | 0 | 0 | 0 | 0 |
| 2 | 1 | 0 | 1 | 0 |
| 3 | 1 | 0 | 0 | 1 |
| 4 | 0 | 1 | 1 | 0 |
|  | ; | ; | ; | ; |

max 3

(b) (i) Max size only limited by memory;

Only uses memory it requires; max 1

(ii) No pointers required; 1

(c) (i) Adjacency Matrix; 1

(ii) Faster to insert/delete; fixed size; 2

[8]

**5.** (a) Table contains partial dependencies;

Or any of SupplierName, SupplierAddress, SupplierTelNo depend upon  
SupplierID 1

(b) *1 mark for primary key, 1 mark for correct other attributes*

(i) CoinID VARCHAR(8) PRIMARY KEY(NOT NULL)//  
CoinID VARCHAR(8) PRIMARY KEY(CoinID);



SupplierID Int ;

**A** any sensible types 2

(ii) SupplierID VARCHAR(8) PRIMARY KEY(NOT NULL)//

SupplierID VARCHAR(8) PRIMARY KEY(Suppliers ID);

 1

(c)



1

(d) SELECT Type, Year, Condition, PricePaid

FROM Coin, Supplier;

WHERE Coin.SupplierID = Supplier.SupplierID;

ORDER BY PricePaid;

*OR*

SELECT Type, Year, Condition, PricePaid

FROM Coin INNER JOIN Supplier; ON

Coin.SupplierID = Supplier.SupplierID;

ORDER BY PricePaid; 3

[8]

**6.** (a) A 192.71.0.1; **A** any valid number instead of 1

B 192.71.0.2; **A** any valid number instead of 2

C 192.71.1.1; **A** any valid number instead of 1 3

(b) To block access to/from the internal network from/to the Internet;

To stop/limit/block/restrict certain kinds of access to the web server,  
e.g. telnet;

To close ports to prevent users from connecting to them//

To block connections on unwanted ports;

To prevent unauthorised access to the private computers;

**A** Filtering

**R** To stop hackers NE Max 5

**4-5 marks** Candidate has provided a detailed explanation with clear  
 reference to the role of ports and at least two functions  
 performed by the firewall, taken from the list above.

Text is legible.

There are few, if any, errors of spelling, punctuation and  
grammar.

Meaning is clear.

The candidate has selected and used a form and style of  
writing appropriate to purpose and has expressed ideas clearly  
and fluently.

Sentences and paragraphs follow on from one another clearly  
and coherently.

Appropriate, specialist vocabulary has been used.

**2-3 marks** Candidate has provided an explanation with limited reference  
 to the role of ports and no more than two functions performed  
 by the firewall, taken from the list above.

Text is legible.

There may be occasional errors of spelling, punctuation and  
grammar.

Meaning is clear.

The candidate has, in the main, used a form and style of writing  
which is appropriate for its purpose, with occasional lapses.

The candidate has expressed ideas clearly and reasonably  
fluently.

Candidate has used well-linked sentences and paragraphs.  
Information or arguments are generally relevant and well  
structured.

**1 mark** Candidate has provided a weak explanation with no, or very  
 limited, reference to either the role of ports or functions  
 performed by the firewall.

The candidate does not demonstrate a clear understanding  
of the purpose of a firewall.

Information may sometimes stray from the point or  
information be weakly presented and not be fluent.

There may be some errors of spelling, punctuation and  
grammar.

The candidate has used a form and style of writing which has  
many deficiencies.

Sentences and paragraphs may not always be well-connected.

(c) Converting/transforming from plain text into ciphertext/secret code;

**A** scrambled

**A** transposition/conversion

The sender processes the data prior to the transmission so that if it is  
accidentally or deliberately intercepted while it is being transferred it  
will be incomprehensible to the intercepting party; Max 4

**4 marks** Candidate has provided a clear description of encryption and  
 explanation of why it is used, with reference to the list above.

Text is legible.

There are few, if any, errors of spelling, punctuation and  
grammar.

Meaning is clear.

The candidate has selected and used a form and style of  
writing appropriate to purpose and has expressed ideas  
clearly and fluently.

Sentences and paragraphs follow on from one another  
clearly and coherently.

Appropriate, specialist vocabulary has been used.

**3 marks** Candidate has provided a limited description of encryption  
 and explanation of why it is used, with reference to some  
 of the points listed above.

Text is legible.

There may be occasional errors of spelling, punctuation and  
grammar.

Meaning is clear.

The candidate has, in the main, used a form and style of  
writing which is appropriate for its purpose, with occasional  
lapses.

The candidate has expressed ideas clearly and reasonably  
fluently

Candidate has used well-linked sentences and paragraphs.

Appropriate, specialist vocabulary has been used.

**2 marks** Candidate has provided a very limited description of  
 encryption and explanation of why it is used, with reference  
 to few of the points listed above, or has not provided a  
 description or explanation.

Text is legible.

There may be some errors of spelling, punctuation and  
grammar, but not such as to cause problems in the reader’s  
understanding and not such as to suggest a weakness in these  
areas.

The candidate has used a form and style of writing which is  
sometimes appropriate to its purpose, but with many  
deficiencies.

The candidate has expressed straightforward ideas clearly, if  
not always fluently.

Sentences and paragraphs may not always be well-connected.  
Information may sometimes stray from the point or be weakly  
presented.

**1 mark** Candidate has not provided a description and/or explanation  
 of encryption and has made limited reference to the points  
 listed above which demonstrates a lack of understanding of  
 this subject area.

Text is legible.

There are many errors of spelling, punctuation and grammar,  
which suggests a weakness in these areas.

The candidate has used a form and style of writing which has  
many deficiencies.

(d) (i) B’s public key; 1

(ii) B’s private key; 1

[14]

**7.** (a) (i) 1 mark for correctly positioned arrow, ignore data on tape



1

(ii) 1; 1

(b) 2 marks for correct tape symbols, 1 mark for correct position of arrow



3

(c) 3 + 1 or the successor to 3; 1

[6]

**8.** (a)

|  |  |  |
| --- | --- | --- |
|  | Expression | Yes/No |
| 1 | 4 \* 9 | Yes; |
| 2 | 8 + 6 / 2 | Yes; |
| 3 |  6 \* 2 | No; |
| 4 | (4 + 5) \* 5 | No; |

4

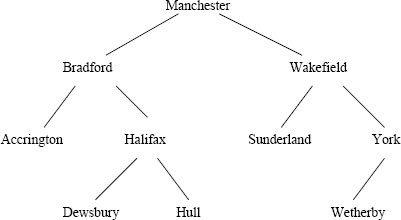
(b) (i) 5 6 2 ;\*; +; 2

(ii) No Brackets;

Easy to Compute; 1

[7]

**9.** (a)



1 mark for Manchester

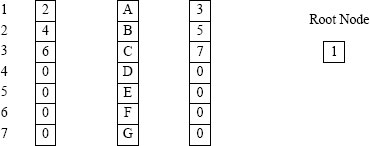
1 mark for Bradford and Wakefield

1 mark for Accrington and Halifax

1 mark for Dewsbury and Hull

1 mark for Sunderland, York and Wetherby 5

(b)



1 mark for each correct array, 1 mark for index 1..7, 1 mark for root  
node pointer with value 1. 5

(c)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Call No | TreeNodePtr | Output in chronological order | | | | | | |
|  |  | First | Second | Third | Fourth | Fifth | Sixth | Seventh |
| 1 | 1 |  |  |  | A |  |  |  |
| 2 | 2 |  | B |  |  |  |  |  |
| 3 | 4 |  |  |  |  |  |  |  |
| 4 | 0 | D |  |  |  |  |  |  |
| 5 | 5 |  |  |  |  |  |  |  |
| 6 | 0 |  |  | E |  |  |  |  |
| 7 | 3 |  |  |  |  |  |  |  |
| 8 | 6 |  |  |  |  |  | C |  |
| 9 | 0 |  |  |  |  | F |  |  |
| 10 | 7 |  |  |  |  |  |  |  |
| 11 | 0 |  |  |  |  |  |  | G |

1 mark for 2,4; 1 mark for 0,5,0; 1 mark for 3,6,0 1 mark for 7,0

1 mark for each of D,B,E,A,F,C,G in correct column 11

(d) Inorder; 1

[22]

**10.** (a) Any three @ one each

Procedure calls itself;

Base case enables escape from recursion;

System keeps pending calls on a stack;

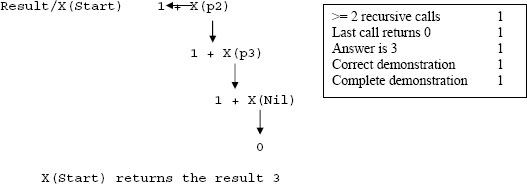
Parameters also passed on a stack;

Need a stack;

System needs a lot of memory to handle recursion;

Recursive programs are usually shorter than their non-recursive  
equivalents; 3

(b)



5

(c) X returns a count; of the number of nodes in the list; 2

(d) Procedure Y(Item) parameter 1

If (Item <> Nil) 1

Then Y(Item.Ptr) 1

Print (Item.Data) 1

EndProcedure

To print whole list in reverse order call Y(Start) 1 5

(e) Non-recursive solutions may

Store data part in nodes in an array

Until Nil found;

Then print output array in reverse order;

Problem is length of list is not known in advance;

Recursive solution fails in the event of stack overflow or running  
out of memory;

Non-recursive solution is easy if each node includes a back pointer  
to the previous node and a separate pointer to the tail of the list is  
maintained;

Follow forward pointers to end then follow backward pointers to  
beginning and print; Max 5

**4-5 marks** Candidate has provided a detailed discussion to the problem,  
 with a clear explanation with reference to many of the points  
 listed above which demonstrates a clear understanding of this  
 aspect of the subject.

Text is legible.

There are few, if any, errors of spelling, punctuation and  
grammar.

Meaning is clear.

The candidate has selected and used a form and style of  
writing appropriate to purpose and has expressed ideas  
clearly and fluently.

Sentences and paragraphs follow on from one another  
clearly and coherently.

Appropriate, specialist vocabulary has been used.

**2-3 marks** Candidate has provided an explanation with limited reference  
 to the problem which demonstrates a lack of understanding  
 in some aspects of this subject area. .

Text is legible.

There may be occasional errors of spelling, punctuation and  
grammar.

Meaning is clear.

The candidate has, in the main, used a form and style of  
writing which is appropriate for its purpose, with occasional  
lapses.

The candidate has expressed ideas clearly and reasonably  
fluently. Candidate has used well-linked sentences and  
paragraphs. Information or arguments are generally relevant  
and well structured.

**1 mark** Candidate has provided a weak explanation which does not  
 demonstrate a clear understanding of this subject area.

Information may sometimes stray from the point or be  
weakly presented and not be fluent.

There may be some errors of spelling, punctuation and  
grammar.

The candidate has used a form and style of writing which  
has many deficiencies.

Sentences and paragraphs may not always be  
well-connected.

[20]

**11.** (a) Bits are sent along a single wire/line; bits are sent one after another;

**R**. Bits of (the) data Max 1

(b) (i) Data bit; Max 2

Parity (bit);

Signal to start data transfer/strobe;

Signal ‘ready to receive data’ / busy;

Signal to acknowledge data transfer / Complete;

Out of paper/ink / error;

On-line/off-line;

Handshaking //control signal/status signal (BUT only if not by

example above);

Ground;

(ii) Transmission over long distances;

When a high data transfer rate is required; Max 1

**A.** No driver is available;

(c) Data is transmitted intermittently (rather than as a steady stream);

Sender and receiver are only synchronized when data is being sent // start  
bit synchronises the receiver;

**R.** Description only of start and stop bits 1

[5]

**12.** (a)



Correct root + left subtree;

Correct root + right subtree;

**I.** identification of PollardJ as the root

**A.** a complete ‘left-right’ mirrored image. 2

(b) (i) PollardJ, AtkinsP, CollinsK 1

from a correctly drawn left sub-tree;

(ii) 4 from a correctly drawn right sub-tree; 1

[4]

**13.** (a) 2-D array; 1

(b) Shows that sales person 2; did meet their target; for Quarter 3 /  
July- September; Max 1

(c)



NewArray initial values all 0; 1

Person loop counter 1 to 3; 1

Person 1 - is followed by quarters 1 to 4 in sequence; 1

NewArray[2] = 1 for person = 1 and Quarter = 2; 1

Final NewArray[1] = 2; 1

Final NewArray[2 and 3 and 4] values are correct; 1

(d) Stores the (total) number of sales staff who did not meet their target // the 2  
(total) number of sales targets not met;

for each quarter;

[10]

**14.** (a) (i) Interactive; 1

(ii) Real Time; 1

(iii) Network; 1

(b) (i) Batch; 1

(ii) Interactive; 1

(iii) Real Time; 1

[6]

**15.** (a) a collection of tables /more than one table; 1

//two or more linked tables / referencing other tables;

(b) (i) two (or more) attributes **R** keys which are jointly used to uniquely 1  
identify a record / tuple / row;

(ii) because no one attribute can uniquely identify a record in this relation; 1

**A** field

// answer in context of Booking table

(c) (i) an attribute in one relation/table which (links to)/is a primary key 1  
attribute in another relation / table; **A** field

(ii) CatOwnerID; 1

(d) 4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field | CageNumber | CatName | Surname | ContactNumber |
| Table | Booking | Cat | CatOwner | CatOwner |
| Criteria | 9 |  |  |  |
|  | ; | ; | ; | ; |

**A**[enter cage number]

*or similar*

Order unimportant; **I** other fields if they don’t inhibit the QBE;

A If Ginger entered for criterion for Cat

*Table e.g. Cat Table, Penalise once*

*Ignore anything written BELOW the grid*

[9]

**16.** (a) Process requires service from a resource;

Process is timed out// Time slice expires;

Process is pre-empted; Max 2

(b) Priority queue; 1

[3]

**17.** (a)



1 mark for correct boxes

1 mark for correct lines

1 mark for correct line endings 3

(b) Loan = class

Public

Procedure CreateLoan

Procedure DeleteLoan

Procedure GetLoanDetails;

Private

Person: Borrower

BookLoaned: BookCopy;

DateOfLoan: Time/Date **A** string

ReturnDate: Time/Date; **A** string

End;

1 mark for Loan = Class + Public + Private + End

1 mark for CreateLoan + DeleteLoan + GetLoanDetails

1 mark for Person + BookLoaned

1 mark for DateOfLoan + ReturnDate

**A** any reasonable names for operations and data items. 4

(c) Add a new data item ShortLoan; of type Boolean; **A** loanlength; integer;

**A** loantype; string;

Modify the code for the operations; Max 2

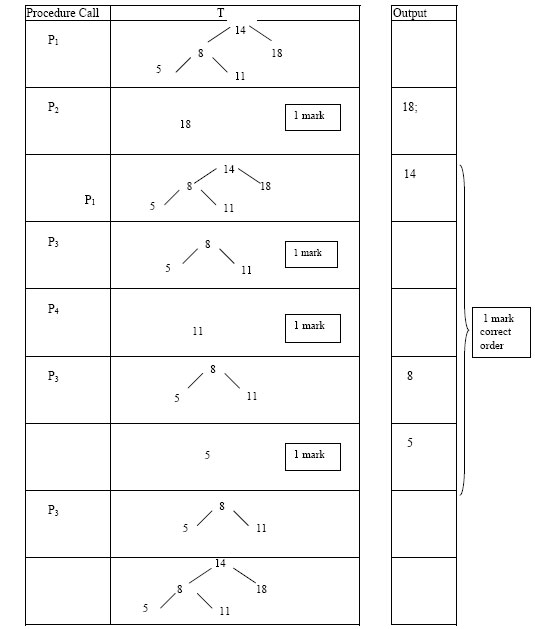
[9]

**18.** (a) a procedure/routine that calls itself/ is defined in terms of itself;

**A** Function instead of procedure

**R** re-entrant **R** program **R** iteration 1

(b) (i)



6

(ii) Reverse Inorder// Reverse order; (tree) traversal; 2

[9]

**19.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| (a) | (i) | ***single word answers not enough***  *interview:*  ask/talk to the finance clerk how costs are charged to departments // ask the finance clerk what info is recorded in the charge book // ask the finance clerk how/when he re-orders items; | Max 1 | *Must say who is being interviewed*  *Accept interviewing* *teachers with details as for* *(ii)*  *Do not accept general descriptions such as ‘what* *he likes about the system’* |

|  |  |  |  |
| --- | --- | --- | --- |
| (ii) | ***single word answers not enough***  *survey:* survey teachers to find out what they like/dislike about the method of recording items; survey teachers whether the items they want are always in stock; survey suppliers for delivery times / availability / current prices; | Max 1 | *General responses such as ‘survey teachers to find out how they use the system’ is not enough. The question* *is giving them the general so candidates need to be specific.*  *Surveying users is also too general* |

|  |  |  |  |
| --- | --- | --- | --- |
| (iii) | ***single word answers not enough***  *paperwork:* examine/look at/read/analyse the charge book to see what/how data is recorded; check the way the costs are charged to the departments;  work out volumetrics | Max 1 | *Do not accept general comments. Accept other* *terms for ‘charge book’ eg order forms, record book, charge sheet* |

|  |  |  |  |
| --- | --- | --- | --- |
| (iv) | ***single word answers not enough***  *observation:* watch how teachers take items and fill in the charge book; watch how the finance clerk charges each department at the end of the month; watch how the finance clerk orders new supplies; | Max 1 | *Do not accept general comments. Accept other* *terms for ‘charge book’ eg order forms, record book Accept Fred/he instead of finance clerk* |

(b) (i) A: Charge Book; 1

(ii) B: Item Description, Quantity (taken), Dept Code, (DateTaken); 1

(iii) C: Item Description, Quantity (taken) 1

(iv) D: Stock Book; 1

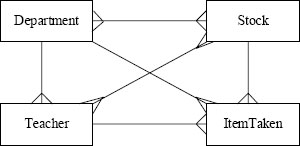
(v) E: Price List; R verb 1

(vi) F: Item Description, Quantity, (Item) Price, Total, (Dept Code); 1

I Charge Book/Form R verb

(vii) G: Item Code, Quantity, School Address/Name; A Oder Form; R 1  
verb

(c) (i)



Max 3

*1 mark per correct relationship* *I other relationships*

A  - 1 instead of ‘crow’s feet’

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| (d) | (i) | Department (DeptCode, DeptName, HoDInitials);  A DeptID instead of DeptCode  R initials on its own | 1 | *Accept attribute* *names consisting of separate words/reasonable abbreviations* |

|  |  |  |  |
| --- | --- | --- | --- |
| (ii) | Teacher (TeacherInitials, FirstName, Surname, DeptCode);;  *1 mark for correct primary key and FirstName, Surname;*  *1 mark for DeptCode;* | 2 | *P1 for each extra attribute*  *Accept* *attribute* *names* *consisting of separate words/reasonable abbreviations* |

|  |  |  |  |
| --- | --- | --- | --- |
| (iii) | Stock (ItemCode, ItemDescription, ItemPrice,  QuantityInStock, OrderQuantity,MinStockLevel); | 1 | No marks if extra attributes given  *Accept* *attribute* *names* *consisting of separate* *words/*  *reasonable abbreviations* |

|  |  |  |  |
| --- | --- | --- | --- |
| (iv) | ItemTaken (TransactionNumber, ItemCode, Quantity(taken), DateTaken, TeacherInitials)  **A** *ItemCode, DateTaken,TeacherInitials as primary key*  *A TransactionID or similar;* *1 mark for an appropriate field as primary key;* *1 mark for ItemCode and Quantity; R QuantityInStock R OrderQuantity* *1 mark for DateTaken; 1 mark for TeacherInitials;*  P1 for each extra attribute | 4 | Accept other appropriate names for primary key in place of ‘Transaction Number’  *Accept attribute* *names consisting of separate words/reasonable abbreviations* |

|  |  |  |  |
| --- | --- | --- | --- |
| (e) | SELECT ItemDescription, Quantity, ItemPrice; FROM ItemTaken, Stock, Teacher;  > 30/11/2007 <1/1/2008 WHERE DateTaken>= #1/12/2007# AND DateTaken<=#31/12/2007#; AND ItemTaken.ItemCode=Stock.ItemCode; AND Teacher.TeacherInitials = ItemTaken.TeacherInitials; ORDER BY (Teacher.)DeptCode; I table name in this part only  *Alternative answer:*  *SELECT Stock.ItemDescription, ItemTaken.Quantity, Stock.UnitPrice*  *FROM (Department INNER JOIN Teacher ON Department.DeptCode = Teacher.DeptCode) INNER JOIN (Stock INNER JOIN ItemTaken ON Stock.ItemCode = ItemTaken.ItemCode) ON Teacher.TeacherInitials = ItemTaken.TeacherInitials*  *WHERE (((ItemTaken.DateTaken) Between #12/1/2005# And #12/31/2005#));*  Ignore Asc / Desc or Ascending / Descending *P1 for spurious symbols / punctuation* | 6 | *Follow* *through attribute* *names from table definitions*  *Note alternative answer:*  *For answers using INNER JOIN*  *Also note alternative date range using BETWEEN… AND …*  *Accept dates without #*  *No semicolon required at* *end of statement* |

(f) mail merge / mail merging; 1

[29]

**20.** Message/data broken down into packets; Max 3

source/destination (address) is added to each packet;

message ID added to each packet;

packet sequence number added to each packet; A numbered packet;

each packet may well travel along different paths to get to the final  
destination

// packets routed independently;

recipient puts packets into correct sequence

// packets reassembled into message at destination;

checking for errors (and resend packets)

// request for corrupted packets to be resent;

// a virtual circuit is established // packets are sent over a virtual circuit;

(allow for non-IP packet switching answers eg. X25 or ATM)

[3]

**21.** (a) acknowledge data received by the printer;

error (signal);

busy / free / ready /’status’ / acknowledge / strobe / off-line / powered  
/ switched off / out of paper;

**A**. ground / earth / return; MAX 1

**R**. Interrupt / clock

(b) (i) 110 1010; 1

(ii) 0110 1010; 1

(iii)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | **0** |  | 8 | **0** |  | 8 | **0** |
| 7 | **0** |  | 7 | **1** |  | 7 | **1** |
| 6 | **1** |  | 6 | **0** |  | 6 | **1** |
| 5 | **0** |  | 5 | **1** |  | 5 | **0** |
| 4 | **1** |  | 4 | **0** |  | 4 | **1** |
| 3 | **0** |  | 3 | **1** |  | 3 | **0** |
| 2 | **1** |  | 2 | **1** |  | 2 | **1** |
| 1 | **1** |  | 1 | **0** |  | 1 | **0** |
|  | **A** |  |  | **B** |  |  | **C** |

8 parallel bits; (above, below or between the lines)

pattern A scores 2; MAX 3

pattern B scores 2;

pattern C scores 1;

(c) (i) set of rules (about the way devices communicate);

**A.** standards **R.** Instructions 1

(ii) sending signals between devices + implication of 2-way; test  
to see if the device is ready to receive /’are you ready?’;

inform device that the data has been sent / ‘here it is …’;

receiver informs the sender that the data has been MAX 2  
received / acknowledge that a transfer is completed;

(d) (i) Universal Serial Bus; 1

(ii) Line 1 used with 7/8 bits shown (above or below);

Correct code **0110 1010**; 2

(iii) The number of bits transferred per sec / per unit of time;

**I.** speed

**A.** frequency at which bits are transmitted 1

[13]

**22.** (a) (i) IP address / Internet Protocol Address; 1

(ii) Uniform Resource Locator;

**A.** Universal Resource Locator 1

(b)  Forwards / backwards / Navigation - move to a previously viewed page;

 Favourites/Bookmarks - setting up/organising/stores regularly visited  
sites;

 Options/Tools/Settings - setting up of the Home page / enable/disable  
features e.g. run JavaScript;

 Home - move to the Home page;

 Refresh - refresh the current page;

 Stop - stop loading the current page / download;

 History  show a list of the last (say) 20 pages displayed;

 Security - change settings / e.g. enable/disable graphics/pop-ups/other  
content/plug-ins;

 View HTML - source (code);

 Address bar - allows the entering of a URL/IP/web address;

 Search bar  search list for specific web site;

 RSS feeds  receiving content news/updates;

 Application launcher icon e.g. to run email client application;

**R**. HTML editor

**Feature followed by NO description scores 0**

**Good description with feature implied scores 1** MAX 2

(c) (i) footyhosting.co.uk 1

(ii) (Each hosted club has) a (sub) folder/directory containing the  
files for their site; 1

(d) 128 kbps // 2Mbps // 128 kbps AND 2Mbps;

**R**. answers where in addition any other answer is circled 1

(e) (i) (magnetic/server) hard disk/ hard drive;

**R**. removable hard disk

**A**. ‘disk’ spelt as ‘disc’ 1

(ii) 8000 GB; 1

[9]

**23.** (a) *collection of* tables / relations;

*created through* common attributes / shared attributes;

**A** common fields / shared fields

**A** primary keys and foreign keys

(must have both primary & foreign) 2

(b) (i) to uniquely identify each record  
/ to uniquely identify a particular instance of an entity;

**A** to uniquely identify a member 1

Purpose of primary key

(ii) because people can change their email addresses; 1

(iii) to speed up searching for a particular item; 1

(iv) MemberID; 1

(c) (i)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Field name | ItemOnOffer | Description | MemberID | Email address | |
| Table | Item | Item | Item /Member | Member | |
| Criterion | \* bed \* |  |  | |  |

**;;** **;** **;** **;**

\* bed \* as criterion in ItemOnOffer - i.e. correct use of wild card 2

Or: bed/ childs bed/ bunk beds, as criterion for ItemOnOffer 1

Or no criterion in ItemOnOffer when \* bed \* in Description 1

\* bed \* or \* bunk beds \* as criterion in Description 2

Or: no criterion in Description 1

MemberId, in table item / table member & no criterion 1

emailAddress in table Member & no criterion 1

Max 3

(c) (ii) 3 *(if wild card used in either ItemOnOffer or Description)*;

2 *(If \* bunk bed \* in Description)*

*1 (If criterion for ItemOnOffer ‘bed’, ‘child’s bed’ or ‘bunk beds’* 1

[10]

**24.** (a) 984; 1

(b) 984; 1

(c) (i)  13.0;;;

Allow method marks

1 mark for correctly identifying negative number

1 mark for integer value correct

1 mark for fraction (dependant on correct integer value)// 01101.000 3

(ii) To maximise precision in a given number of bits //

To minimise rounding errors;

**A** to maximise accuracy in a given number of bits 1

(iii) leftmost 2 digits/bits are different//

a significant bit is stored after the binary point//

bit after point different from bit before point;

**A** the first bit after the sign bit is a ‘0’;

**A** The second bit is a ‘0’;

**A** *an answer that clearly implies a ‘0’ follows the ‘1’* 1

(iv) 127// 27 – 1;;

Max 1 for correct mantissa (01111111) or exponent (0111/7) 2

[9]

**25.** (a) (i) Empty entries waste memory // Maximum size// fixed size; 1

(ii) Memory used by pointers//takes more time to add / delete nodes//  
indirect access takes more time; **R** programming difficulties 1

(b) Place next item in first location/ location 0/ location 1//

Implement a circular array/queue // allow wraparound; 1

(c) IsFull/IsQueueFull; 1

[4]

**26.** (a) Address of page in memory// memory frame address// physical  
address of page// Base address of page;

Page in memory or on disk// page in or out of memory// valid/invalid bit;

Dirty/ modified Bit;

Last time accessed; Max 2

(b) Page table is accessed using the page number as an index;

Address found in page table; is added; to the offset; Max 3

(c) In cache memory// associative memory/storage//

content-addressable memory/ storage// in main memory;

Each executive process needs to be able to access its physical pages//  
needs to be accessed very quickly //

Used every time memory is accessed; Max 2

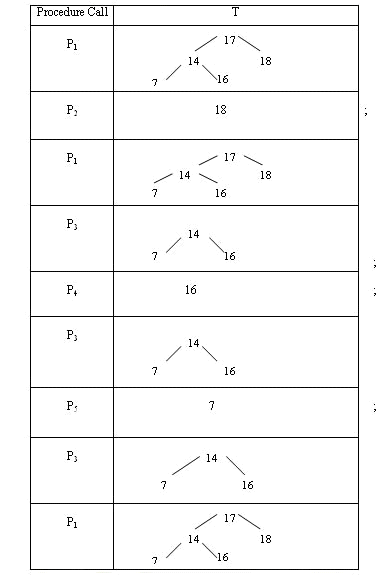
[7]

**27.** (a) a procedure/routine that calls itself/ is defined in terms of itself;

**A** Function instead of procedure

**R** re-entrant **R** program iteration (TO) 1

(b) (i) 7



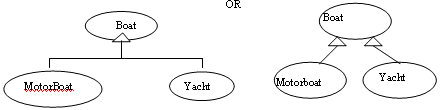
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Output | 18; | 17; | 16 | 14 | 7; |

(ii) Reversed Inorder; Tree traversal;

**I** Sort/ Re-arrange 2

[10]

**28.** (a) 2



1 mark for all three classes in appropriate boxes;

1 mark for arrows in correct directions;

(b) Insert a SetColour Procedure; **A** Function

into the Public section;

**R** make Colour Public 2

(c) Yacht = Class/ subclass (Boat) 1

(Public)

Procedure SetBoatDetails (Override) 1

Function GetMasts 1

Function GetEngine 1

Private

Masts : Integer 1

Engine : Boolean 1

End

**A** Procedure SetMasts and Procedure SetEngine/ Procedure

AddNewYacht/SetYachtDetails instead of Procedure SetBoatDetails

Masts and Engine must be private

P1 if extra functions/ variables are included

**R** any diagrams

**I** any parameters to methods

OR

Public class/subclass Yacht extends/inherits Boat 1

{

public void SetBoatDetails() 1

public int GetMasts() 1

public boolean/int GetEngine() 1

private int Masts 1

private boolean/int Engine 1

}

**A** public void SetMasts and public void SetEngine//

public void AddNewYacht/SetYachtDetails instead of public void

SetBoatDetails

[10]

**29.** (a) (i) member ID / user name; password/PIN;

**A** account name instead of memberID;

**A** answers to security questions; 2

(ii) Member (MemberID, CreditCardNo, Member(Full)Name, Address,  
DrivingLicenceNo, EmailAddress, Mobile(Tel)No/TelNo); + attributes  
from b(i)

**I** bars over attributes 1

(iii) ParkingArea (LocationCode, ParkingAreaName, PostCode);

**A** ParkingAreaID instead of LocationCode

**R** ParkingArea **R** Name as attributes 1

(iv) Car (CarRegNo, LocationCode);

**A** RegNo/CarReg instead of CarRegNo

Allow follow through on foreign key from (iii) 1

(v) Booking (BookingRefCode, CarRegNo, MemberID, StartDateTime,  
EndDateTime, LocationCode);;;

*1 mark for CarRegNo and MemberID;*

*1 mark for StartDateTime and EndDateTime;*

*1 mark for LocationCode;*

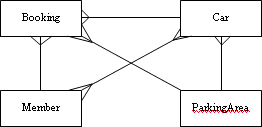
*1 mark for BookingRefCode as primary key;*

***A*** *2 separate attributes for DateTime*

**A** BookingRef/BookingID instead of BookingRefCode Max 3

Follow through on attribute names

(b)



*1 mark for each correct relationship,*

*If 4 or 5 relationships given, mark as follows:*

*All 4/4 or 5/5 correct: 3 marks*

*3/4 or /54 correct: 2 marks*

*2/4 or3/5 correct: 1 mark*

*All other cases: 0 marks*

**I** *relationship between Member and Parking Area* Max 3

(c) SELECT MemberID, (MemberFullName,) CarRegNo,

StartDateTime, (EndDateTime) FROM (Member,) 1

Booking

WHERE Member.MemberID = Booking.MemberID 1

AND EndDateTime BETWEEN 1/12/07 AND 31/12/07 1

ORDER BY MemberID (ASC/DESC) 1

**A** other attributes if present in candidate’s booking table 1

*Alternative Answer:*

SELECT \*; FROM Booking;

WHERE EndDateTime LIKE “\*/12/07”

**A** StartDateTime instead of EndDateTime 1

**P1** if attribute.table notaion used

**P1** for extra punctuation or tbl in front of table name 1

**I** punctuation around dates/times

**I** case of keywords etc 1

**A** other wildcard characters

*Alternative Answer:* 1

SELECT MemberID, MemberFullName, CarRegNo, 1

StartDateTime, EndDateTime

FROM Member INNER JOIN Booking

ON Member.MemberID = Booking.MemberID

WHERE EndDateTime >= 1/12/07 AND  
 EndDateTime <= 31/12/07 Max 4

ORDER BY MemberID

[15]

**30.** (a) *symmetric key encryption*: the same key/process/algorithm is used for  
encrypting and decrypting; **A** *sending/receiving instead of encrypting*  
*/decrypting  
public key encryption*: a public key and a private key // a pair of keys  
are used in combination; one to encrypt, the other to decrypt; 3

(b) (i) *when:* the symmetric key is sent (from B to A)

// when establishing the initial connection;

*how:* B must encrypt the symmetric key; with A’s public key;

so A can decrypt (the symmetric key) with A’s private key;

**A** A must encrypt the symmetric key; with B’s public key;

so B can decrypt (the symmetric key) with B’s private key; Max 3

(ii) anyone could intercept the message with the symmetric key  
(and then decrypt the personal data);

distributing the symmetric key securely is not possible  
(unless it is encrypted);

**R** unspecific answers such as ‘easily hacked’ 1

[7]

**31.** CREATE TABLE // CREATE INDEX // CREATE DOMAIN //  
CREATE TRIGGER // CREATE VIEW // GRANT …;  
**R** CREATE DATABASE 1

[1]

**32.** (a) next item to be added is at position/location/address (Tail + 1);

Position/location/address Tail is the last item in the queue ; max 1

**R.** ‘points to the end of the queue’

(b) Cat // item at position Head ; 1

(c)

|  |  |  |
| --- | --- | --- |
|  | 6 |  |
| Tail | 5 | ‘Shark’ |
|  | 4 | ‘Eel’ |
|  | 3 | ‘Snake’ |
| Head | 2 | ‘Frog’ |
|  | 1 | ‘Dog’ |
|  | 0 | ‘Cat’ |

Snake + Eel + Shark at positions 3,4,5 ; 1

Tail points to 5 ; 1

Head points to 2 ; 1

**I.** Dog and Cat crossed through

(d) Tail will eventually reach position 99 (**A**. 100) ;

Head will eventually reach 99 (**A**. 100);

Memory/queue will become full ;

Space is not re-useable ; max 2

[7]

**33.** (a) E X A M ; *Mark as follows:*

1 or 2 correct 1 ;

3 correct 2 ;

4 correct 3 ; 3

**R.** lower case

(b) (i) Universal Serial Bus; 1

(ii) Parallel ; 1

(iii) set of rules ;

sending signals between devices;

(computer) asks are you ready? ;

(printer) acknowledges yes I am ;

(computer) responds here comes the data ;

(printer) ‘thank you received’ ; max 2

(iv) acknowledge data received by the printer ;

error ;

line is busy / free / ready /‘status’ / ACK Request ;

timing / strobe;

interrupt; max 1

**R.** Ground

(v) operating system ;

word processing software / text editing software / any sensible

application ;

print spooler ;

printer driver ; max 2

**R.** ‘printing software’

[10]

**34.** (a) Interactive 1

(b) Real time 1

(c) Network 1

[3]

**35.** (a) by common / shared attributes;

/ by primary and foreign keys;

**A** actual example(s) from the tables

**A** fields instead of attributes 1

(b) BookID, DateOut;;

**I** MemberID

Other fields, penalise 2

(c) To speed up searching; 1

(d) Check digit; 1

[5]

**36.** (a) (i) Security: *1 mark for each of 2* ***examples*** *of different* ***types*** *of security  
failure* MAX 2

Unauthorised access to data;

Unauthorised / deliberate corruption / loss / alteration of

data/software;

Theft of / damage to hardware;

Accidental destruction of data by hardware failure /operator error;

Loss of data through natural hazards e.g. fire, flood, earthquake;

(ii) *Integrity: 1 mark for each of 2 reasons* MAX 2

Error on data entry;

Insufficient validation checks;

Virus corrupting file;

Program error corrupting a file or data;

Transmission errors;

(Duplicated) info. not fully updated;

(b) (i) Information about (living,) identifiable individuals

/ information that can identify (living) individuals; 1

(ii) *Up to two marks for practice relevant to a school / college  
for each type of security problems given in (a)(i)* MAX 4

*Unauthorised access to data*

Encrypt data;

only give key to certain people;

/Password protect;

change passwords regularly / password policy for ‘strong’ passwords;

/ Use *relevant*;

access rights;

/ Keep administration and academic networks;

separate;

/ Install firewall;

and regularly update it;

/ Described physical protection of system / data / workstations;;

*(marked in spirit of above)*

*Unauthorised / deliberate deletion / loss of data*

/Virus checker;

kept up to date;

/Regular backups;

kept securely;

*plus relevant items from unauthorised access if not already given*

*Accidental destruction by hardware failure / operator error*

/ Require confirmation;

of any editing / deletion;

/Regular backups; *(if not already given)*

kept securely;

*Natural hazards*

Regular backups; *(if not already given)*

kept securely;

/Uninterrupted power supply;

To allow systems to close down safely;

*Theft of / damage to hardware*

/ Described physical protection of system / data / workstations;;

*(marked in spirit of above)*

[9]

**37.** (a) *social;*

some people get so many junk e-mails/ spam take up

so much space;

that they have to change their e-mail address;

/ that legitimate e-mails get submerged by them;

/ service degrades;

//Some ISP’s spam filters;

reject legitimate e-mails;

// unkind / spiteful/ gossip type e-mails;

can be spread about a work colleague / ex ‘partner’; MAX 2

*economic*

wastes resources;

dealing with junk e-mail;

// corruption /damage to software and data;

from viruses carried by spam;

//many spam are fraudulent;

people pay for things that never arrive;

// ISPs have to pass on the cost of extra bandwidth;

to their customers; (Spam slows down Internet)

//people with dial-up connections

/ who receive e-mails on mobile phones;

have to pay to download the junk mail;

cost of;

spam filters; MAX 2

*ethical;*

/people / vulnerable adults upset by;

obscene / inappropriate e-mails;

phishing e-mails;

extracting personal /financial information; MAX 2

**A** *ethical - social, economic - social* cross over where valid, but points  
must be different.

(b) Have more than one e-mail address;

Use a spam black-list to refuse e-mails from known spamming sites;

Use a spam filter in the e-mail software / in house;

Careful choice of e-mail address; 1

[7]

**38.** (a) 40E 1

(b) 1038 1

(c) 64.875 1 mark for 64, 1mark for .875 **A** 7/8 2

(d) (i) 0.125//⅛;;;

If incorrect part marks as follows

mantissa = 0.5 or ½ 1

exponent = -2 1

times 2exponent 1

(ii) leftmost 2 digits/bits are different//

a significant bit is stored after the binary point//

bit after point different from bit before point;

**A** the first bit after the sign bit is a ‘1’;

**A** The second bit is a ‘1’;

**A** *an answer that clearly implies a ‘1’ follows the ‘0’* 1

(iii) 127;;//1111111;;//0.1111111; x 27/2111; 2

[10]

**39.** (a) Temp  Front;

Front  Temp.Next//Front  Temp^.Next;

Dispose (Temp); **A** Free(Temp)

Alternative

Temp  Front.Next// Temp  Front^.Next;

Dispose (Front); **A** Free(Temp)

Front  Temp; 3

(b) AddItem//Add; 1

(c) (i) Full/FullQueue; 1

(ii) No memory used for pointers;

**I** Faster

**R** Easier to program 1

(iii) Size is limited by array size;

memory wasted when not full; 2

[8]

**40.** (a)

|  |  |  |  |
| --- | --- | --- | --- |
| Number | Lower | Upper | Current |
| 12 | 1 | 9 |  |
|  |  | 5 | 5 |
|  | 3 |  | 3 |
|  | 4 | 4 | 4 |

|  |  |
| --- | --- |
| Value returned | 4 |

*1 mark for 1st row (12, 1, 9)*

*2 marks for second row (1 mark for each 5)*

*2 marks for 3rd row (3 and 3)*

*2 marks for 4th row (1 mark for Lower = 4, 1mark for upper = 4)*

*1 mark for correct return value* 8

(b) Find the position of 12/ a number in the array// search for 12/ a number in  
the array; 1

[9]

**41.** (a) mouse click// mouse movement// keyboard operation// any interrupt; 1

(b) event-driven programs service an event and wait for another;  
non event-driven programs run to completion/ are sequential; 2

(c) contains its own data/fields/variables/properties;

contains its own

operations/methods/functions/procedures/behaviours/code;

responds to messages;

**A** Based on a Class definition max 2

(d) frame/form/window/button/check box/radio button/menu/text box;

**A** any sensible widget

**R** Plurals 1

[6]

**42.** *(a)* *& (b) must be different* *(c) & (d) must be different*

(a) **barcode scanner**: scan ID card to register when entering/leaving the  
room; 1

(b) **fingerprint scanner**: to login at computer, can not be abused like user

name and password;

to register when entering/leaving the room;

to ensure the identity of the student (can not use someone else’s)

entering the room/logging on;

**I** fingerprint to check ID card is genuine max 1

(c) **digital still camera**: to produce photos for ID card;

to produce photos for database to help identify students;

to take photos of student entering room; max 1

(d) **digital video camera**: to record/monitor activity in room;

to help identify students if there has been misuse/damage; max 1

(e) **programmable doorlock/turnstile**: admit only authorised persons;

admit only persons with valid ID card; automatic locking at certain times;

if used when entering and leaving, can record time in room; max 1

(f) **RFID tag reader**: if students are issued with a RFID tag instead, the

reader will detect their presence without the student having to swipe their

ID card through a reader;

faster process to log student’s ID as they enter/leave the room if student

is given an RFID tag;

tracking location of students with RFID tags;

tag equipment to stop it being taken out of the room;

scan RFID **BoD**; swipe RFID is **T.O.**

**R** references to smart card **R** tagging unauthorised people max 1

[6]

**43.** (a) Copyright, Designs and Patents Act (1998); *if other laws included* **T.O.** 1

(b) *boxes for correct entities: SoftwareLicence SoftwareInstallation one mark*

*correct degree of relationship: 1 to many one mark*

*suitable name for relationship: one mark* 3



(c) *any sensible field length accepted except for SoftwareID, ComputerID,  
StaffID*

(i) SoftwareID VARCHAR(10) PRIMARY KEY (NOT NULL)

// SoftwareID VARCHAR(10) PRIMARY KEY(SoftwareID);

|  |  |
| --- | --- |
| SoftwareName VARCHAR(30)  Supplier VARCHAR(20)  DatePurchased DATE  Version VARCHAR(10) |  |
| ExpiryDate/DateValidTo DATE | 1 mark for any 3 attributes correct  P1 if extra symbols used  Ignore spaces and case in attribute names |
| NoOfLicences INT |  |

3

(ii)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SoftwareID VARCHAR(10) | A char/string/text/alphanumeric  Instead of VARCHAR  A Date/Time instead of Date  A Integer instead of INT  BOD any attributes which are clearly more than 1 word | | | | | |
| ComputerID VARCHAR(6) | | | | |
| DateInstalled DATE | | | 1 mark for any 2 attributes correct | | |
| StaffID VARCHAR(3) | |  | | | |
| PRIMARY KEY (SoftwareID, ComputerID);  FOREIGN KEY (SoftwareID) | | | | If not DDL give 1 mark  if composite key  identified | |
| REFERENCES Software Licence(SoftwareID); | | | | | |

4

**I** NOT NULL

(d)

|  |  |
| --- | --- |
| SELECT ComputerID, SoftwareName, Version ; | Extra attributes: T.O. |

FROM SoftwareLicence, SoftwareInstallation ;

WHERE SoftwareLicence.SoftwareID=SoftwareInstallation.SoftwareID ;

ORDER BY ComputerID; **A** ASC or DESC 4

|  |  |  |
| --- | --- | --- |
| Accept (instead of FROM WHERE): FROM SoftwareLicence INNER JOIN SoftwareInstallation ON SoftwareLicence.SoftwareID = SoftwareInstallation.SoftwareID |  |  |
|  |  | P1 for other spurious punctuation inc semicolons |

**A** LEFT JOIN

|  |
| --- |
| Table names prefixed with tbl, P1 |
| If table name and attribute transposed, P1 |

[15]

**44.** (a) If you send the key with the message, anyone can decrypt the message 1

key would need to be sent by means other than email, otherwise anyone

could intercept the key and use it do decrypt the message;

(b) (i) Jill’s public key; 1

(ii) Jill’s private key; 1

(c) (i) the message data is hashed into a message digest;

the message digest is encrypted; with the sender’s private key; 3

(ii) Jill’s software decrypts the signature;

using Jack’s public key; contained in digital certificate sent with

message;

to verify Jack’s public key;

decrypt digital certificate using Certificate Authority’s (trusted third

party’s) public key;

Jill’s software then hashes the document data into a message

digest;

If recalculated message digest is the same as

the original message digest (decrypted signature);

then Jill knows that the signed data has not been changed; 4

**I** decryption of message

[10]

**45.** (a) (i) computers/devices/nodes/PCs connected/linked/communicate together ;

**R.** machine

**A.** using a LAN protocol e.g. Ethernet

over a small geographical area / e.g. a room/a building /a site ; 2

(ii) bus ; **R.** line 1

(iii) serial ; 1

(iv) ring // star ; 1

(v) printer; (bar code) scanner; multifunction machine ; modem ;  
message boards ; server

providing audio/video or any additional server; console dedicated  
to audio/video ;

projector ; FAX machine ; external hard drive ; card reader ;

**A**. bridge / hub, / switch / router / gateway / firewall ; MAX 2

(b) (i) bargainbooks-r-us.co.uk ; 1

**R.** answer with anything added to this

(ii) The file (name); the page requested; home page; MAX 1

(iii) the web server cannot find the page requested //

(examples) the page has been deleted / moved to different folder /  
does not exist ;

the page is in the process of being updated / page is currently off-line;

**R.** anything which implies there is no connection

**R.** timed out 2

(c) (i) computers (and networks) connected/linked/communicating ;

**A**. using a WAN protocol e.g. TCP/IP

over a large/wide geographical area / e.g. city/county/country/ globally /  
e.g. The

Internet ;

**R.** WWW 1

(ii) e-mail communication with the outside world (A or B) ;

email/easier communication between libraries // the library and a  
borrower (A or B) ;

enquiries about books available at other libraries (A or B) ;

electronic transfer of documents/information between libraries (A only) ;

backup of data/network administration for all libraries is more

manageable/done centrally (A only) ;

**A**. Accept benefits which imply access to the World Wide Web /  
Internet (A or B) ; MAX 2

[14]

**46.** (a) (i) String / Text / Char ;

**R.** alpha / alpha-numeric / character 1

(ii) Integer / Date (and Time) ; **A.** String 1

(iii) Boolean ; **R.** Yes/No 1

(b) (i) Book ; 1

(ii) False / F / No // f/t from the (a) (iii) answer e.g. stated as  
integer - value 0/1 1

(iii) True / T / Yes // f/t from the (a) (iii) answer e.g. stated as  
integer - value 1/0

(MAX 1 for (ii) and (iii) if no indication of meaning when integer used) 1

(c) (i) T76542 ; 1 ; 2

(ii) T ;

**I.** the quote marks (i) and (ii) 1

(iii)

|  |  |  |
| --- | --- | --- |
| NextAvailableCode | Book | LocationLetter |
| 1 | 1 | ‘T’ |
| 2 | 2 | ‘T’ |
| 3 | 3 | (gap not required) |
| 4 | 4 | ‘M’ |
| (in sequence – possible repeat of 3 and/or 4 | 5 | Penalty -1 if the first ‘M’ is followed by either ‘T’ or ‘X’ |
|  | 6 |  |

**Figure 2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Location |  |  | NewCode |
| [1] | ‘Torrington’ |  | [1] | 1 |
| [2] | ‘Torrington’ |  | [2] | 2 |
| [3] |  |  | [3] |  |
| [4] | ‘Morristown’ |  | [4] | 3 |
| [5] |  |  | [5] |  |

**Figure 3** **Figure 4**

6

[15]

**47.** (a) Last (item) in, is the first (item) out / first (item) in is the last (item) out ; 1

**R.** LIFO / FILO

(b) (i)

|  |  |
| --- | --- |
| 600 | ‘A’ |
| 601 | ‘V’ |
| 602 | ‘E’ |
| 603 | ‘R’ |
| 604 | ‘Y’ ; |
| 605 |  |

All items in the correct locations 1

(ii)

|  |  |
| --- | --- |
| 599 |  |
| 600 | ‘A’ |
| 601 | ‘V’ |
| 602 | ‘E’ ; |
| 603 |  |
| 604 |  |
| 605 |  |

Correct three items // ft from an incorrect (i) including 605  
as the first location used ; 1

**A**. ‘R’ and ‘Y’ entries indicated in some way as ‘deleted’ 1

(iii)

|  |  |
| --- | --- |
| 600 | ‘A’ |
| 601 | ‘V’ |
| 602 | ‘E’ |
| 603 | ‘S’ |
| 604 | ‘P’ ; |
| 605 |  |

Correct list of five items // ft from an incorrect (i) + a correct ft  
(ii) including 605 as the first location used ;

(c) (i) Queue ; **A.** First In – First Out FIFO / LILO 1

(ii) Items are removed/popped from the stack (one at a time)  
(and items are then added to the queue); 1

(iii) Items leave the queue on a ‘first in-first out’ basis ;  
**A.** from the front of the queue 1

(iv) ‘Y’, ‘R’, ‘E’, ‘V’, ‘A’ on the queue ;

‘Y’, ‘R’, ‘E’, ‘V’, ‘A’ on the final stack ;

**A.** using 701 for the first queue location 2

[9]

**48.** (a) (i) *Unauthorised access*

password protect sensitive files; 1

//have username & passwords to log on;

/ have username & password / use biometrics to restrict access;

AND change passwords on a regular basis; 1

/ choose passwords that are difficult to guess;

/ do not write passwords down;

/ shut down after (e.g.) 3 attempts at guessing the password;

**A** and set attributes/permissions/access rights;

//Set attributes/permissions/access rights; 1

AND to restrict access to specific users or groups of user; 1

//Use biometrics /lock doors to rooms where terminals are 1

/employees log off / lock machines when they leave them;

AND to restrict access to sensitive files to certain terminals; 1

// encrypt (sensitive) files; 1

AND only authorised users have (decryption) code/key; 1

(ii) use software that can monitor /log user activity **A** record, **R** store  
/monitor file changes; 1

(b) (i) *data protection*

Firewall; 1

**A** ‘strong’ passwords

**A** Encrypt data ;

(ii) Use up to date virus checking software; 1

A Regular backups (*if not given in iii*)

(iii) Regular / automated backups; 1

/Uninterruptible power supply; (so that system can be shut down safely)

(c) *restore*

a good recovery / restore procedure; **A** description of this 1

/backup media must be available immediately;

/ availability of alternative hardware;

**A** Make regular backups *if not given in (iii)*

**A** have a contract with an outside recovery service;

[13]

**49.** (a) (i) *operating systems*

Allocate hardware resources;

between applications / processes requiring them;

to ensure efficient use / no hold-ups / maximise throughput;

to deal with hardware malfunctions / maintain hardware functions;

*1 mark per point to max* 2

(ii) Processor / CPU;

(Main) Memory / IAS ;

Backing Store / Secondary Store /File space; **A** *examples, but only one*

Input devices; *of each type*

Output devices;

Peripherals; *(if I/O devices NOT given)*

File space;

**R** programs, data, files (as *not hardware*)

*1 mark per resource to max* 3

(b) hides the complexity of the hardware;  
from the user;

// provides an interface; **A** GUI

between the user and the computer; max 2

(c) (i) *Batch processing*

Payroll;

BACS cheque processing;

Producing Utility bills;

*1 reasonable example* 1

(ii) Data entered off line;

Processing delayed until all data entered

/ data collected over a fixed period of time before processing;

Batch integrity checks employed;

There is an acceptable time delay between data input and final output

Processing frequently carried out at night when system is quiet;

Once started, there is no interaction between user and computer;

Data is processed sequentially;

Process controlled by instructions written in JCL;

*1 mark per point to max* 2

(d) *Batch operating system*

Supports processes which are sequential in nature;

Requires all data and commands to be supplied along with job;

Once started, there is no interaction between user and computer;

Processes (jobs) are queued;

Operator can intervene;

Process controlled by instructions written in JCL;

OS schedules tasks;

*1 mark per point to max* 2

[12]

**50.** (a) 35,37; 1

(b) 53,55; 1

(c) 00111001;; *1 mark for sign, 1 mark for value*

**A** 11000111 *1 mark* 2

(d) 0.1110010 ; 00000110; 2

(e) To allow a wider range of values to be stored;

To minimise rounding errors//

greater accuracy/precision using a given number of bits; 2

[8]

**51.** (i) To provide a standard interface to the O.S.;  
**A** Communicates with the O.S.;  
To control the hardware/device;  
To sense the status of the device;  
To read/write registers in the device controller; max 2

(ii) To allow a range of hardware;  
That was not available when the O.S. was written;  
To allow compatibility between different manufacturers;  
To reduce the size of the O.S.; max 2

(iii) A language that allows registers to be read/written//  
Assembly Code;  
**A** Machine Code  
**A** ‘C’/BCPL/CPL  
**A** Low level language 1

(iv) Requires direct access to the registers/memory (in the I/O (device)  
controller);  
**R** access hardware  
Needs high speed execution/processing;  
Uses minimum memory// Minimises program code;  
Needs to allow low level commands found in the instruction set;  
**A** Assembly Code/‘C’/BCPL/CPL easier to write than machine  
code if consistent with (iii) max 2

[7]

**52.** (a) An object that contains other objects;

**A** A class containing other classes; 1

(b) (i)



*1 mark for class entries*

*1 mark for connections* **A** circles or diamonds, filled or not 2

(ii)

max 8

[11]

**53.** (a) A procedure that is defined in terms of itself;

**A** A procedure that calls itself

**R** re-entrant 1

(b) Store return addresses;

Store parameters;

Store local variables/ return values; max 1

(c)

|  |  |  |
| --- | --- | --- |
| Number | Entry | Output |
| 11 | 1 |  |
| 11 | 2; |  |
| 11 | 3; |  |
| 11 | 4; | 4; |
|  |  |  |

4

(d) A linear search//  
To find/output the position/index of Number in Items; 1

(e) Number is not an entry in Items// Stack overflows; 1

(f) Test for reaching the end of Items; 1

(g) Binary Search;  
An iterative solution; max 1

[10]

**54.** (a) (i) *dialup*: A temporary, as opposed to dedicated, connection over  
a telephone line;

slow rates of data transfer; **A** slow;

baseband // can only be used by one device at a time;

converting signal from digital to analog (and vice versa);

(ii) *cable modem*: A cable modem can transfer data at much higher rates  
compared with dial-up

modems; A faster than dial-up;

**R** references to DA conversion

connection is via cable television cables/fibreoptic cable; **R** wire

dedicated connection//always on;

Speed depends on concurrent sharing;

broadband // line can be used by several devices at the same time;

(iii) *ADSL*: allows more data to be sent over a telephone line per unit time

// supports higher data rates when receiving data than when sending data

// greater downstream rate than upstream rate; A faster than dial-up;

speed/availability is dependent on distance from telephone exchange;

broadband // line can be used by several devices at the same time;

dedicated connection // always on // computer connects almost  
instantaneously; 6

**I** cost/payment

(b) (i) router/gateway connects to modem/Internet/telephone line;

each computer links to the router;

any computer can link to Internet without access to another computer;

Laptop can access the desktop computer’s files (via the router);

OR

desktop computer(‘s modem) connects to Internet;

laptop computers link to desktop;

desktop must be switched on for laptops to be able to access  
the Internet;

laptop can access the desktop computer’s files; max 3

(ii) desktop acts as server // buy a dedicated server (to store the shared files);

server/desktop’s modem connects to Internet;

laptops act as clients (to desktop/server);

laptops request files from [desktop] server; max 3

(c) (i) 192.168; **A** 192.168.0.0; R 192.168.x.y 1

(ii) *range for desktop:* 192.168.0.2; to 192.168.255.254;

192.168.0.1; to 192.168.255.254; A 192.168.255.255  
as top end of range 2

(iii) *subnet mask:* 255.255.0.0 // 255.255.224.0 // 255.255.192.0 //  
255.255.128.0; 1

(d) (i) *virus attack:* run/use/install virus checking/ anti-virus software

// regularly update the virus checking software (database); 1

(ii) *unauthorised access:* use/install firewall; using non-routeable  
addresses in LAN;

make folders/directories/files non-shareable/invisible/  
password-protected // encrypt data;

**P1** for buy password-protect computer/data NE max 1

(e) (i) *cable required:* Ethernet cable // 10BASE-T // 100Base-T // 1000Base-T

// twisted pair // Cat3 // Cat5 // mains cable // internal tel cable  
// fibre optics; 1

(ii) *hardware required:* wireless access point/hub/router;

wireless network card/adapter; 2

(iii) *advantage:* do not need cables trailing through house

// can work anywhere within range of access point

// other members of family/visitors can easily join network; 1

(iv) *disadvantage:* less secure // neighbours may try to use bandwidth;

prone to interference;

signal may be poor (depending on house construction);

likely to be slower than any cabled connection;

Health & Safety issues; max 1

[23]

**55.** (a) (i) Recipe table; **A** Figure 2; 1

(ii) *Why:* contains multiple values in Ingredients field/attribute/column

// data in Ingredients column not atomic // repeating groups; 1

(b) (i) *fully normalised:*

every attribute is dependent on the key, the whole key and nothing  
but the key;;

OR (tables contain no repeating groups of attributes,) no partial  
dependencies;

no non-key dependencies; A rely on instead of depend on

OR if (and only if) every determinant in the relation is  
a candidate key;; 2

(ii) *Why:* to aid consistency of data // to avoid potential data  
inconsistency problems

// to eliminate data inconsistency // to minimise data duplication

// to eliminate data redundancy; A reduce instead of eliminate

R saving space 1

(c) (i) Recipe (RecipeID, Dish, PrepTime, CookTime, NoOfServings,  
CookInstructions); 1

(ii) FoodItem (FoodItemID, FoodItemName, PackSize, Price); 1

(iii) RecipeIngredient(FoodItemID, RecipeID, Quantity) 4

*1 mark for each correct field, 1 mark for correct primary key*

*(take off 1 mark for every extra field included)*

(d) SELECT FoodItemName, Quantity, PackSize, Price 1

FROM FoodItem, RecipeIngredient, Recipe 1

WHERE (Recipe.RecipeId = RecipeIngredient.RecipeId) 1

AND (RecipeIngredient.FoodItemId = FoodItem.FoodItemId) 1

AND (Recipe.Dish = “Feta Salad”) 1

ORDER BY FoodItemName ASC 1 max 5

*field names* **F/T** **P1** *for fieldname.tablename* **P1** tbl prefix

**A** ORDER BY FoodItemName

**A** Dish instead of Recipe.Dish

**A** ‘feta salad’ instead of ‘Feta Salad’ A #feta salad# instead of ‘Feta Salad’

[17]

**56.** (a) *Network card*

• allow the PC to communicate/send and receive/transfer data with   
other devices on the network / uses a standard protocol;

• card holds the unique network address for that device / decides  
whether data sent along the cable has a destination of ‘this’ computer;

• card converts parallel data from the PC to a serial stream of data  
(for sending on the network) / or vice versa;

**R.** ‘connnect’ MAX 2

(b) *Benefits of having a network*

• provides for more effective data transfer / easier to transfer data;

• provides for the centralised storage / management of data files /   
folders / documents / programs / e.g. improved management of   
documents/contract changes;

• allows specialist applications to be used e.g. internal e-mail,   
diary scheduling applications;

• more flexible work practices;

• Internet access from any terminal;

• central control over the security of data / backup of data / usage;

• centralised management of software patches/upgrades;

• create an Intranet site;

• sharing files;

• sharing of peripherals /e.g. colour printer; MAX 3

**R.** Sharing programs // Better communication between users

[5]

**57.** (a) *Serial transmission*Bits are sent along a single wire/line // bits are sent one after the   
other / ‘bit by bit’; 1

(b) (i) 1; 1

(ii) (5 \* 768 \* 1024 / 1024) // 3840 Kbytes;  
**F/T** from (i); 1

(c) *Advantage:*The sound quality is higher/better; 1

*Disadvantage:*The files will be larger / files take up more disc space; 1  
**R.** anything which suggests ‘data transfer’

[5]

**58.** (a) (i) • poorly structured code;

• uses GoTo statements;

• the flow of control jumps out of a loop;

• nothing reported to the user when no matching name found;

• abbreviated variable for ‘position’ variable;

• ReadLn is better than Read;

• Program only iterates once / considers only the first array element;

• (if duplicates) only the first matching surname is found;

• (loop terminates at 20) does not allow for additional array   
/name entries;

**A.** poor layout - excessive indentation used; MAX 2  
**I.** variable declaration // reference to the syntax

(ii) *All statements must have*correct identifier name  
correct data type (String / Text // Integer / Byte / Word / Int /   
Shortint / Short as appropriate)

*In addition, either array must have*brackets to indicate an ‘array’  
19/20 to indicate a range; MAX 2

(b) *Intialisation of counter or Boolean variable* P := 1 / P := 0 / For P := 1 to 20 // IsFound := False;

*Looping* LOOP UNTIL // DO WHILE // WHILE DO // REPEAT UNTIL   
 and used at the beginning/end of a code block as appropriate;

*Some loop condition is met* (P = 20/21) OR IsFound = TRUE / P = 20/21 // IsFound = TRUE / IsFound;

*IF with use of the array* IF NoOfClaims [P];

*Selection condition* >4 / >=5;

*Loop counter incremented* P = P+1

*Final output* Correct logic followed with OUTPUT ‘Yes’  
 **A.** multiple times

*Final output* Correct logic followed with OUTPUT ‘No’  
 **R.** Multiple times

**R.** ‘Prose’ scores 0 5

[9]

**59.** *Any 2 reasons @ 1 mark each*  
to prevent unauthorised users understanding any intercepted data;  
to prevent the message being altered; to identify authentic users; 2

[2]

**60.** (a) So the resulting password will not be easy to guess 1  
/Harder to hack;   
**R** general security - TV

(b) 1 Convert each character to a numeric equivalent; **A** password

2 Perform some arithmetic on the number string;   
**A.** concat, algorithm, example of arithmetic,   
**R.** Process number, Translate

3 Reduce/Map arithmetic result onto two-byte integer range  
//example of mapping;  
*NB must be two bytes***R.** To give a byte no. 3

[4]

**61.** (a) 974; 1

(b) 151.25;;  
1 mark for integer part, 1 mark for fractional part 2

(c) –104.75;;  
If answer not correct award 1 mark for attempt at complementing   
the binary pattern 2

(d) (i) –13.125;;;  
Allow method marks  
 1 mark for 2 4 seen or correct 4 bit shift  
 1 mark for integer value correct including sign  
 1 mark for fractional part 3

(ii) To maximise precision in a given number of bits //   
To minimise rounding errors //   
To have just one representation of the number //   
To simplify arithmetic operations;   
**A** to maximise accuracy in a given number of bits 1

[9]

**62.** (a) (i) Empty entries waste space // Maximum/fixed/static size  
**A** stack may overflow 1

(ii) Space used by pointers // more complex to program; 1

(b) (i) The size of the stack /amount of data is known/limited/predictable   
Memory saved since no pointers (if not given in a (ii))  
**R** easier to program 1

(ii) The size of the stack is unknown//  
The stack is volatile/ number of items fluctuates widely; 1

[4]

**63.** (a) a procedure/routine that calls itself/ is defined in terms of itself;  
**A** Function instead of procedure   
**R** re-entrant **R** program **R** iteration 1

(b) (i)



6

(ii) In order; (tree) traversal 2

[9]

**64.** (a)



1 mark for all three classes in appropriate single enclosures   
1 mark for correct independent arrows in correct diections 2

(b) (Insert) a SetColour Procedure;   
**A** Function into the Public section;   
**R** make Colour Public 2

(c) Van = Class/ subclass (Vehicle)ie. Clearly identify Van as a (sub) class   
of vehicle 1

(Public)  
Procedure SetVehicleDetails (Override) condone if not included 1  
Function GetCapacity 1  
Function GetTailLift 1  
(penalise extra functions/procedures once)   
Private

Capacity : Integer/real/fixed/float 1  
 TailLift: Boolean 1  
(penalise once if not private and once if extra variables listed)

End

**A** Procedure SetCapacity and Procedure SetTailLift/  
Procedure AddNewVan instead of Procedure SetVehicleDetails

OR

Public class/subclass Van extends/inherits Vehicle 1  
{  
public void SetVehicleDetails 1  
public int GetCapacity 1  
public boolean/int GetTailLift 1  
private int Capacity 1  
private boolean/int TailLift 1

**A** public void SetCapacity and public void SetTailLift//  
public void AddNewVan instead of public void SetVehicleDetails   
**R** any diagrams   
**I** any parameters to methods 6

[10]

**65.** (a) CandidateNumber; 1

(b) table contains repeating groups; **R** repeated data/fields/attributes

|  |
| --- |
| There is redundant data **T.O.** |

ModuleCode, ExamSession, ModuleMark, Level, TotalMark, Grade  
contain multiple values; *mention at least one attribute by name  
(forename/ surname T.O.)* max 1

(c) *1 mark for correct primary key, 1 mark for correct other attributes*,  
***I*** *spaces/underscores in attribute names*

|  |
| --- |
| *Extra attributes = T.O.* |

(i) Pupil (PupilForenames, Pupil Surname, CandidateNumber);  
**A** (Forename,Surname,CandidateNo) 2

(ii) ModuleResult (CandidateNumber, ModuleCode, ExamSession, 2  
ModuleMark)

(iii) PupilGrade (CandidateNumber, Level, TotalMark, Grade) 2

(d) 2



(e) *Must use same attributes as in (c) above (mark as F. T.)* ***I*** *case*

|  |
| --- |
| If pupilForename.pupil penalise once |

SELECT PupilForenames,Pupil Surname, Grade *I pupil*. / *pupilgrade*. 1

FROM Pupil, PupilGrade 1

WHERE Pupil.CandidateNumber = PupilGrade.CandidateNumber

AND Level=“ A” *accept* Level=‘A’ *or* Level=A 1

ORDER BY TotalMark DESC; **A** Descending 1

OR SELECT PupilForenames,PupilSurname, Grade 1

FROM Pupil INNER JOIN PupilGrade ON Pupil.CandidateNumber =  
PupilGrade. CandidateNumber 2

WHERE Level = “A” *accept* Level = ‘A’ *or* Level=A 1

ORDER BY TotalMark DESC; **R** = Desc 1 5

[15]

**66.** (a) in a peer-to-peer network there are no dedicated servers;  
in a peer-to-peer network all computers are equal / have equal status;  
each computer functions as both a client and a server;  
user at each computer acts both as user and administrator;  
user at each computer controls what is shared with other computers;  
a user logged in at one peer computer is able to use resources on any   
other peer computer;  
**R** each computer directly connected to each other, so can send to  
each other without a server  
**R** all computers have same rights max 1

(b)



*1 mark for switch with 4 computers/PCs connected;*  2 *1 mark for printer connected to computer;*

(c) (i) Computer C is in a different subnet // network ID is different; 1  
**A** correct IP address

**A** there are two subnets **R** not on the same LAN

(ii) 192.168.5; **A** 192.168.5.0; 1

(iii) 0-255; more correctly: 1-254;  
**or any in the range** 192.168.5.1 - 192.168.5.254

|  |
| --- |
| **R** a specific  IP address |

(since 0 means all addresses on subnet, and 255 is reserved as  
broadcast address) 1

(d) (i) a router is a device that receives datagrams/packets from one  
computer and uses the IP addresses that they contain to pass on   
these packets, correctly formatted, to another computer;   
a router is a device that uses IP addresses to route packets/datagrams;

router keeps LAN traffic segregated from connection to ISP; 1

(ii) IP address: 222.125.105.15

Reason: router needs to have a presence on Internet so that it can be  
reached from anywhere;

Public address must be unique over whole Internet // must be visible   
on Internet // provides identity on Internet;  
**A** because 192.168.5.1 is a private/non-routable address; 2

(iii) 192.168.5.1 1

[10]

**67.** (a) converting/transforming from plain text into ciphertext/secret code;  
**A** scrambled; **A** transposition / conversion / coding

the sender processes the message prior to transmission so that if it is   
accidentally or deliberately intercepted while it is being transferred it   
will be incomprehensible to the intercepting party;

Data coded so that unauthorised users can’t read or access the data; max 1

(b) (i) B’s public key; 1

(ii) B’s private key; 1

(c) (i) a hashing function is applied to the text of the message;  
the result/message digest is encrypted;  
using B’s private key;

**A** the data generated is added to the end of the message;  
**A** message/date stamp is used to produce digital signature; max 3

(ii) A uses Certificate Authority’s public key;  
to verify B’s public key;  
digital signature is decrypted;  
using B’s public key;  
the hashing function is applied to the text of the message;  
the result of the hashing function is compared with the digital   
signature;  
if they are the same the message is authentic; max 4

[10]

**68.** (a) salesperson 7;  
April /month 4;  
The number of storecards ‘taken out’; max 2

(b) StoreCards + sensible subscripts [1..10, 1..6] / (1 to 10, 1 to 6) / [0..10, 0..6]   
/ (0 to 10, 0 to 6) / (10,6) / [10] 6];  
StoreCards + Integer / Byte; 2

(c) StoreCards (8, 1);  
= 13 / := 13 / ← 13;  
Must be an *assignment statement* 2

(d) key in / Input the employee number;  
the program calculates the total number of store cards for a single person  
// print/outputs/displays the total for a single person;  
over six months; max 2

(e) (i) single / real / float;  
**R.** Floating point / Double 1

(ii) Boolean /Yes-No / True-False; **R.** Y/N / T/F 1

(iii) integer/ byte; 1

[11]

**69.** (a) allows for the sharing of peripherals/hardware; **R**. ‘Resources’  
programmers can access their work from any terminal;  
better communications / internal e-mail/instant messaging;  
easier/quicker/instant sharing of a program library/ sharing   
program code/ data files;  
central storage of documents e.g. program specifications;  
changes to important documents are held centrally / document management;  
setting up of an Intranet (for document management);  
easier for the backup of data;  
**R.** anything about program updates max 2

(b) (i) Easier/quicker installation/maintenance of the application software   
/ easier backup (only if not in(a)); 1  
**R.** Saves space on the PCs / ‘Security’ / cheaper (licensing)

(ii) if server goes down software (may) still be available;  
software will load/accessed faster from secondary store;  
software can be personalised for individual user;  
helps to avoid degradation in network performance; 1 **R** anything about the software runs faster

(c) (i) *protocol*set of rules (about the way devices communicate); 1  
**A** standards **R.** Instructions

(ii) *handshaking* …  
sending signals between devices + implication of 2-way;  
confirmation of ready for sending / receiving data;  
acknowledge that a transfer is completed; max 2

(d) smk-solutions.co.uk; 1  
**R.** www.smk-solutions.co.uk

[8]

**70.** *Characteristics of real time OS*

(a) *1 mark per characteristic to max:*  
to support operations which are non-sequential in nature; 2  
to deal with a number of events which happen in parallel;  
to deal with events at unpredictable moments in time/ *concept of* monitoring & reacting;

(b) *examples of real time systems (must be appropriate to real time processing)*

1 *mark per reasonable example of each to max:* 2e.g.:  
Extremely fast, **to:** control a nuclear reactor;  
 control a fly-by-wire aeroplane;  
 control a life support machine / car navigation system (GPS) / Engine   
 ECU / autopilot

Not so fast, **to**: manage climate control in a(Kew Gardens) plant house /   
greenhouse;  
manage Traffic lights /   
**R** pseudo real-time systems such as on-line transaction processing, ATMs.

[4]

**71.** *e-mails*

encrypt the message: 1  
//keep password(s) for accessing account(s) / system private;  
//log off from the computer at the end of the session;

[1]

**72.** (a) *Resource management*  
memory management;  
resource allocation and scheduling;  
file / magnetic disc / secondary store /backing store management;  
peripheral device management;   
interrupt handling;  
 ***A*** *valid specific tasks* *one mark per task to max:* 3

(b) *Provision of a virtual machine*  
hide the complexities of the machine from the user; 1  
// provide an interface between the user and the computer;

(c) Network OS *in addition to a stand-alone computer*  
control access by multiple users;   
share network resources such as (shared files / applications / databases)   
manage more than one user using an application concurrently;  
manage printing from more than one computer on the network;  
manage security with more than one work station;  
redirect request to a remote resource (e.g. shared disk);  
establish / maintain communication between the work station and the   
server / between two workstations; **R** connections  
*1 mark per point to max* 3

[7]

**73.** (a) *Disadvantages of system*  
*Causes* Repetitive data entry;  
 Data items stored on more than one file / duplicated;  
 files cannot be shared;  
 No centralised, authoritative store of data;  
*Effects:* wastes time;  
 increases risk of errors;  
 wastes storage space;  
 can cause data inconsistency;  
 won’t know which data is correct if two different versions;  
 *1 mark per cause and 1 per resultant effect to max*  4  
 *Can give more than 1 effect per cause*

(b) *sharing files*  
Data files are structured differently / have different fields;  
for different applications;  
so may not be compatible;  
//Different files may have e.g. names and addresses;  
in different formats / field lengths; 2

(c) *Definitions*

(i) attribute – a property or characteristic of an entity; 1

(ii) primary key – an attribute that will identify a particular instance   
of an entity  
Aa field which identifies a record 1

(iii) foreign key – an attribute in one table that is (linked) to a primary   
key attribute in anther table;  
A a field in one table which is a primary key field in a (linked) table 1

(d) (i) CustomerID; 1

(ii) OrderNumber & OrderLineNumber 1  
**A**OrderNumber & PartNumber

(iii) PartNumber, OrderNumber 1

(iv)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Field* | *Surname* | *FirstName* | *DateOfOrder* | Description | Quantity |
| *Table* | Customer | Customer | Order | Stock | OrderLine |
| *Show* |  |  |  |  |  |
| *Criteria* | [(Enter) Surname] | [(Enter) First Name] | [(Enter) Date of Order] |  |  |
| *//Criteria* | Smith | Jeremiah | =23/04/06 |  |  |

*Mark as follows: nb Either Enter or [ ]*2nd column Customer + [Enter Surname] / Smith 13rd Column Customer + [Enter First Name] /Jeremiah 14th Column Order + [Enter Date of Order] or =23/04/06 1 //Order + = #23/04/06#  
 **A**date in other similar formats, Order + 23/04/06  
5th Column Description + Stock 1 // PartNumber + OrderLine   
6th Column Quantity + OrderLine 1  
‘Show’ (tick, ‘Yes’, ‘true’) for Description (PartNumber) + Quantity 1 **A**Show in all columns  
**I** anything else in ‘show’ cells  
*(5th & 6th columns can be interchanged)*

[18]

**74.** (a) Server provides a resource/the Internet/a database/file/application/  
CD ROM/printer;  
Within a network;  
Client computer requests the service;   
and waits for the response;  
**I** any reference to the user Max 3 3

(b) (i) Software request causes an event;  
**A** external change causes an event  
The event causes a program/ procedure/ function to execute;  
**I** References to user 2

(ii) Mouse Click// mouse movement// key pressed// record read/  
written//any external/internal device requires attention; 1

[6]

**75.** (a) Part of the hard disk is allocated to be used as virtual memory;  
Contents are copied into main memory as required;  
Partially loaded programs may be executed;  
Virtual address space can exceed physical address space; Max 3 3

(b) Main Memory is divided into fixed sized pages/frames;  
Program subdivided into same sized pages;  
Pages are swapped/loaded as needed;  
Page table keeps track of pages;  
**A** Paging is a method of implementing virtual memory;  
Do not give same point in (a) and (b) Max 2 2

(c) The memory that is unallocated/ available/free;  
Is used by the operating system to allocate memory to   
processes/running programs;  
Is used when a process/running program requires memory   
dynamically; Max 2 2

[7]

**76.** (a) (i) 271; 1

(ii) The required item might be the 271st one/last one/ not be present//  
Every item accessed; 1

(b) (i) 9; 1

(ii) Each comparison halves the number of items to be accessed//  
271 lies between 28 and 29; 1

(c)



1 mark for Count1  
1 mark for Count2   
1 mark for Temp 5

(ii) (bubble) sort the items into ascending order; 1

(iii) Reduce the number of tests each pass// stop when no swaps   
occur during a pass//Add a flag NoSwaps to indicate when   
no swaps occur// change loop control to Repeat until no   
swaps// sort variable sized array; 1

[11]

**77.** (a) (i) A HardwareItem   
B EquipmentLoan 2  
C ‘is out on’ ; *accept any wording with similar meaning*

**R** one to many relationship

(ii) Entity-Relationship Diagram; **A** E-R diagram; 1  
**A** E-R D **R** E-A-R diagram

(b) CREATE TABLE HardwareItem

|  |  |  |
| --- | --- | --- |
| (Description VARCHAR (30) | |  |
| Make VARCHAR(15) | 1 mark **A** text/string instead of char/varchar | |
| Model VARCHAR(15) | |  |

(Inventory)RefNo CHAR(20) PRIMARY KEY, 1

|  |
| --- |
| **A** string/text/character/VARCHAR(20) instead of CHAR(20) |

PurchaseDate DATE,

|  |
| --- |
| **A** DateOfPurchase DATE **A** Date/Time instead of Date |

PurchasePrice CURRENCY, 1

Location VARCHAR(4))

|  |
| --- |
| **A** DECIMAL/MONEY/Number/Real/Float/Single instead of CURRENCY |
| **A** Room VARCHAR(4) **A** INT/number instead of VARCHAR |

Alternative for InventoryRefNo:

|  |
| --- |
| **A** VARCHAR(20) instead of CHAR(20) |

(Inventory)RefNo CHAR(20), PRIMARY KEY(InventoryRefNo),  
(Inventory)RefNo CHAR(20), NOT NULL,, PRIMARY KEY(InventoryRefNo),

*Note: string lengths do not have to be exact/present except for InventoryRefNo*

CREATE TABLE EquipmentLoan

(Inventory)RefNo VARCHAR(20),

|  |
| --- |
| **A** NOT NULL |

|  |
| --- |
| *If not DDL but composite key identified, give 1 mark* |

Location VARCHAR(4),  
(Staff)Initials VARCHAR(3), 1  
DateRemoved DATE,

|  |
| --- |
| **A** NOT NULL |

DateReturned DATE,  
PRIMARY KEY (InventoryRefNo, DateRemoved), 1  
FOREIGN KEY (InventoryRefNo) REFERENCES HardwareItem  
(InventoryRefNo)) 1 6

|  |
| --- |
| **P1** for extra attributes |

(c) SELECT (HardwareItem.)Description, (EquipmentLoan.)DateRemoved, 1  
EquipmentLoan. (Inventory)RefNo, 1

|  |
| --- |
| **A** HardwareItem.InventroryRefNo |

FROM HardwareItem, EquipmentLoan 1  
WHERE HardwareItem. (Inventory)RefNo = EquipmentLoan.  
(Inventory)RefNo 1  
AND (EquipmentLoan.)DateRemoved > givenDate 1

|  |
| --- |
| **A** > =  **A** = > |

ORDER BY (EquipmentLoan.) (Inventory)RefNo; 1

**or**SELECT (HardwareItem.)Description, (EquipmentLoan.)DateRemoved, 1  
EquipmentLoan. (Inventory)RefNo 1

|  |
| --- |
| **A** HardwareItem.InventroryRefNo |

FROM HardwareItem   
INNER JOIN EquipmentLoan 1

|  |
| --- |
| Note: can swap tables |

ON HardwareItem. (Inventory)RefNo = EquipmentLoan. (Inventory)RefNo 1  
WHERE (EquipmentLoan.)DateRemoved > givenDate

|  |
| --- |
| **A** > =  **A** = > |

ORDER BY (EquipmentLoan. )(Inventory)RefNo; 6

|  |
| --- |
| **A** HardwareItem.InventroryRefNo |

[15]

**F/T** with attribute names  
**P1** for tbl prefix  
**P1** if table name after attribute name  
**I** extra punctuation

**78.** (a) LAN; because the buildings are on one site 2

(b) (i) pupils benefit: can access their work/resources on any computer;   
can print on any printer;   
can access information from any computer;  
can use VLE/intranets/shared folder;  
can submit work over network; 1

|  |
| --- |
| Some answers can occur in more than one section but can only be awarded once  Ignore references to Internet |

(ii) teacher:   
 can access pupil database/information from any computer;  
 can register pupils from any computer;  
 internal e-mail/communication between staff or between staff   
 & pupils;  
 monitoring useage of network; 1

(iii) head of year / personal tutor: can access pupil attendance data directly;  
 can access pupil database from any computer;  
 internal e-mail/communication between staff or between   
 staff & pupils; 1

(iv) head / principal: can get stats of attendance (more easily);  
 can get stats of pupils (on courses) (more easily);  
 internal e-mail/communication between staff; 1

(c) 1 mark for PC/workstations linked to hub;  
1 mark for 15 PCs connected to hub(s);

|  |
| --- |
| If hubs incorrectly labelled but topology ok, give 1 mark |

1 mark for hub to hub links (if all PCs connected to 1 hub give 1 mark for this); 3



*components must be labelled. Accept PC/Computer as equivalent label  
no arrows needed for physical diagram  
allow connection between hubs via backbone  
Accept hubs connected via another hub****R*** *link via server  
Ignore a server connected to bus or hub*

(d) (i) hub: collision domain involves all computers connected to hub;   
switch: collision domain limited to 2 computers;  
hub broadcasts packet to all computers; switch only sends packet   
to receiver; 2

(ii) no collisions possible with a switch // collisions reduced; 1

(e) to prevent unauthorised access to a private network  
// to safeguard the school’s network against hackers  
to prevent unwanted intrusion from outside internal network;  
to block internal access to specific external sites;  
block certain ranges of IP addresses;  
close ports; max 2

**R** references to viruses

[14]

**79.** (a) bus;  
**R** line 1

(b) star; 1

(c) (i) (*Advantage:*) (*Reason:*)  
lower cost// reduced cabling//  
more flexible; easy to add/remove stations;

**A** advantage and reason swapped round  
**A** cheaper  
**R** Easier to set up 2

(ii) (*Advantage:*) (*Reason:*)

if one cable/wire fails it affects as each computer is directly  
only one computer// connected to central computer//  
simple to isolate faults// as messages are sent directly  
different computers can transmit at different to central computer;  
speeds// system more secure// **A** each computer has its  
 own line;  
network does not degrade when  
highly loaded;

**R** collision free *unless explained*  
**R** easy to add / remove computers  
**R** reliability **R** faster  
**R** computer/node failure

**A** advantage and reason swapped round

*Reason mark not dependent on gaining advantage mark* 2

[6]

**80.** (a) x  5  
y  3  
Result  1  
REPEAT  
 Result  Result \* x  
 y  y – 1

UNTIL y=0

|  |  |  |
| --- | --- | --- |
| **x** | **y** | **Result** |
| 5 | 3 | 1 |
| **5** | **2** | **5** |
| **5** | **1** | **25** |
| **5** | **0** | **125** |

1 mark for each entry in column Y (max 3)

1 mark for each entry in column Result (max 3)

1 mark for not changing value of x (max 1) 7

(b) calculate 53 // calculate 5×5×5 // calculate x3 // calculate xy //  
multiply x by itself y times; 1

[8]

**81.** (a) Cables are cheaper // uses fewer wires;  
Data does not get skewed // out of line/sync;  
Simpler/cheaper/easier to boost signals;

**R** Cheaper on its own (n.e) 2

(b) (i) baud is the number of signal / pulses / voltage changes per second;  
**A** rate at which signals / pulses are sent;  
**A** rate at which voltage changes; 1

(ii) number of bits per second / bits per unit of time;  
bit rate = baud rate \* number of bits per signal change;  
**R** rate at which bits are sent 1

(iii) range of frequencies that can be transmitted; 1

(c) greater bandwidth allows greater bit rate; 1

[6]

**82.** (a) To support programs / processes which are non-sequential in nature;  
To deal with a number of events which happen in parallel;  
To deal with events at unpredictable moments in time;  
To carry out processing and produce a response within a specified  
interval of time;  
To produce output fast enough to effect next input; 3

1 mark per requirement to max 3

(b) Process control system  
Booking system;  
Expert system;  
**A** specific example of a type of system 1

1 type of real time computing systems

[4]

**83.** (i) allow addresses in the Pointer column. 3



(ii) array; of records; *OR* linked list; of records; *OR* 4 1-D arrays;  
one for each column; *OR* one 1-D array for process name;  
one 2-D arrays for numerical data; 2

(iii) *Marks to be allocated as follows*: 4

*1 for initialisation* ListPointer  HeadPointer;  
*1 for while not at end of list* While ListPointer <>-1 Do;  
*1 for printing* Print ListArray[ListPointer].Name;  
*1 for getting next pointer* ListPointer  ListArray[ListPointer].Pointer; *P1 if headpointer is reassigned*

Any name acceptable for ListPointer and ListArray

Note: a sorting method gets a maximum of 3 marks (inefficient)

*Alternative solution*REPEAT UNTIL next=-1 OR IF listpointer <>-1 then REPEAT..

(iv) 2

|  |  |
| --- | --- |
| *List* | *Reason* |
| List of suspended/blocked/halted/ unrunnable processes; | waiting for a resource or complete a requested I/O transfer; |
| List of inactive/dormant jobs; | Waiting to be admitted to the system; |

**I** currently running processes **I** interrupt

[11]

**84.** (a) produces re-useable code because of inheritance/encapsulation;  
Produces re-useable objects;  
data is protected // only accessible in well-defined ways (because of  
encapsulation);  
more efficient to write programs which use pre-defined / inherited  
objects / classes;

storage structure of data and method code of a class may be altered without  
affecting programs that make use of the class;

code produced contains fewer errors / more reliable;

solutions are easier to understand (when expressed in terms of objects);

easier to enforce design consistency; easier to debug;

less maintenance effort required by developer since objects can be re-used;

new functions can be added to objects easily (because of inheritance);

**R** Easier to program 2

**I** references to GUIs

(b) *1 mark for correct base class and derived classes incl. containers;*

*1 mark for 2 correctly directed arrows;* 2

|  |
| --- |
| **R** E-R diagrams **I** methods listed in containers |

(c) Member = Class  
(Public)

(procedure) AddNewMember(s); }  
(procedure) AmendMember(s) } ; *no mark if methods are private*(Procedure) ShowMember(s); }

|  |
| --- |
| **A** proc instead of procedure **R** function instead of procedure |

Private ; *1 mark for all data fields marked as private*

MembershipNo : Integer } **A** string/text *as data type* **R** number  
FirstName: string/text };  
Surname: String/text }

|  |
| --- |
| **A** ID  **A** FName  **A** SName  **A** Tel |

TelephoneNumber: string/text : **R** *number/integer as data type* 4

End (Class)

Public may come after Private. Each line may be preceded by Public or Private & in no particular order **R** diagrammatic answer **I** case **I** white space

[8]

**85.** (a) BE4; 1

must be capital letters

(b) 190.25 / 190 ¼ ;; 3

one mark for correct integer part,  
one mark for correct fractional part  
one mark for correct working  
(e.g. correct place values)

(c) –1052;; 2

1 mark for workings if result incorrect  
1 mark for sign, 1 mark for 1052

(d) (i) -8.25 / -8¼;;; 3

partial marks for workings if result incorrect

1 mark for sign, 1 mark for moving binary point 4 places or showing 24

(ii) starts with 1 0  
the first 2 binary digits are different;  
a significant bit is stored after the (implied) binary point;  
bit after (implied) binary point different from bit before binary point; 1

**A** all leading 1’s have been removed // there are no leading 1’s;  
**R** there are no leading zeros

[10]

**86.** (a) One channel system // single signal sent thro’ bandwidth //  
single stream of data;  
Whole bandwidth dedicated to one data channel;  
**R** Single signal sent at a time on its own  
**R** Uses single frequency 1

(b) Multi-channel system // several signals sent simultaneously //  
several signals sent using different frequencies;  
Several channels combined onto a carrier signal;  
Bandwidth shared by several data channels;  
**A** Multiple signals sent at a time on its own 1

(c) Transmitter and receiver keep in step at all times  
(by transmitter transmitting synchronising signals periodically). 1

[3]

**87.** (a) WAN 1

(b) Software cannot be copied;  
Customer does not have to keep track of/worry about illegal copies of  
product on its computers;  
The elimination of staff and systems to distribute products;  
Help-desk support is simplified when all customers are using the same  
centrally managed, shared software;  
Smaller software development team because different flavours of a product  
do not have to be developed for customers with different machines, OSs;  
Cheaper implementation of improvements, as new software versions only  
have to be placed on central server;  
Faster implementation of improvements, as new software versions only  
have to be placed on central server //Updates available immediately//Instant  
delivery – no postal delay;  
The elimination of customisation, which means that system integration  
becomes simpler;

**A** more efficient feedback loop for getting users’ views of suggested enhancements;

Reduces customers’ hardware costs;  
Reduces customers’ storage/hard disk space requirements;  
Reduces customers’ maintenance support (handling updates//  
configuring software) requirements;  
Access from any computer connected to Internet/network; 3

**A** Software cheaper because ....  
**R** Don’t have to pay for updates;

[4]

**88.** (a) **I** Minor spelling

(i)  1

(ii)  1

(iii)  1

(b) Penalise table name. field name in reverse order once

**R** Quotes and additional constructs  
**I** Table names unless in wrong order or wrongly expressed

(i) Select FirstName, Surname  
 From Student; 1

(ii) Select Student.FirstName, Student.Surname,  
 MarkAwarded.Mark;

**I** table names unless incorrect

From Student, MarkAwarded;  
Where MarkAwarded.LifeCyclePhaseID = 1;  
 And Student.StudentID = MarkAwarded.StudentID ;

**I** table names unless incorrect

Order By Student.Surname; 5

**I** table names unless incorrect

Order By Student Surname Asc  
**A** Ascending  
Asc/Asending must be in correct position  
**A** OrderBy

[9]

**89.** (a) **A** set of rules/procedures; 1

(b) Bus; **R** Ethernet on its own 1

(c) Twisted pair//coaxial (cable)//optical fibre//fibre optic; 1

(d) Need first octet or first and second octet or first, second and third octet  
to be identical. Also must have four octets.  
For example:

**R** without full stops

192.168.0.1  
192.168.0.2  
One mark for four octets;  
One mark for same LAN; 2

(e) (Use candidate’s example from (d))

(i) 192.168.0; 1

(ii) 1 or 2; 1

(f) a (unique) address/identifier assigned to network card // (unique) hardware  
address/identifier; 1

(g) Any two tasks @ one each  
Allocation of port numbers;  
Routing a packet/frame/segment to correct application/service;  
Splitting messages/data into packets // Disassembling messages //  
Assembling packets;  
Adding TCP headers // Adding sequence nos;  
Error handling // sets parity bits;  
Checking that transmission successful;  
Resending transmission if necessary;  
**A** Sets packet size; 2

(h) Any one of the following applications for one mark;  
Telnet;  
Internet browser;  
http (client) // web server;  
email;  
FTP;  
TFTP;  
SMTP;  
**R** Non-networked applications such as word processor 1

(i) Internet Registry // Internet Registrar;  
**A** I.P. Registry/Registrar 1

[12]

**90.** (a) (i) Name: Start Bit;  
Purpose: Synchronise receiver; 2

(ii) Name: Parity Bit;  
Purpose: Perform parity check// check for errors in transmission;  
**A** Prevent errors 2

(iii) Name: Stop Bit;  
Purpose: Allow start bit to be recognised//  
Allow receiver to process received bits;  
**A** Indicates end of data 2

(b) (i) the number of signal/voltage changes per second;  
**A** rate at which signals are sent;  
**A** rate at which voltage changes; 1

(ii) number of bits per second / unit of time;  
**R** the rate at which bits are sent *(question paraphrased)* 1

(iii) Range of frequencies a channel can handle;  
**A** maximum line speed; **A** maximum transmission speed; 1

(c) A signal can contain one or more bits;  
Bit rate can be higher than baud rate;  
bit rate = baud rate \* number of bits per signal change;; 2

[11]

**91.** (a) (i) First In First Out; or by description

(ii) Last In First Out; or by description 2

(b)

|  |  |  |
| --- | --- | --- |
|  | FIFO | LIFO |
| Queue |  |  |
| Stack |  |  |

2

(c) Reverse the contents of a queue/list;  
Push all contents of queue/list onto stack then pop them off into a new  
queue/list;  
Procedure/function calls;  
Local variables;  
Parameters;  
Return Address;  
Volatile environment; **A** register contents  
State 1 Describe 1 2

(d) list of elements inserted into tree;  
to allow rapid/fast searching of the data;  
to output sorted/ordered data; 2

[8]

**92.** (a) (i) world-wide collection of networks/computers using TCP/IP;  
world wide collection of networks/ gateways/ servers/ computers  
using a common set of telecommunications protocols to link them  
together;  
world-wide collection of networks/ computers using the same protocol;  
world-wide collection of networks/computers using a standard protocol; 1

(ii) collection of servers using Hypertext Transfer Protocol/HTTP//  
collection of data files/ documents using Hypertext Mark-up  
Language/ HTML/ XHTML/ XML; 1

(iii) computers connected within a small geographical area/building/site;  
**A** computers connected using local area network/LAN protocols; 1

(iv) computers connected over a large geographical area;  
**A** computers connected using wide area network/WAN protocols; 1

(v) Network providing Internet facilities within an organisation/  
LAN using Internet protocol; 1

(b) (i) any valid domain name, e.g. aqa.ac.uk; **R** www.aqa.ac.uk 1

(ii) any valid address in the range 0.0.0.0 to 255.255.255.255; 1

[7]

**93.** (a) 1 mark for each correct entry 6

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Values | | | | |
| New | Last | Ptr | [1] | [2] | [3] | [4] | [5] |
|  |  |  |  | **max** | **6** |  |  |
| 6 | 3 | 1 | 4 | 7 | 9 |  |  |
|  |  |  |  | **max** | **1** |  |  |
|  |  | 2 |  |  |  |  |  |
|  | 2 |  |  |  |  | 9 |  |
|  | 1 |  |  |  | 7 |  |  |
|  |  |  |  | 6 |  |  |  |

(b) Insert 6/a value into the array/ in the correct position; 1

[7]

**94.** (a) (i) Collection of tables / Linked tables; 1

(ii) Relationships are modelled by shared (common) attributes;  
*BoD field*//primary key & foreign key; 1

(b) (i) Not necessarily unique; 1

(ii) TownName 1

(iii) To speed up searching 1

(iv) They slow down data entry / editing; **A** system 1  
because indices have to be updated each time a record is  
added / deleted; 1

**A** Indices take up more space;

(c) (i) *Suitable input method* 1  
Mousepad / trackpad built into a desk;  
/ Touch sensitive screen;  
**R** keyboard, mouse, anything not fixed.

(ii) *Software Feature:* 1  
Drop down menus /Index;  
Zoom feature / Thumbnails which expand on click  
Hotspots/Hyperlink /Navigation Bar / Tabbed pages /Forward  
and back icons;  
Ability to enter details to narrow down search;  
**R** Scroll bar

(iii) *1 mark for each of 2 requirements: (Must be in context)* 2  
Access to help screen;  
Ability to zoom in / large text for partially sighted / choice of text size;  
Ability to have instructions in other languages;  
Careful choice of colours;  
Ease of navigation;  
Other points if justified (not *clear* *instructions*);

[11]

**95.** Compare Pascal with middle item of list / Lisp;  
Compare Pascal with middle item of upper sublist / Prolog;  
Compare Pascal with Pascal // compare only item in this sublist to get a match; 3

*Lose 1 mark if Pascal not explicit in comparison*

***stop marking from time it goes wrong***

OR

List[4] = Pascal? False; **A** [4] = Pascal **R** 4 = Pascal

List[6] = Pascal? False;

List[5] = Pascal? True; 3

if formula explicit, follow through on formula

[3]

**96.** (a) 140 ¼ ;; *one mark for correct integer part,*

140.25;; *one mark for correct fractional part* 2

(b) (i) -14.5;;; *give 2 marks for 14.5* 3

*partial marks for workings if result incorrect:*

1 mark for negative number;  
1 mark for x24 (accept 16 instead of 24);  
**A** showing that binary point moves 4 places right;

(ii) leftmost 2 digits/bits are different;  
a significant bit is stored after the binary point;  
bit after point different from bit before point;  
(negative number) starts with 10…  
(positive number starts with 01)….; max 1

**A** the first but after the sign bit is a ‘0’;  
**A** The second bit is a ‘0’;  
**A** an answer that clearly implies a ‘0’ follows the ‘1’

(iii) to maximise accuracy/precision for a given number of bits  
// to minimise rounding errors;  
**A** more accurate/precise for a given number of bits;  
a given number can only be expressed in one way in a given  
number of bits  
// a given number can only be expressed in one way in a given format;  
to simplify arithmetic/logical operations; 1 **I** range

[7]

**97.** (a) a class has properties/fields/attributes/characteristics and  
methods/procedures/functions of the parent class it is derived from  
// a subclass/derived class inherits all the properties/fields/attributes/  
characteristics and methods/procedures/functions from a  
super-class/base-class/parent class; 1

(b) StockItem (=) Class **//** Class (=) StockItem;

1 mark for keywords Class and StockItem

(**A** Object instead of Class)



Book = Class (StockItem) // Class Book extends/derives from StockItem

// Book Subclass: StockItem;

**A** without keyword Class



End



*No marks for a diagrammatic answer*. **I** *method parameters* max 7

Java version:

Public Class StockItem

{

Private String title;

Private boolean onLoan;

Private String dateAquired;

Public void displayDetails ();

Public void setLoan ();

}

Public Class Book extends StockItem

{

Private string author;

Private string isbn;

Public void displayDetails ();

}

Public Class CD extends StockItem

{

Private string artist;

Private integer playingTime;

Public void displayDetails();

}

[8]

**98.** (a) it calls itself / is defined in terms of itself / contains within its body a  
reference to itself; 1

Ensure ‘it’ refers to procedure, if meaning program or object no mark

(b) the current state of the machine is saved/preserved;  
 so can return correctly (to previous invocation/call of **Process)**;

*or*

return address / procedure parameter / status register / other register  
values / local variables must be saved/preserved;  
so can return correctly to “*correctly’ can be implied*(previous invocation of Process); 2

(c) Printed Output:

1; 3; 5, Bird; Bremner; 4, Fortune, Jones; 2, Smith; 6

mark from left and stop marking when error encountered

ignore punctuation.

(d) (in-order) traversal of a tree; **A** printing of tree (elements in order) 1

**I** wrong order

[10]

**99.** *accept Immediate Access Store or IAS as an alternative to main memory*

(i) hard disk / secondary memory;  
**R** backing store **R** hard drive 1

(ii) (used when execution of a program/process)  
not enough main memory / RAM / physical memory;  
to run process(es) // load program(s) // allocate data area; **A** store  
**R** computer fooled into thinking more main memory max 2

(iii) physical/main memory/RAM is conceptually divided into a number of  
(fixed size) page frames; **A** pages/segments;

(virtual address space of) program/process is divided into a number  
of (fixed size) pages;

page table indicates which pages of process are loaded (and where);

**A** page table keeps track of pages

pages are swapped between disk/secondary memory and main  
memory as required //

pages are swapped into, and out of, main memory as required; max 2

No marks for a point which references just data when  
it should reference a program

backing store is not acceptable as a substitute for disk

[5]

**100.** (a) External/User/Local (schema);  
Conceptual/Logical/The schema;  
R. Internal/Storage (schema)  
R. System Schema 2

(b) Any one @ one mark each  
 Create Table;  
 Create View;  
 Create Index  
 Create Unique Index;  
 Create Domain;  
 Create Database;  
 Create Trigger;  
 Alter Table; max 1

(c) (i) Collection of tables/relations (A. anything that suggests multiple tables);  
R. Entities  
R. Files 1

(ii) Collection of Objects;  
A. Collection of properties/attributes/fields + methods;  
A. Collection of instances of a class/classes  
R. Collection of classes 1

[5]

**101.** (a) Contains a repeating group;  
Or  
Cells for one or more of SubjectID, SubjectName,  
ExamBoardSubjectOfficerName,  
NumberOfCandidatesEntered contain multiple values;  
R. Repeating attributes, etc 1

(b) Attribute names must not be redefined (exception: allow Center).  
One mark for attributes(lose this mark if extra attributes), one mark for  
correct primary key



Penalise misspelling once

(c) (i)



(ii)



(d) I. Inner join, Join  
A. Without commas  
R. Brackets in Select and anywhere else except:  
A. Brackets around (DateReported < 1/3/2005) and (ExaminationOfficer.CentreNo=Problem.CentreNo) as shown  
Asc is optional but if present it must be at end of **Order By** line  
(A. Ascending) Max 5

Penalise brackets once



(e) R. Brand names  
word processor//word processor with e-mail support; 1

[15]

**102.** (a) (i) Wide area network is a set of links that connect together geographically  
remote computers;  
R. Definition that doesn’t reference “connects computers.....and geographically remote” 1

A. Hosts/Nodes/Devices for computers

A. far apart/Large distance/large geographical area

R. > some measurement, e.g. 2km

(ii) Networking based on virtual circuits established across a wide area  
packet switched network;  
Networking which specifies the nodes or pathway through a  
packet-switched network before transmission begins so that no  
routing decisions need to be taken for each packet at each node  
during transmission;

A. Network that guarantees packets will arrive in the order that  
 they are sent;

R. Network that uses cells

R. Quality of Service max 1

(iii) The data-carrying capacity of the medium is divided into (fixed size)  
time-slots, with a time-slot assigned to each data stream;

A. Clearly labelled diagram max 1

(b) One mark for central hub and one mark for computers connected to hub  
as shown

NB If hub incorrect answer scores zero  
If hub correct but computers incorrect answer scores one mark  
Router can be replaced by a computer labelled with router’s 2  
IP address



Don’t have to label computers with their IP addresses.  
A. IP addresses in place of computers + router

Don’t have to label server if drawn as shown

(c) So that these are reachable from anywhere on the Internet//so that can be  
seen/reached from the world outside;

A. So that they can be uniquely identified.  
R. So can be reached by another branch of company 1

(d) Document(Web page) split into smaller chunks;  
A. segments/packets/frames  
Destination IP address doesn’t match this  
segment’s IP address so document chunks sent to nearest router/default  
router/gateway;  
Using nearest router’s network card address/MAC address;  
Router sends chunks to router connected to web server segment using  
its routing tables;  
And using network card address of router connected to web server;  
This router sends chunks to Web Server;  
Web server rebuilds document;  
End to end connection established//port/socket connections made; max 5

(e) To block access to/from the internal private network from/to the  
Internet/world outside;  
To stop/limit/block/restrict certain kinds of access to the Web server,  
e.g. telnet;  
To close ports to prevent users from connecting to them;  
To block connections on unwanted ports;  
To prevent unauthorised access to the private computers;

A. Filtering  
R To stop hackers (must state more than this = one of the above answers) max 1

(f) A network in which resource security/user authentication/  
administration/resource allocation;  
managed/controlled by/carried out by servers;  
OR  
A network in which servers provide specialist services  
(A. specific servers e.g. web servers) ;  
for client computers;  
OR  
Shared information stored on servers;  
rather than individual PCs/client computers; 2

(g) A database server is software/computer that processes SQL  
requests from client computers returning results to the clients across  
a network or using network protocols (the data resides on the same  
machine as the database server);  
Client requests data from server, server responds with data  
(require request, data and response); max 1

Database server listens on a particular port for client requests.  
TCP/IP protocol used.

[15]

**103.** (a) data bus; carries data to/from processor / memory / devices /  
 components;

address bus; carries addresses / identifies locations;

control bus; carries control signals / controls devices;

**A** by example  
maximum 1 mark for carries Data / carries addresses / carries control signals 6

(b) network adapter / network card;  
**A** named example e.g ethernet card  
generate / understand signals / data (that conform to the LAN protocol) /  
Allows (successful) communication / Provides a unique network address;  
**R** connect 2

(c) Faster transmission; 1

(d) Data transmitted longer distance than is possible with parallel /  
less expensive to cable;  
**R** cheaper 1

[10]

**104.** (a)  


1 for connections; 1 for directions; 2

(b)  


1 for connections; 1 for directions; 2

[4]

**105.** (a) world-wide collection of networks/ computers using the same protocol;  
world-wide collection of networks / computers using a standard protocol;  
world-wide collection of networks / computers using TCP/IP;  
world wide collection of networks / gateways / servers / computers using  
a common set of telecommunications protocols to link them together;  
max 1 1

(b) Name used to reference Internet connected computer /  
User friendly reference that maps to an IP address;  
**R** Web site name / address  
**R** example 1

(c) Network providing Internet facilities within an organisation /  
LAN using Internet protocol; 1

(d) Protocol used + address of resource (in two parts: the server and  
then the path to the resource on this server) / Uniform Resource Locator;  
**R** example 1

(e) Numerical address / Stored in 4 bytes / Range 0.0.0.0 to 255.255.255.255/  
Used to identify an individual computer / Internet Protocol address;  
**R** example 1

[5]

**106.** (a) Last In First Out; 1

(b) (i)  1

(ii)  1

(iii)  1

(iv)  1

(c) To reverse elements/ pass parameters/ store volatile environment;  
**A** store return address 1

[6]

**107.** ISBN; 1  
unique identifier; 1  
**R** unique to books 2

[2]

**108.** (a) Unauthorised access to } computer programs or data;  
Unauthorised modification of } computer material;  
Unauthorised access with criminal intent; 2

1 mark for each to max  
Wording must be close

(b) Guidelines / policy on choosing passwords which are not easily guessed;  
Keeping a log of all movements on confidential files;  
System should disable keyboard after 3 wrong passwords have been entered;  
Additional passwords should be required to access / alter important files;  
Encrypt sensitive files;  
CCTV used as a deterrent;  
Swipe / smart card for access;  
Biometric logon (**A** once);  
Some software only available on certain computers; 3

1 mark for each to max

[5]

**109.** (a) (i) An attribute/field which uniquely identifies a record; 1

(ii) LecturerID; 1

(b) (i) A attribute/field in one table which is the primary key in another table; 1

(ii) LecturerID; 1

[4]

**110.** (a) B76; **R** lower case B 1

(b) 1833/8 ;;  
183.375;; 2

one mark for correct integer part,

one mark for correct fractional part

(c) (i) -36.5;;; 3  
*partial marks for workings if result incorrect:  
1 mark for x26; accept showing that binary point moves 6 places right;  
1 mark for negative number;*

(ii) a significant bit is stored after the binary point;  
bit after point different to bit before point;  
negative number starts with 10… positive number starts with 01….;  
to max 1

(iii) to maximise accuracy / number stored with maximum precision;  
**A** more accurate;  
a given number can only be expressed in one way in a  
given number of bits; 1

[8]

**111.** (a) it calls itself / is defined in terms of itself / is re-entrant   
/ contains within its body a reference to itself; 1

Ensure ‘it’ refers to procedure, if meaning program or object no mark

(b) the current state of the machine must be saved/preserved   
so can return correctly to previous invocation of B;

*or*

return address / procedure parameter / status register / other register values /   
local variables must be saved/preserved so can return correctly to   
previous invocation of B**)**; 1

(c)

|  |  |  |
| --- | --- | --- |
| Call Number | Parameter |  |
| 1 | 53 |  |
| 2 | 26 |  |
| 3 | 13 |  |
| 4 | **6** | **;** |
| 5 | **3** | **;** |
| 6 | **1** | **;** |

Printed Output: 1 1 0 1 0 1;;; 6

one mark for each correct pair of bits  
mark from left and stop marking when error encountered  
ignore punctuation. if more than 6 bits give a max of 2 marks

(d) conversion (of a denary number) into binary; 1

[9]

**112.** Compare Newcastle with (middle item of list), Manchester;  
Compare Newcastle with (middle item of upper sublist), Sheffield;  
Compare Newcastle with Newcastle // compare only item (in lower sublist  
of this upper sublist) to get a match;

Lose 1 mark if Newcastle not explicit in comparison  
stop marking from time it goes wrong

*or*

List[4] = Newcastle? False; **A** [4] = Newcastle **R** 4 = Newcastle  
List[6] = Newcastle? False;  
List[5] = Newcastle? True;

if formula explicit, follow through on formula

[3]

**113.** (a) (i) sequence of execution of instructions determined by programmer;  
**R** user *instead of* programmer **R** a specific order  
Example: Pascal/Fortran/Basic/ C/C++/Cobol/Algol; **R** Visual… 2

(ii) program is a set of facts and rules   
// programmer declares what has to be done but not how to do it;  
Example: Prolog/LISP/SQL; 2

(iii) execution of code dependent on an event such as user clicking mouse;  
Example: Visual Basic / Delphi / C#/ Java /Smalltalk/ Visual C++;   
Visual ….; **R** VB 2

(b) (i) joining together of code/procedures/methods  
and data/properties/characteristics/record/attributes into objects;to max 1

(ii) Member (=) Class **//** Class (=) Member 4

1 mark for keyword Class; 1 mark for Member;

(**A** Object *instead of* Class)

Public

1 mark for keyword Public in context;

(procedure) AddNewMember(Details);  
(procedure) Amend(Member)Details;  
(procedure) Display(Member)Details;

1 mark for correct procedure definitions;

Private

1 mark for keyword Private in context;

Surname: String; **A** protected;  
Firstname: String;*;*TelephoneNumber: String;  
Handicap: integer; **A** text *instead of* string

1 mark for correct data fields & data types  
don’t allow extra fields

End;

No marks for a diagrammatic answerto max 4

[11]

**114.** (a) (i) the concurrent execution // apparent simultaneous execution  
(over the same time period) of two or more tasks // the concurrent  
execution of a group of co-operating/a single user’s tasks;  
**A** programs/processes **R** jobs / applications  
between which communication is possible // to achieve some  
common goal;  
**R** descriptions which imply multi-user or batch O.S. 2

(ii) memory on hard disk;  
(used when execution of a program/process)   
where total virtual address space exceeds / program and data /  
main memory needed exceed the physical/main memory capacity;  
to store pages (of the process) / parts of the process not currently needed;  
**A** program *instead of* process  
lets user think there is more main memory/RAM // not enough  
main memory;  
**R** computer fooled into thinking more main memory  
**A** disk is used as RAM;to max 2

(iii) physical memory/RAM is conceptually divided into a number  
of (fixed size) page frames; **A** pages/segments;  
(virtual address space of) program/process is divided into a number  
of (fixed size) pages;  
page table indicates which pages of process are loaded (and where);  
**A** page table keeps track of pages;  
pages are swapped between disk and main memory as required  
// pages are swapped into, and out of, memory as required;

No marks for a point which references just data when it should reference a program backing store is not acceptable as a substitute for disk

to max 2

(b) (i) a thread is the processing performed on a single set of data in the system;  
a thread is a process that shares most of its environment;  
threads may be distinguished only by the value of their program  
counters and stack pointers;  
several threads share one copy of program code;  
a thread executes in the address space of its parent process;  
sharing global variables but with its own local variables;  
a thread is a line of execution within a process; it has its own  
program counter,  
stack pointer and register values but runs in the same address  
space as other threads in the process; 2

(ii) threads have access to the same memory so they can communicate easily;  
multi-threading allows threads to access the same data as they  
can access the same area of memory (RAM), separate processes  
do not allow this as they are self-contained;  
only one copy of the program needs to be loaded;  
saves main memory;threads share more of their environment with each other  
than do processes;  
faster execution than separate processes // faster execution overall;

Allow carry forward/back between (i) and (ii)

to max 1

[9]

**115.** (a) Contains a repeating group;  
*or*One or more of RouteId, RouteName, RouteArea, RouteDescription contain  
multiple values; 1

(b) Attribute names must not be redefined

(i) Leaflet 2

(ii) Route  
  3

(c) 1  


(d) **I.** Inner join, Join  
Asc is optional but if present it must be at end of **Order By** line (**A**. Ascending)  
 Penalise **And** once in this line  
 **R.** If And used  
 **I.** Quotes/hashes/Absence of separators  
  


*or*











Candidate may use relation name in front of attributes, eg. Select Person.Surname

Asc is optional  
to max 6

(e) **R**. Brand names

(i) word processor//word processor with e-mail support; 1

(ii) desktop publishing; A. publishing package or anything with publishing 1

(iii) spreadsheet; **R**. Database & spreadsheet  
**R**. Finance package. **R**. Accounting package 1

[16]

**116.** (a) To exchange/transmit business documents electronically( Accept invoices /  
(purchase) orders/catalogues);  
**R.** To exchange data. **R.** Stock control 1

(b) Wide area network is a set of links that connect together  
geographically remote computers;  
**R.** Definition that doesn’t reference “connects computers.....” 1

(c) (i) **R.** Quicker to set up.... (Time is not an issue).  
Accept disadvantage that can be mapped to an advantage.  
No expertise required to manage the wide area network;  
Lower costs applied to something reasonable, e.g. setting up, managing, maintaining; **R.** Lower costs on its own  
Availability of a help desk;  
Conversion between standards possible;  
Common standard enforced by VAN;  
Software provided by VAN for document conversion;  
to max 1

(ii) More secure;  
More difficult to tamper with a transmission;  
Reliable authentication;  
to max 1

(d) One mark for central hub and one mark for computers connected to  
hub as shown  
NB If hub incorrect answer scores zero  
If hub correct but computers incorrect answer scores one mark  
Router can be replaced by a computer labelled with router’s IP address 2



Don’t have to label computers with their IP addresses.  
**A.** IP addresses in place of computers + router

(e) So that these are reachable from anywhere on the Internet//so that  
can be seen/reached from the world outside;  
**R.** So can be reached by another branch of supermarket 1

(f) Document split into smaller chunks; A. segments/packets/frames  
Destination IP address doesn’t match this segment’s IP address;  
Document chunks sent to nearest router;   
Using its network card address/MAC address;  
Router sends chunks to router connected to print server segment;  
Using its routing tables and;  
This router’s network card address;  
This router sends chunks to print server;  
to max 5

(g) To block access to/from the internal private network from/to the Internet;  
To stop certain kinds of access to the Web server, e.g. telnet;  
To close ports to prevent users from connecting to them;  
To block connections on unwanted ports;  
To prevent unauthorised access to the private computers;  
**A.** Filtering  
to max 1

(h) A network in which resource security/user authentication/  
administration/resource allocation;  
managed/controlled by/carried out by servers; 2

[15]

**117.**   


(a) correct position of Louise;  
correct position of Christine and Peter;  
correct position of Alan and Leslie;  
correct position of Maria and Robert; 4  
*(If consistent mirror image give full marks)*

(b) Root node marked correctly; 1

(c) Louise, Peter, Maria in correct order (allow follow through from (a)); 1

[6]

**118.** (a) (i) Local Area Network; 1

(ii) Wide Area Network; 1

(b) (i) Intranet // Any example of communication within a building or site;  
**I** Connection of computers 1

(ii) Internet// World Wide Web //   
Any example of communication over a substantial distance;  
**I** Connection of computers 1

(c) (i) A set of rules; 1

(ii) The rate that signals/ voltage changes are transmitted; 1

(iii) The number of bits transmitted per second//  
the number of bits transmitted per time unit;  
**R** the rate that bits are transmitted;  
**R** bits of data 1

(iv) The range of frequencies a medium is capable of transmitting; 1

(d) Greater bandwidth allows greater bit rate // bit rate proportional to bandwidth; 1

(e) (i) Bits transmitted one after the other (along a single channel/ wire/ line);  
Or by diagram  
**R** Bits of data 1

(ii) Bits transmitted (along several wires/ channels/ lines) at the same time;  
Or by diagram 1

(iii) Can be transmitted over a longer distance// cabling is cheaper //  
Less chance of skew; 1

(iv) Faster transmission; 1

[13]

**119.**

|  |  |
| --- | --- |
| Result | Index |
| 0 | 0 |
| 24 | 1 |
| 24 | 2 |
| 57 | 3 |
| 57 | 4 |

(a) mark for each correct entry in Result – max 4 marks  
**A** blank as a repeat of the entry above  
1 mark for all the entries in Index; 5

(b) Obtain the largest value; 1

[6]

**120.** (a) (i) a common attribute(field);  
links two /related tables;  
//  
primary and foreign keys;  
create a link;  
*1 mark per point to max* 1

(ii) property / characteristic of an entity;  
one piece of information about an entity / item; 1

(b) (i) to check that data is reasonable/ appropriate;  
to check that the data entered meets requirements;  
to reduce the chance of incorrect data being entered; 1

(ii) Presence check / required field check;  
Uniqueness check;  
List membership / lookup list;  
Range check;  
Format check / picture check;  
(data)Type check;  
Existence (of data item or record) check;  
Field length check / length check;  
No of fields check;  
**R** Check digit, Verification;  
Also accept a reasonable example;  
*Any one of the above* 1

[5]

**121.** (a) (i) allocate hardware resources;  
between applications / processes requiring them;  
to ensure efficient use / no hold-ups / to maximise throughput;  
to report hardware malfunctions;  
*1 mark per point to max* 2

(ii) Processor(s) / CPU(s);  
Memory / IAS / Main memory;  
Disk (space) / backing store;   
**A** Hard disk / drive //floppy disk (drive) //secondary storage;  
I/O devices //peripherals **R** examples  
File space; **A** files **R** data  
**R** programs  
*1 mark per resource to max* 2

(b) ‘provide a virtual machine’;;  
//  
hide the complexities of the machine;  
from the user;  
//  
provide an interface;  
between the user and the computer; 2

(c) controls access by multiple users to / share network resources such as  
(shared files / applications / databases / printers.)  
/ manage more than one user using an application concurrently ;

manage printing from more than one computer on the network;  
manage security with more than one work station;  
establish / maintain communication between the work station and the server  
/ between two workstations; **R** connections  
*1 mark per point to max* 2

[8]

**122.** (a) 2  


1 mark if correct hierarchy (including rectangles or round/oval shapes) in an inheritance diagram;

**A** no shapes this year only   
1 mark for arrow in correct direction

(b) THourlyPaidEmployee = Class (Employee) 6(Public)  
 procedure CalculatePay (override)  
 procedure GetNumberOfHoursWorkedInMonth  
Private  
 hourlyrate/hourlypay/HourlyPayRate: Currency  
 NumberOfHoursWorkedInMonth : Integar/Real/Float

End

OR

public class/subclas THourlyPaidEmployee extends/inherits TEmployee; 1  
{

public void calculatePay; 1  
public void getNumberOfHoursWorkedInMonth; 1  
private; float hourlyPayRate; **1 mark for private, 1 mark for var name**  
private int numberOfHoursWorkedInMonth; 1

}

Accept “Object” instead of “Class”  
Accept Public implied  
Lose one mark if properties from parent class included  
**R** any diagrams

[8]

**123.** (a) 4



1 mark for showing 16 bits throughout

(b) (i) 4

|  |  |  |  |
| --- | --- | --- | --- |
| Symbolic Address | Hexadecimal Representation | Binary Representation | Decimal Value |
| Num2 | A802 | **1010 1000 0000 0010;** | **-2.75;;;** |

if answer wrong give:  
moving e places to right / exponent processing 2e or equivalent:1 mark  
correctly identifying negative number 1 mark  
**follow through if binary representation wrong**

(ii) To maximise precision in a given number of bits // to minimise rounding  
errors  
// to have just one representation of the decimal number // to simplify  
arithmetic operations; 1  
**A** to maximise accuracy in a given number of bits;

[9]

**124.** (a) a procedure/routine which calls itself//is defined in terms of itself; **R** re-entrant; 1

**A** function instead of procedure **R** program  
iteration Talked Out (no mark)

(b) (i) 7

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **E** | **L** | **H** | **M** | **List[M]** | **Printed Output** |
| 6502 | 1 | 11 ; | 6 | 5789 ; |  |
| 6502 | 7 | 11 ; | 9 | 8407 ; |  |
| 6502 | 7 | 8 ; | 7 | 6502 ; |  |
|  |  |  |  |  | True; |

Accept True in row 3  
Marks in each row for all three/two parts correct  
Accept empty cell to mean: same as in previous row.  
Stop marking when logic goes wrong

(ii) binary search;;  
search;  
**R** any other type of search 2

[10]

**125.** (i) Name and TotalOfFines; (Accept slight mis-spelling/spaces) 1

(ii) NB Borrowers with FinesOwed > 0 required  
surnames and fines owed of borrowers who owe fines; 1

[2]

**126.** (a) NB Take note of labelling inside boxes because candidate’s positioning  
of labels may be opposite to that shown below



(i) 1  


(ii) 1  


(iii) 1  


(iv) 1  


(b) **R**. Tbl in front of table name - penalise once

(i) 1  


(ii) 3  


A.Asc or Ascending in  
correct place i.e. after  
TimeRecordedForRace  
R. Asc/Ascending in any  
other position and/or with  
other words

(iii) 3  




[11]

**127.** (a) (i) 23; 1

(b) (i) 1010 0001;; 2

one mark for correct ASCII code, one mark for odd parity bit (follow through)

(ii) 11010 00010 *OR* 01010 00011 *OR* 1

allow stop bit to be 1 or 0 but stop and start bits must be different  
follow through if (i) wrong

01000 01011 *OR* 11000 01010;

Allow both ways round for transmission

[4]

**128.** (a) network adapter/network (interface) card/Ethernet card;

A a named card type eg Token Ring Card; **R** NIC *on its own* **I** hub 1

(b) (i) A=Ring (network); B= Bus (network); 2

(ii) higher transmission rates possible with high traffic/  
performance of B degrades with heavier traffic;

**R** quicker no collisions; **A** fewer collisions;  
transmission of messages is simple (as messages travel in one  
direction only); max 1

(iii) easy/inexpensive to install;  
easy to add more stations/computers/nodes/clients without  
disrupting network;

**R** users instead of node

**R** cable breaks, **R** computer breaks max 1

(c) (i) a protocol is a set of rules; **A** set of procedures; **A** a rule; 1

***I*** *other terms unless talked out in rest of sentence*

(ii) to ensure successful communication/transmission/interaction;  
(between different computers)  
answer must imply communication/receiving data not hardware linking  
**R** *sending data only* **R** *if connection only* 1

[7]

**129.** (a)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **List** | | | | | | | | | |
| **Ptr** | **Temp** | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
|  |  | 43 | 25 | 37 | 81 | 18 | 70 | 64 | 96 | 52 | 4 |
| 1 | 43 | 25 | 43 |  |  |  |  |  |  |  |  |
| 2 | 43 |  | 37 | 43 |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |  |  |  |
| 4 | 81 |  |  |  | 18 | 81 |  |  |  |  |  |
| 5 | 81 |  |  |  |  | 70 | 81 |  |  |  |  |
| 6 | 81 |  |  |  |  |  | 64 | 81 |  |  |  |
| 7 |  |  |  |  |  |  |  |  |  |  |  |
| 8 | 96 |  |  |  |  |  |  |  | 52 | 96 |  |
| 9 | 96 |  |  |  |  |  |  |  |  | 4 | 96 |
| 10 |  |  |  |  |  |  |  |  |  |  |  |

**ignore Ptr & Temp column**

1 mark for each of rows 1, 2, 4, 5, 6, 8, 9

(Final list 25, 37, 43, 18, 70, 64, 81, 52, 4, 96)

7

(b) control will pass to the instruction after Endwhile;  
/the instruction/command/statement after Endwhile will be executed;  
program will exit while-block; loop stops;  
**A** algorithim stops; **R** program stops; max 1

(c) (i) 25; 3

if part (a) not fully correct allow follow through: or lower of [1] & [2]

(ii) 81;

only allow follow through mark if the list at the end of part(a) is still a partially sorted list

(iii) 96;

must be 96 in all cases

[11]

**130.** (a) OS hides complexities of hardware from the user; 1

(b) Any three @ 1 each  
Processor(s)/cpu(s);  
Memory/IAS/Main memory;  
Disk (space)/backing store; **A** Hard disk/drive //Floppy disk (drive)//  
Secondary storage  
I/O devices//peripherals; **R** examples  
File space; **A** files **R** data  
**R** programs max 3

[4]

**131.** (a) (i) Network; 1

(ii) Interactive; 1

(b) (i) EditionId;  
Or  
Date; max 1

(ii) Date; (If EditionId used in (i))  
EditionId; (If Date used in (i)) max 1

(iii) EditionId; 1

(iv) 1 1 3

EditionId, PageNo, BlockNo;; **R** FilePathName  
Unique or equivalent;

(c) Enlarge/Stretch;  
Reduce/Shrink;  
Crop or an accurate equivalent;  
Airbrush/Rubber;  
Filter;  
Change resolution;  
Rotate;  
Change colours/greyscale;  
Distort;  
Flip;  
Zoom;  
**R** Cut out required bits, **R** Cut, Paste, **R** Adjust contrast/brightness  
**R** Moving image max 2

[10]

**132.** (a) (i) Data must be in given order  
1 pheasant 2  
2 teal 3  
3 widgeon 5

START 4 partridge 1  
5 woodpigeon 0

//



End Pointer can be blank  
1 for correct START and END pointers;  
1 for correctly numbered nodes and correct pointers  
(Need all birds);

(ii) 1 pheasant 7 2  
 2 teal 3  
 3 widgeon 5  
 4 partridge 1  
 5 woodpigeon 0  
START 6 grouse 4  
 7 snipe 2

// correctly amended diagram

1 for grouse and snipe physically at end;

1 for correct pointers (if not as ms than clear and logical);

(b) The amount of memory taken up can vary;

// The size / length of the structure / linked list can vary; 1

at run time; 1

(c) A heap / stack/ a pool of available locations;  
A pointer holds the address of the allocated block / next available location; 2

[8]

**133.** (a) (i) 8; 1

(ii) Each time a comparison is made in a binary search the number  
of items to be searched / list is halved; 1

// 137 lies between 27 and 28;

Could give (ii) even if (i) incorrect

(b) (i) 137; 1

(ii) In a linear search of 137 items, the required item might be the 137th one; 1

need a termination – must explain why 137 is the maximum

[4]

**134.** (a) (i) 1011 1101 1001 0011; 1

(ii) 1011101000 000011

-ve number; 1

exponent +3; (*explained or demonstrated*) 1

value 4 3/8; 1

Answer –4 3/8 / -4.375

1 mark for each of three points to max 3

(b) Normalisation ensures the maximum possible accuracy for Any 2 points to max 2  
a given number of bits; (*given no. of bits can be implied –  
e.g. leading zeroes can be replaced by significant digits  
at the end of the mantissa*)

Arithmetic operations simplified  
Ensures that only a single representation of a number is possible;

[6]

**135.** (a) Files are stored in separate directories / folders; 1  
**A** path / pathway

(b) disk stores a disk map to indicate free and used blocks / FAT; 2  
disk stores information such as disk volume name / label/  
capacity of disk / number of sectors;  
boot sector / messages;  
disk stores directories for disk / contains system files;

**Any 2 points @ 1 each**

(c) (i) *n.b. loading executable file* 2  
searches directory for match with given file name;  
obtains a block address / uses FAT to locate file;  
obtains size of file;  
load file into memory;  
checks file is compatible / not corrupted / no virus;  
check file status (not already open, licensed)

Any 2 @ 1 each

*Error:* no matching file / invalid file name / file corrupt / 1  
file already opened / /incompatible file type;

(ii) finds required amount of memory space / allocates memory; 3  
loads into memory / co-ordinates sharing of memory (DLLs);  
relocating loader translates addresses;  
using size of file;  
marks memory as taken / keeps track of where loaded;  
allocates base and limit register values;  
set up Page Management Table / **A** allocates segment descriptor table;  
manages virtual memory;

Any 3 @ 1 each

*Error*: insufficient memory / memory full. 1

[10]

**136.** (a) Produces re-usable code because of inheritance / encapsulation; 2  
Data is only accessible in well defined ways (because encapsulated);  
More efficient to write programs which uses pre-defined / inherited  
objects / classes;

*Storage structure of data and the code in an object may be altered  
without affecting programs that* *make use of the object;*

*Code produced contains fewer errors / more reliable;*

*Solutions are easier to understand when expressed in terms of objects;*

*Easier to enforce design consistency – Windows GUI functionality;*

*Cheaper production costs / Less maintenance effort required by  
developer since reliable ‘objects’ can be re-used / bought in;*

*New functions can be added to objects easily (because encapsulated);*

Any 2 advantages @ 1 each – must state an advantage, not make a statement.

***R*** *Object is independent.*

(b)



1 mark for correct base class and derived classes ; 1

1 for 2 correctly directed arrows. ; 1

(c) Member = **Class**  
 (Procedure) AddNewMembers; }  
 (Procedure) AmendMembers; } ;  
 (Procedure)ShowMembers; }  
 **Private** ;  
 MembershipNo : Integer  
 Name : String;  
 Address : String; ;;  
 **End;**  
*Exact syntax not required, but must be in style of .  
3 procedures* 1  
*Private* 1  
*All 3 field (property) names* 1  
*3 reasonable data types* 1

[8]

**137.** (a) E-mail may pass through many computers/servers if it travels over  
a network, each computer can make a copy/can be accessed;  
When a message arrives at its destination, it waits until the  
intended recipient picks it up. During this time the message  
is vulnerable to being read or copied by the computer’s operator;  
Electronic eavesdropping of telephone wires and local area  
networks is possible;  
With e-mail alterations leave no trace(no physical damage)  
whereas with paper alterations leave a physical mark; max 1

(b) (i) E-mail encrypted using public key;  
Recipient’s private key used to decrypt e-mail; 2

(ii) E-mail encrypted by sender using private key;  
Recipient decrypts e-mail using sender’s public key; 2

[5]

**138.** (a)



(NB don’t allow relationship between Ward and PatientMedical Condition) max 3

(b) **For each extra attribute lose one mark**

(i) Ward(WardName, NurseInCharge, NoOfBeds) **;**  
**A** NumberOfBeds, NameOfNurseInCharge, NurseInChargeName  
**R** WardId, Name, NurseName. NameOfNurse, BedNo, BedNumber,  
NumOfBeds 1

(ii)   
Patient(PatientNo, Surname, Forename, Address, DOB, Gender,  
*WardName*)  
**A** PatientId, PatientNumber, PatientSurname, PatientForename,  
PatientAddress, DateOfBirth, PatientDateOfBirth, PatientGender,  
Sex, PatientSex 2

(iii) MedicalCondition(MedicalConditionNo,  
Name,RecommendedStandardTreatment)  
**A** MedicalConditionId, MedicalConditionNumber,  
MedicalConditionName, **;**  
ConditionName, StandardTreatment,  
Treatment, RecommendedTreatment  
**R** ConditionNumber, ConditionID 1

(iv) **; ;**  
PatientMedicalCondition(*PatientNo*. *MedicalConditionNo*)  
**A Attributes rejected in (ii) and (iii) for PatientNo and  
MedicalCondition No  
R If attributes used are not consistent with (ii) and (iii)** 2

(c) **Accept tbl in front of table name** **;**

Select Patient.Forename, Patient.Surname,  
PatientMedicalCondition.MedicalConditionNo  
 From Patient, PatientMedicalCondition **;**   
 Where Patient.WardName =‘Victoria’ **;**  
 And Patient.PatientNo = PatientMedicalCondition.PatientNo **;**  
A. Forename, Surname, MedicalConditionNo, WardName max 3

[12]

**139.** (a)

 2

(i) First mark: collisions; **R** clashes  
Second mark: Frame/Packet//Description of how collisions occur,  
e.g. two stations sending at same time/stations have to resend;  
**R** Accessing file server at same time 2

(ii) 1 mark for drawing two segments connected by a bridge. 2  
1mark for a second segment consisting of hub and workstations  
D, E, F and File Server 2.



(c) (i) First mark is for switched Ethernet explanation. Second mark is for hubbased Ethernet explanation.  
Switched Ethernet allows a computer such as workstation A to send a  
packet to workstation D, for example, at the same time as another, e.g. B,  
is sending to workstation F//a sending workstation’s packets are sent to  
only one workstation//Switched Ethernet segments network into smaller  
segments;

If this is attempted in a hub-based network a collision will occur/only two  
workstations are permitted to communicate at the same time//a sending  
workstation’s packets are broadcast to all workstations//hub-based network  
is just one segment; 2

(ii) **NB** Emphasis is on transmission not performance of file server  
Transmission or equivalent speed is higher;  
Transmission or equivalent speed is faster;  
Transmission or equivalent speed is greater;  
Transmission or equivalent speed is quicker;  
No collisions;  
**A** Network is faster max 1

[9]

**140.** (a) nodes/systems/networks/machines/computers connected/ linked/  
communicating;

on different sites; over large geographical area/by satellite/telephone line/; 2

**R** different buildings

(b) (i) modem/ISDN adapter/ADSL adapter; **R**  network card 1

(ii) Browser software; http communication software; Telnet; FTP;   
Gopher;SSH;

**R** internet server **R** dial-up networking software  
 1

(c) Bits are sent one after another/bits are sent one at a time/ bit by bit /bits   
sent singly / bits along a single wire / line;

**R** data 1

(d) (i) one baud is the number signal/voltage changes per second;

**A** rate at which signals are sent; **A** rate at which voltage changes;

(ii) number of bits per second / bits per unit of time;  
bitrate = baudrate \* number of bits (per signal change); 2

**R** the rate at which bits are sent *(question paraphrased)*

[7]

**141.** (a) Any two at two each; If entrance method doesn’t match exit method  
mark one wrong and the other correct  
**R.** Voice **R.** Written to ticket  
Computer system/Printer prints number on ticket at entrance;  
Driver types number into system using a keypad at exit barrier;

Computer system encodes number on a magnetic stripe on ticket  
at entrance;  
**R.** Magnetic card  
Ticket number read by a magnetic stripe reader at exit//inserted  
into a magnetic stripe reader at exit; **A** magnetic strip/stripe scanner

Computer system/Printer prints number printed on ticket at entrance;  
Number read by an optical character reader/OCR at exit//ticket inserted  
into an optical character reader at exit;

Computer system/Printer prints number in barcode form on ticket at  
entrance;  
Number read by barcode reader at exit//ticket inserted into barcode  
reader at exit;

Computer system/Printer at entrance punches holes on ticket which  
are a coded form of number//Kimbal tag produced at entrance which  
encodes number;  
Number read by sensor (mechanical or optical) at exit//ticket inserted  
into sensor at exit//Number read by Kimball tag reader at exit;

Computer system/printer prints number using magnetic ink;  
At exit MICRreader reads number;

Computer system/printer prints marks (encoding number) on ticket;  
At exit, OMRdevice is used; 4

(b) **R.** any other data types. Mark is for field name + correct data type.

NB synonyms for RandomNumber must include Number, e.g. IDNo,   
TicketNo, Number. **A.** RandomInteger, **R** e.g. Vehicle ID **A.** VehicleIDNo

A. DateTicketWasIssued

Record

RandomNo : Integer; **R.** anything else 1

CurrentDate :

String/Date/DateTime/TDateTime/TDate; 1

ArrivalTime :

String/Integer/Time/DateTime/TDateTime/TTime; 1

LengthOfTime/LengthOfStay/TimeStayed : Integer;

**R.** anything else 1

Cost/AmountToPay : Integer/BCD; 1

End;

**A.** Alphanumeric for String

**R.** Text **R.**LeavingTime **R.** Binary,Byte,LongInteger

**R.** Date for FieldName

**R.** Date/Time but don’t penalise twice

[9]

**142.** (a) **A** card that is embedded with a microprocessor/processor/cpu and memory chip;  
**A** card that is embedded with a memory chip with non-programmable logic;  
**A** card that is embedded with a memory chip and logic circuits ;  
**R.** Card that remembers something 1

(b) CallId;  
SimCardNo, Date, Time; 1

(c) (i) An attribute/field in one relation/table that is the  
primary key in another relation/table; 1

(ii) SimCardNo 1

(d) (i) Changes/Updates are made in a timely manner ;  
Changes are made immediately/instantaneously/in an instant ;  
Changes are made as they happen;   
**R.** updated continuously 1

(ii) Processing which is not carried out until all the data have been   
entered into system;  
Processing is applied to all the transactions in one go/at one time;  
Processing that proceeds without human interaction;  
**R.** Collected – must be entered  
**R.** Processed in batches 1

(iii) Network needs to know the current base station of each mobile phone;  
Network needs to know the current location of each mobile phone;  
To keep location information current;  
Because user may change location; 1

(e) (i) To speed up searching/queries;  
To speed up access;  
**R.** To speed up processing 1

(ii) SimCardNo 1

(f) (i) 2 1

(ii) **A.** or ? or \* or × in SimCardNo and ServiceType fields  
Column headings must be accurate  
**A.** <= 28/02/2002

|  |  |  |
| --- | --- | --- |
| **SimCardNo** | **ServiceType** | **ActivationDate** |
|  |  | < 01/03/2002 |

; ; ; 3

(g) (i) What: Calculated digit// digit calculated from other digits in  
 MobilePhoneSerialNo; 1

(ii) Purpose: To check MobilePhoneSerialNo not corrupted;  
 To check integrity in MobilePhoneSerialNo;  
 To detect error in MobilePhoneSerialNo;  
 To check MobilePhoneSerialNo has been recorded/input   
 correctly;

**R.** To make sure(ensure) data/MobilePhoneSerialNo  
 is not corrupted/erroneous  
**R.** To check number is valid/correct **R.** To check for correctness 1

[15]

**143.** Queue is FIFO ; 1  
Stack is LIFO; 1  
*Given that:*Process of taking elements from queue to stack 1  
Process of popping stack 1

[4]

**144.** TForm1 = Class(TForm) 1  
 Button1:Tbutton; 1  
 Button2:Tbutton; 1

End

NB 1 mark for BOTH buttons

*//*

Class Tform1 extends Tform  
{Tbutton Button1;  
Tbutton Button 2;  
}

Must look like code.  
1 mark for connecting TForm1 to Tform **A** inherits, :  
1 mark for defining both buttons as type Tbutton **A** As  
1 mark for {} or End

[3]

**145.** (a) (i) positive 1

(ii) <2-2 1

(b) Correct answer 194.5 or 194 ½ 2  
working 1 3

If wrong answer, method marks as follows:  
 exponent 28 clearly identified 1  
 application of shift / \*28 from correct start point 1  
 correct interpretation of bits 1

**Basically here, if it is a little inaccurate, give 2 marks,  
if quite inaccurate but slightly correct give 1.** Max 2

(c) (i) Processing fixed point numbers is quicker than floating point /  
less processing required;  
More accurate/greater precision; 1

(ii) Where the possible range of numbers to be stored is limited / small;  
Where number is of a set format / processing integers /   
Working with currency;  
Where maximum precision is required 1 2

[7]

**146.** (a) Head (Tail ( Days)) = Mon **R** [Mon], MON 1

Tail([Head(Days)]) = [ ] 1

Empty(Tail(Tail(Tail(Days))))=False 1 3

(b) Elements in a list can only be accessed sequentially;  
 elements in an array can be accessed directly;  
 using the subscript;  
*Any 2 points to max* 2

[5]

**147.** (a) root, 1  
branch 1  
leaf node 1  
*must circle!*



(b) left sub-tree 1



right sub-tree 1



(c) W-X / Y+Z 3  
 1 1 1

**A** column vector  
*Spurious punctuation* 1

[8]

**148.** LAN;  
Justification:  
 Computers in health centre are in close proximity to each   
 other/geographically close/in same building/on same site;  
 **R.** Computers within health centre on its own 2

[2]

**149.** (a) (i) 1



(ii)



**I.** other entities 1

(b) (i) Select Book.Title **A** Title   
From Book;  
Where Book.ISBN = “1-57820-082-2”; **A** ISBN = “1-57820-082-2”;  
Any extra attributes lose mark where extra attributes used  
**R.** 1-57820-082-2 Need quotes  
**A.** ‘1-57820-082-2’  
**R.** TblBook – penalise once  
**R.** Title.Book, wrong order 2

(ii)

Don’t need Book in Select

Select Book.AuthorName, Book.ISBN ;

**A. BookCopy.ISBN in place of Book.ISBN**

From Book, BookCopy ;

Where (Book.ISBN = BookCopy.ISBN) ;

And (BookCopy.AccessionNumber = 1234) ;

**A. AccessionNumber in place of BookCopy.AccessionNumber**

**R.** quotes on 1234  
Any extra attributes lose mark where extra attributes used  
Brackets non-essential. May see conditions interchanged, this is Ok

**A. in for =**  


**Penalise TblBook/TblBookCopy once**

(c) Mail-merge//Mail-merging 1

[9]

**150.** (a) (i) Too much traffic//Congestion//slow to respond//too many (packet/frame) collisions; (Candidate may answer reduces traffic, etc. This is OK)  
**A.** Performance degrades 1

(ii) Bridge “learns” which desktop PCs connected to each port//bridge stores  
Ethernet addresses of desktop PCs connected to port **A** and port B;  
Bridge blocks packets destined for a desktop PC on same segment from   
being passed to other segment// Bridge only passes packets destined for   
a desktop PC on other segment;Packets between machines on same   
segment are ignored by bridge/blocked by bridge;

Packets between machines(using machine identifiers is OK, e.g. PC1)   
on different segments transferred by bridge;

**A.** Messages for packets 2

(iii)



**R.** Missing bridge correct hubs – penalise once  
No hubs – scores zero 2

(iv) **A** user logged in at one peer computer is able to use resources on   
any other peer computer;  
In a peer-to-peer network, there are no dedicated servers;  
In a peer-to-peer network all computers are equal/have equal status;  
Each computer functions as both a client and a server;  
User at each computer acts as both a user and an administrator   
(determining what data, disk space and peripherals on their computer   
get shared on the network)//User at each controls what is shared   
with other computers;  
**A** Network with no central control;

**R.** Each computer is directly connected to each other and so can  
send to each other without a server

**R.** All computers have same rights 1

(b) (i) To provide access/interface to the Internet/World Wide Web  
(to individuals/organisations/businesses);  
To act as hosts for Web pages (that individuals/organisations/  
businesses wish to publish on the Internet);  
To provide electronic mail boxes;  
To provide services related to Internet access; 1

(ii) **A** router is a device that receives datagrams or packets from one   
computer and uses the IP addresses that they contain to pass  
on these packets, correctly formatted, to another computer;  
Device which uses IP addresses to route packets; 1

(iii) 192.168.1.1; 1

[9]

**151.** (a) several bits are transmitted simultaneously/at the same time;  
down several wires;

**A** several bits of data; **R** data

**R** down 2 wires **A** diagram **A** a byte/word at a time; 1

(b) exchange of signals between devices/devices communicating  
with each other; to establish their readiness to send or receive  
data/a method of ensuring that both the sender and receiver are  
ready before transmission begins; 2

[3]

**152.** (a) (i) share printer; share database; central backup possible;  
data consistency; electronic messaging/communication;  
share data/information/files/software; access files from  
any computer; easier to upgrade software; max 2

(ii) network adapter/network card; **R** modem 1

(b) (i) more secure;  
if a cable breaks only one node is out of action; **R** computer  
instead of cable  
performance does not degrade with increase in traffic;  
easier to find cable fault; max 1

(ii) cheaper to set up; less cable needed; max 1

(c) (i) the name of an internet site/user friendly id of an internet site;  
R address 1

(ii) (www.)companyname.co.uk *(any valid domain name)  
does not need www, could be ftp or wap also* 1

(d) a communication system providing similar services to the Internet;  
solely within a particular company or organisation/company wide;  
an internal; internet; max 2

[9]

**153.** (a)



A mirror image (this time) 4

(b) ‘T’ 4; ‘U’;

‘T’ 5; ‘S’;

‘T’ 7; ‘T’; 6

no penalty if candidate gets ‘item’ wrong  
ignore ‘item’ column.

[10]

**154.** (a) Real-time processing:

Inputs processed in a timely manner(immediately) and system responds  
in a timely manner (immediately);  
**R** Examples 1

(b) Real-time; 1

[2]

**155.** (a) Name: Copyright/Copyright, Designs and Patents Act/Right to copy;  
Way: Any one for one mark  
 Copying music without a licence/Copying music without permission  
 Copying music without authority/Copying music without consent/  
 Copying software without a licence/Copying software without permission/  
 Copying software without authority/ Copying software without consent;  
 **A** Obtaining without permission 2

(b) (i) CD-ROM;  
DVD-ROM;  
CD-R;  
DVD-R;  
**R** DVD, CD, CD-RW, DVD-RW 1

(ii) Any two @ one each  
CD drive or DVD drive or DVD player;  
Speaker(s)/Headphones;  
Sound card;  
Graphics/Video card;  
Video Projector; max 2

(c) Data Protection Act;  
Integrity: Personal data must be up-to-date (accurate). (Not “used  
only for correct, declared purpose”);  
**A** Personal data must be correct/true  
Security: Personal data must be kept secure(safe)/Prevent  
unauthorised access/ prevent unauthorised alteration/ prevent  
unauthorised deletion/prevent unauthorised disclosure/ prevent hacking; 3

[8]

**156.** (a) Magnetic Strip(e) Reader (Not swipe card reader); 1

(b) What: Extra/last digit(**A** number) in borrower code;  
Calculated digit;  
Why: To detect if data/code has been corrupted;  
To check that data/code is valid;  
To ensure integrity of data/code;  
**A** To check that number is valid  
**A** To check that data/code is still correct after transmission  
**R** To check that data is plausible 2

(c) Reason: magnetic stripe reader may not be able to read borrower code;  
Because magnetic stripe is damaged;  
Can phone in code;  
Code needs to be entered through a keyboard; 1

(d) Bar code reader/Bar code scanner;  
**R** Scanner  
**R** Light pen 1

(e) (i) Unique field of a record/field used to identify record; 1

(ii) BookCode; 1

(iii) Serial; 1

(f) (i) BookCode; 1

(ii) Reason: Any one for 1 mark  
So one pass is possible;  
Reduce time taken to update Books file;  
Saves time;

Order: Same as Books file/ordered on BookCode; 2

(g) **NB** steps must be clear. **R** a narrative in which steps  
 not made explicit  
 = zero marks

Alternatives:  
Compare Current Date with DateBookToBeReturnedBy field;  
If = or >= or >; If (LoansStatus = OnLoan);  
And TodaysDate >|>=|= ;  
 DateBookToBeReturnedBy

Steps:  
Open Books file;  
(Read or idea of going to) each record in turn/  
(Read or idea of going to) next record;  
Until EOF;  
If LoanStatus = OnLoan;  
 Then  
 Compare DateBookToBeReturnedBy field with current date;  
 If = (allow <= and <) ;  
 Then Write details to OverDueBooksFile; 4

Data:  
Any three @ one each (No T.O.)  
BookCode;  
BorrowerCode;  
DateBookToBeReturnedBy;  
ISBN;  
Title:  
Author; 3

**R**. any others Candidate must state these accurately

[18]

**157.** (a) Collection of tables/a database in which relationships are modelled  
by shared(common) attributes;  
**A**. Set of tables  
**A**. Two or more tables  
**R** Two tables  
**R** Entities 1

(b) (i) Primary key: CompetitorId;  
Justification: Unique; 2

(ii) RacingDivisionId 1

(c) (i) Foreign key = An attribute/field(Not key) in one table; which is  
 the primary key in another table/identifies  
 a row in another table;  
 **R** record or file  
 **R** Foreign key links two or more tables 2

(ii) RacingDivisionId; 1

(d) (i) To speed up searching/To make access faster;  
 **R** easier  
 **A** Save time; 1

(ii) RacingDivisionId; 1

(e) Three correct columns gets 1 mark 2  
All four correct gets 2 marks

**A** Cat1 in place of =Cat1

|  |  |  |  |
| --- | --- | --- | --- |
| CompetitorId | Name | PointsAccumulated | RacingDivisionId |
|  |  | > 300; | = Cat1; |

[11]

**158.** (a) Diagram



(b)

1 for position, 1 for correct arrows. 2

Circles not necessary

OK if completely upside down.

e.g. number of legs, colour, web type; 1

*Property Method*

Spin web/eat; 1

***R*** *instance of property, e.g. 8 legs*

*Does not have to be biologically correct but sensible!*

[4]

**159.** (a) *Client –server system*

A server provides services required by client workstations/applications; 1

Such as file storage/communications/web access; *(dependant on first point)* 1

OR

Server distributes data to client system requesting it; 1  
Clients process data;. 1

(b) *3 benefits*

Client workstations can have lower processing speeds/hard disc  
capacity – and so cheaper;

A print server will manage the printing on behalf of the clients;  
All client workstations can share 1 copy of an application;  
All client workstations can share data/backups easier;  
Enables greater security such as access rights/control over  
Internet access/firewall/one Internet access point;  
Upgrades easily managed because only one copy of software;  
Licensing managed because use can be monitored. 3

[5]

**160.** (a) *Mantissa*

Significant digits/precision/answer by example; 1

*Exponent*

Power of 2 by which mantissa is to be multiplied to get original  
value/How many places the point has to move/answer by example;  
***R*** *decimal point* 1

(b) (i) Mantissa  Mantissa identified

0110101100 000011 1

(ii) Msb/leftmost bit/starts with determines sign of number; 1

0 so +ve &/or 1 if –ve. 1

(c) Convert –3 into 2’s complement; 0000 0011

Add to 2’s complement value of +5; 1111 1101;

*If 3-5 calculated correctly give 1* 0000 0101*+  
method mark* 000 0010; 2

(d) Increased range that can be stored in a given number of bits; 1

[8]

**161.** (a) *Tail(Ports)* [Barcelona, Athens, Alexandria, Tunis, 1  
 Lisbon] *square brackets needed*

*Head(Tail(Tail(Ports)))* Athens 2

[Athens] 1

*Empty(T(T(T(T(T(T(Ports)))))))* True 2

True [ ] 1

[True] 0

(b) *Recursively defined*

A definition which is defined in terms of itself/contains within  
its body a reference to itself/calls itself ;

**A** re-entrant; *(In specimen papers 2001/2, but refers  
specifically to a procedure)* 1

(c) *Stack necessary*

The state of the machine/contents of appropriate registers/  
return address // saved each time the procedure is called; 1

and retrieved in reverse order from the stack as control is  
progressively returned; 1

OR

different value of parameters /local variables; 1

must be available each time procedure is called; 1

OR

P must be re-entrant *(In specimen papers 2001/2 )* 2

(d) Lisbon first; 1

Southampton last; 1

All 6 in order 1

No punctuation; 1

i.e. Lisbon Tunis Alexandria Athens Barcelona Southampton; 4

(e)



2

[14]

**162.** (a) bus;  
**R** line 1

(b) (i) *connections correctly done as a star; allow a hub drawn in  
no arrows required.* **R** *diagram of a mesh network* 1

(ii) (*Advantage*)  (*Reason*:)

if one cable fails it affects only one computer; as each computer is directly connected to central computer;

**R** computer fails

simple to isolate faults; **A** each computer has its own line;

different computers can transmit at different “  
speeds;

system more secure; as messages are sent directly  
 to central computer;

network does not degrade when highly “  
loaded;

**R** collision free *unless explained*

**R** easy to add / remove computers **R** reliability **R** faster max 2

[4]

**163.** (a)

  
*Ignore other cells*

(b) convert an integer into its binary equivalent; 1

[7]

**164.** (a) bits transferred simultaneously / concurrently; **R** data **R** bytes  
bits sent down many wires at the same time; **A** bits of data max 1

**A** *a clear diagram*;

(b) (i) data get skewed; timing of bits becomes different / out of line;  
**A** over longer distances the data may not be correct;  
**A** too expensive because of amount of wires/cables/lines;  
**R** signal decays **R** corrupted data max 1

(ii) use serial transmission; 1

[3]

**165.** (a) (parity bit is adjusted to make) number of 1’s / on/off bits even;

parity bit is regenerated/checked by receiver;  
check parity bit after transmission;  
if number of 1-bits is now odd, there was an error in transmission; max 3

(b) the greater the bandwidth the greater the rate at which data can be sent;  
bit rate increases as bandwidth increases;  
bit rate (directly) proportional to bandwidth; max 1

[4]

**166.** Primary key = ProductId;  
Justification: Other fields would not be unique/ ProductId is likely to be unique; 2

[2]

**167.** Treat candidate’s responses to name and reason independently, i.e. name gets mark  
even if reason is wrong and vice versa.

(a) Name: Network;  
A. Network qualified by interactive, multi-access, multi-user  
R. Peer-to-Peer network, LAN, network topologies  
Reason: File requests must be re-directed to other computers on network  
R. file sharing, data sharing, printer sharing, communication between  
computers, security checking 2

(b) Name: Real-time Or Real-time process control, Real-time control;  
Reason: System must respond in a timely manner to variations  
in flow-rate Or instantaneous response required Or must react quickly; 2

[4]

**168.** (a) Collection of tables Or a database in which relationships are modelled by  
shared(common) attributes;  
R. Two tables  
A. Two or more tables  
A. Relations in place of tables  
A. Fields for attributes  
R. Entities for tables 1

(b) Primary key = MagazineEditionId;

Justification = Unique; 2

(c) R. Record

(i) Foreign key = An attribute(field) in one table which is  
 the primary key;  
 in another table;

A. a linking field; 2

(ii) MagazineEditionId; 1

(d) (i) To speed up searching;  
To speed up access;  
R. To sort 1

(ii) AuthorName; 1

(e) (i) 2; 1

(ii) A. < 2000, =< 1999 for Year. A. =Management, “Management”  
for ArticleType. A.  in Authorname and ArticleTitle boxes.  
 1 1 1 1

|  |  |  |  |
| --- | --- | --- | --- |
| AuthorName | ArticleTitle | ArticleType | Year |
|  |  | Management | <=1999 |

<= must be to left of 1999  
Attribute names must be fairly accurate (minor misspellings and spaces allowed  
but REJECT plurals)  
A. LT 2000, LTE 1999, LE 1999

A. 

in place of Year column ;;;;

4

[13]

**169.** (a) +3x; 1

(b) 3+x; 1

(c) 3x+; 1

[3]

**170.** (a) 11, 17, 9,21,15,23; 2

(2 if all right, 1 if 4 of 6)  
If > misinterpreted, follow through for 1 mark

(b) A bubble sort; 1

(c) To detect when all the numbers have been sorted  
Efficiency (to stop procedure repeating unnecessarily);  
**R** to detect when numbers have switched 1

[4]

**171.** (a) 2



Dean accessed first  
Pointer / arrow

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Dean | Claire | Bob | Anne |

End pointer **** Start pointer ****

Anne accessed first;  
Named pointers correct;

(b) 2



correct item replaced;

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Eden | Dean | Claire | Bob |  |

Eden Start pointer ****  
pointer  
****

correct item retrieval & input;  
correct moving of pointers

(c) In a linear queue data is static, so queue ‘moves’ through storage/  
In a FIFO structure storage locations are only used once; 1

In a circular queue, the locations will be re-used; 1

Thus a circular queue has a more efficient use of memory; 1

1 mark for each of 2 points

[9]

**172.** (a) (i) *A class* 1

A grouping of data structures and behaviours /  
methods / procedures / functions;  
A set of objects / object type which share a  
common data structure and common behaviour /  
methods / procedures / functions;

Need both structure and behaviour  
**A** variables, attributes

(ii) *Inheritance*Relationship among classes wherein one class shares  
the data structure and behaviour/methods / procedures /  
functions / actions of another class

OR when a class has the same characteristics as its parent class  
**A** attributes / features / properties 1

(b) 3



1 mark for correct base class  
1 mark for two correct derived classes  
1 mark for **2** correctly directed arrows

(c) *Advantages* 3

Produces re-usable components (you do not have to know how they  
are written);  
**A** code  
Data is protected – only accessible in well defined ways;  
Easier to write programs which use pre-defined objects / classes;  
Storage structures of data of an object may be altered without affecting  
programs that make use of the object;  
Code of an object may be altered without affecting programs that make  
use of the object;  
Solutions that use objects tend to contain fewer errors / more reliable;  
Solutions are easier to understand when expressed in terms of objects;  
Easier to enforce design consistency;  
Cheaper production costs when software can be re=used;  
Less maintenance effort required by developer since reliable ‘objects’  
can be bought in;  
New functions / features can be added to objects / classes easily (inheritance);

1 mark for each of 3 points to max;

[8]

**173.** (a) (i) **Baseband:** Single /data signal sent at a time Or single  
 message/packet/frame sent at a time Or uses single channel Or one  
 transmission at a time  
 **A.** Single stream of data;

over full bandwidth (of the cable) Or occupying full bandwidth  
(of the cable)  
Or signal uses all available frequencies;

(ignore any additional references which are bits, 0/1 in  
any part of the above)  
**R.** Single bits sent at a time  
**R.** Only works over short distances

(ii) **Broadband:**  
Several /data signals sent simultaneously Or several messages/  
packets/frames simultaneously Or more than one signal occupies  
bandwidth ;  
Each at a different frequency Or in a different channel  
Or in a different time slot;

Or

Multiple channels used;  
Each at a different frequency Or in a different time slot;

Or signal(or equivalent) uses only one frequency Or signal  
(or equivalent) uses only part of bandwidth;;

**R**. fast connection  
**R**. Video, sound and text .....  
**R**. ADSL, cable examples, etc 4

(b) (i) **Two reasons:**

Wide area networks expensive to install;  
Wide area networks expensive to maintain;  
Wide area networks involve long distances;  
Can allow multiple data streams to keep down costs  
Or can share transmission medium to keep costs down;  
Many channels needed to cope with high volume of traffic  
Or enables more users to use network without experiencing  
congestion;  
**R**. Faster  
**R**. can work over longer distances  
**R**. More than one user will want to use it simultaneously  
**R.** Cheaper, more efficient max 2

(ii) First mark: (More packet) collisions take place;  
 Stations attempting to send at the same time;  
 Each station broadcasts to every other one;  
 Some stations may be attempting to broadcast  
 at the same time;  
Second mark: Packets need to be sent again;  
 Station has to retransmit (after a random delay); max 2

(iii) First mark: Exclusive bus connection (made temporarily  
 between sender and receiver)  
 Or data transfers take place in turns  
 Or switch connects just sender and receiver  
 Or collision domain limited to two stations  
 Or switch splits bus LAN into several  
 smaller segments  
 Or switch allocates a time slot to each transmission  
 Or each host/computer/station/workstation/  
 node has its own link on which one packet  
 at most can travel  
 Or switch allows a dedicated connection/pathway  
 to be set up when a computer wishes to send  
 information to another  
 Or switch separates work stations (in different  
 segments)and only passes packets between  
 segments when necessary  
 Or switch (ports) act as bridges which  
 segment network;

Second mark: therefore collisions cannot occur  
 (between two stations)  
 Or collisions reduced; 2

[10]

**174.** (a) 3



If candidates gives more than required mark all to a max of three

(b) NB Order of attributes is immaterial

(i) *1 mark for primary key 1 mark for other attributes unless additional attributes*

**A**. Quantity, StockLevel, Stock, AmountInStock, Amount,  
NumberInStock, Qty\_Stock, Qty  
**A**. Description

Product (ProductId, ProductDescription, QuantityInStock) 2

(ii) *1 mark for primary key 1 mark for other attributes  
(unless extra other attributes)*

**A**. Name, Address, (Customer)TelephoneNo, (Customer)  
TelephoneNumber, TelNo, (Customer)TelNumber,  
**R**. Phone, Telephone, **A**. Multiple lines for address  
including postcode, etc, **A**. Breakdown of name into  
forename, surname.

Customer (CustomerId, CustomerName,  
CustomerAddress, CustomerTelNo);

2

(iii) *1 mark for primary key 1 mark for foreign key  
CustomerId 1 mark for other attributes unless extra other attributes*

Order (ABCOrderNo, CustomerId, CustomerOrderNo,  
OrderHasBeenDespatched)

**A**. Despatched, OrderDespatched, OrderStatus 3

(iv) *1 mark for primary key 1 mark for ABCOrderNo, LineNo,  
1 mark for foreign key ProductId, 1 mark for QuantityOrdered,  
unless additional attributes*

**A**. OrderLineNo, OrderLineNumber LineNumber, Line  
**A**. Quantity, Amount, Qty, Number

OrderLine (ABCOrderNo,LineNo, ProductId, QuantityOrdered) 4

(c) Attributes must correspond with table  
attributes given in part (b)

**A**. Yes, ‘Yes’, “Yes”, Y, ‘Y’, “Y”,  
Despatched, ‘Despatched’, “Despatched” in place of True 1

Select CustomerName  
(Score zero for extra attributes) 1

From Order, Customer  
(Each extra table cancels one of these marks) 1 + 1

Where Customer.CustomerId = Order.CustomerId 1  
And Order.OrderHasBeenDespatched = True 1

Order By ABCOrderNo 1

Mark first Select statement, but give credit for Order By ABCOrderNo.  
Associate And with one of the conditions.  
OK for parts of statement to be on same line, e.g. Select CustomerName  
From Order, Customer  
**A.** Customer.CustomerName  
**A.** Order By ABCOrderNo ASC  
**A.** Order By Order.ABCOrderNo  
**A.** OrderBy for Order By  
**A.** the use of aliases, e.g. Select D1.CustomerName  
 From Customer D1, Order D2  
 Etc.  
**A.** “Customer.Db” Or Customer.Db , “Order.Db” Or Order.Db  
**A.** OrderHasBeenDespatched = True  
**A.** Order By ABCOrderNo Ascending  
**A.** From tbl Customer, tbl Order 6

[20]

**175.** (a) Correctly placed labels: main memory (1);

keyboard & keyboard controller (2,5*);*disk controller & HD drive (6,4);  
monitor & monitor controller (7,3); 4



*(allow names instead of numbers)*

(b) Machine code instructions/program stored in main  
memory/RAM/IAS;  
fetched and executed; *(concept)*Can be replaced by another program any time;  
**R** cache Max 2

(c) (i) bits are sent one after another / bits sent one at a time / bits sent  
singly / along a single wire/line;  
**R** data */* character 1

(ii) bits transferred simultaneously/concurrently / bits sent down  
many wires at the same time;  
**A** diagram; **R** data / character 1

(d) (i) Between devices in close proximity / communication within  
computer / communication over short distances; 1

(ii) distance: parallel transmission only operates over short distances;  
speed: parallel transfer faster than serial; Max 1

(e) start bit marks beginning of character to be transmitted /  
alerts/synchronises receiving device; 1

stop bit(s) marks end of character to be transmitted */* gives time  
for receiving device to recover;  
frames the character; 1

[12]

**176.** (a) Computers/devices connected together by cables;  
In a small (geographical) area / on one site;  
using a recognised local area protocol eg Ethernet/Token Ring;  
**R** users connected 2

(b) (i) Bus/ Ethernet; 1

(ii) easy/inexpensive to install; easy to add/remove more nodes;  
**R** general network advantages **R** less cable **R** node failure Max 1

(iii) *if* cable fails, whole network goes down; network performance  
degrades under load; cable failure difficult to isolate;  
lower security; max 1

(c) (i) dedicated link; fixed rental independent of usage;  
constant/permanent connection/ fixed line;  
**R** private line **R** direct line Max 1

(ii) only connected while in use; pay for time connected; re-connect  
to go on-line;  
**R** public line / shared line Max 1

(d) used most of the time/a lot of traffic; need fast access; always  
available;  
**R** more reliable max 1

(e) if used only occasionally; cheaper to set up; access easier to  
control / more secure; **R** only pay for what they use max 1

[9]

**177.** (a) Interactive operating system: Any one point for one mark  
User and computer in two way communication.  
Processing carried out on data or command executed as users  
enter the data/command so that results of processing are available  
immediately to users.  
Communicating directly with program as it is running. max 1

(b) Real time 1

[2]

**178.** (a) Any 2 points @ 1 each  
NB do not accept allows more data on disk or faster access to data.  
Each directory of a manageable size/easier to maintain.  
Allows increased protection by restricting directories to certain  
users/improved security.  
Allows identical program names to be stored in different directories.  
Allows users their own directories.  
Allows special directories.  
Allows directories containing files of similar type.  
Reduces the risk of accidentally erasing other peoples’ work.  
Allows the system manager to monitor usage.  
Makes selective backup easier.  
Easier to locate files/faster to locate files.  
Allows more files on disk  
(NB easier to organise files is insufficient on its own, candidate needs  
to say something specific to get a mark) max 2

(b) Any 2 points @ 1 each  
NB on its own, the right to PROTECT a file is worth ONE mark,  
zero otherwise.  
The right to

set file status to

read only  
read/write  
execute only  
delete authority  
write only (update only)  
hidden  
set shareabilty of file  
alter/create/specify file rights max 2

[4]

**179.** (a) Unauthorised access to computer material (allow an answer which  
implies this, e.g. illegal use of a userid) 1

Unauthorised modification of computer material (allow an answer  
which implies this, e.g. change data without authorisation) 1

(b) Any three points at one each  
Computer keyboard lock  
Closed circuit television cameras  
System should enforce a choice of password that is hard to guess,  
e.g. at least six characters long, not a word in a dictionary  
System should be aware of repeated unsuccessful attempts and  
disable terminal after three wrong passwords have been entered.  
Network manager should be alerted by a message at the server if  
a number of wrong passwords have been entered in a short time  
A network access log should be kept  
Additional passwords should be required to access/alter important files  
Fingerprint/retina scan  
Swipe card  
Encrypt files  
Set files to read only Max 3

[5]

**180.** (a) Optical Mark Recognition/Reading. (Not Optical mark reader) 1

(b) Extra digit added to the transaction code 1

To detect if data has been corrupted 1

(c) (i) Unique field of a record/filed used to identify record 1

(ii) Transaction code 1

(iii) Not indexed sequential  
Serial or Sequential 1

because all the records have to be examined 1

Or

Direct access based on a hash code of the chosen numbers 1

Only a few records will need to be checked (when collisions  
occurred) 1

max 2

(iv) Random or direct access 1

Record can be located by simple transformation of transaction code  
/hashing technique used/algorithm used to store and retrieve records 1

Indexed sequential with transaction code as key field 1

Rapid access via the index is possible to find the necessary record 1

max 2

(d) Any four points at one each  
Ticket scanned/ Read ticket  
Check digit used to check accuracy of scanning Ticket validated,

(e.g. not out-of-date, draw not yet made)

Operator informed if ticket does not scan/is invalid  
Transaction code sent to central computer  
Correct file selected  
Ticket’s record found/Look up ticket’s record/Look up record with given  
transaction code  
Get draw date from transaction record  
Get numbers from system (for the correct draw date)  
Ticket numbers checked against draw  
If a winning ticket prize money determined  
Result sent to point of sale machine  
Result displayed at point of sale machine max 4

[13]

**181.** (a) (i) Four at one each  
(Do not allow non-essential fields, e.g. description, price, etc.)  
StockCode/StockNumber/StockId  
(Allow Item/product in place of Stock prefix and Barcode)  
QuantityInStock/CurrentNumberInStock  
Reorderlevel  
ReOrderQuantity  
SupplierId/SupplierCode/SupplierNumber(Supplier details but not  
supplier) 4

(ii) Three at one each  
TransactionTypeCode  
StockCode (Allow alternatives as above)  
Quantity 3

(b) One mark for correct order  
Order = same as Master file 1

Any one point for one mark  
Because transaction file will be serial  
So one pass is possible  
Reduce time taken to update master file 1

max 2

[9]

**182.** (a) Collection of tables 1

(b) DonorId 1

Unique attribute 1

(c) (i) An attribute in one table which is  
the primary key 1

in another table 1

Or

a common or shared attribute 1

used to model a relationship 1

max 2

(ii) DonorId 1

(iii) DonationId 1

Or

DonorId, DateDonationGiven 1

max 1

(d) (i) To speed up searching (Do not allow so any record can be found easily) 1

(ii) DonationType 1

(e) (i) 2 1

(ii) 12 1

[11]

**183.** (a) (i) Physical components/devices of the computer; **(1)**

(ii) Programs which run on the computer; **(1)** 2

(b) (i) Modem; OR ISDN adapter; **(1)**

(ii) To convert digital signals/waves to analogue signals; and vice versa;   
**R**  binary instead of digital  
If ISDN above: To connect to the digital telephone network;  
so digital signals from the computer can travel to the digital  
telephone exchange. **(2)** 3

(c) (i) Browser software; http communication software; **(1)**

**R**  internet server **R** dial–up networking software

(ii) (hypertext transfer) protocol / protocol used; **R**  http format **(1)**

(iii) domain name/address / name/address of web server/site; **(1)** 3

*(NOT URL or anything else)*

(d) (i) nodes/machines/computers connected/communicating; over  
large geographical area/by satellite/telephone line/on different  
sites; **R** different buildings **(2)**

(ii) need a common standard / because machines are different;  
so computers can understand each other; **(1)** 3

**R**  *definition of protocol on its own*

[11]

**184.** (a) (i) Bits are sent one after another / bits are sent one at a time/  
bit by bit / bits sent singly / bits along a single wire /  
line; **R** data **(1)**

(ii) Bits transferred simultaneously / concurrently / bits sent down  
many wires at the same time; data is sent one word/byte at a  
time; **R** sending blocks of data **R** down 2 wires **(1)** 2

(b) Speed of (serial) transmission/rate at which data is sent; the number  
of signal/voltage changes per second; **A** units of time   
one baud is (approx) one bits per second; 1

**R** rate of data transmission

(c) (i) 1 0 1 0 0 1 1 0

 **(2)**

*one mark for correct ASCII binary code in 6 rightmost bits  
one mark for even number of 1s in 8 bits*

(ii) **0 0** 1 0 1 0 0 1 1 0 **1**; OR **0** 1 0 1 0 0 1 1 0 **1 1**; OR **(1)**  
**1 1** 1 0 1 0 0 1 1 0 **0**; OR **1** 1 0 1 0 0 1 1 0 **0 0**; 3

[6]

**185.** (a) System software / program which controls the computer hardware;

Manages computer (system) / hardware;

Interface between user and computer;

Runs programs; handles input/output; Max 1

(b) (i) Executes instructions/programs/code; **R** data

Performs calculations/instructions; **(1)**

**R** controls … **R** processes …

(ii) Stores/holds program /instructions / data; **R** permanently

**R** files **(1)** 2

(c) **Data bus**; **(1)**

carries the data/instructions to/from component; **R** holdsAddress bus; **(1)**

carries identification/address about where the data is being sent to   
/fetched from; **R** holds **(1)**

**Control bus**; **(1)**

to send control signals; whether process is read or write; **(1)**

carries timing signal; **R** holds **R** controls flow of data **(Max 1)** 6

[9]

**186.** (a)



(1 mark for correct position of London,   
1 mark for correct position of Berlin and Paris,  
1 mark for Amsterdam and Lisbon correct,   
1 mark for Madrid and Rome correct)  
*no follow through in this part of the question* 4

(If consistent mirror image give marks)  
(Note (b) and (c) must follow on)

(b) Root node marked correctly  
*Tick by question* **(1)**

(c) London, Paris Madrid; *in correct order* **(1)**

[6]

**187.** No carry back/forward

(a) Any two methods @ one each  
Not validation on its own, not proof reading, not backing up/back up  
  
Data entry methods:  
Accept description in place of names

Range checks;  
Presence checks;  
Uniqueness checks;  
Type check;  
Format check;  
Data verified /by entering twice and comparing;  
Length check;  
List of valid values/enumerated list of values/radio buttons/  
list boxes; (Not combo box, menu of any kind)

Data protection methods:  
Not parity

Check digit, (e.g. ISBN);  
Check sum;  
Virus checking;  
Hash total;  
Control total;  
Batch total;

Data consistency methods:

Cascaded deletes;  
Referential integrity checking; 2

(b) Data Protection Act (DP Act/DPA)/Personal Data Protection Act/  
Data Protection Legislation; (Not Data Protection on its own) (Ignore year) 1

[3]

**188.** No proprietary names, e.g. Windows NT.

(a) Type: Network(allow networking, networked but NOT LAN and WAN capability); **(1)**

Reason: Do not allow “to allow each computer to print to printer”

Print requests must be re–directed to part of network   
controlling the printer ;  
Needs to control print queue;  
To allow communication between computers;  
To allow sharing of resources (Allow share printer connected via  
server but not just to share printer); **(1)** 2

(b) Type: Real time (not process control); **(1)**

Reason: System must respond in a timely manner/quickly to variations   
 in temperature and humidity level to achieve   
 equilibrium; **(1)** 2

(c) Type: batch; **(1)**  
(Ignore qualifications like “serial/linear–based”)

Reason: OMR forms can be processed in one go (but NOT inputting in one go);  
 No user/human intervention/interaction; **(1)** 2

[6]

**189.** (a) Not entities.

Collection of tables/relations;  
Tables/relations are related to one another;  
A database in which relationships are modelled  
by shared(common) attributes/fields; 1

(b) Primary key = CustomerId;  
Justification = Unique field/Every CustomerID will be different; 2

(c) (i) A field which is in two tables is worth one mark.

Foreign key = An attribute/field in one table;  
 which is the primary key in another table;

Field which links/relates;  
to tables; 2

(ii) CustomerId; 1

(iii) AdvertId; 1

(d) (i) Not easier/easier to access

To speed up searching;  
To make searching quicker; 1

(ii) Name; 1

(e) (i) 2; 1

(ii) For any column, both rows must be correct to get column mark.

No marks if there are three rows. There should be one header row and one criterion row.  
Allow criterion row above header row.  
Allow **GT 12/7/2000 in place of** >**12/7/2000**Allow **GTE 13/7/2000 and >=13/7/2000 in place of >12/7/2000  
Do not accept “after” FOR >. Do not accept ranges, e.g. 13/7/2000–1/12/2000**Order is immaterial. Ignore any extra columns.

 4

[14]

**190.** (a) Array must be sorted **(1)**, on the field being used as the search key **(1)**

(b) Description must include the following points:  
Find median record of array **(l)**Compare key field of record at median position with required search key,  
exit if found **(1)**  
If search key lower (ie required record in first half), discard second half,  
else discard first half **(1)**  
Repeat process **(1)**-until either found, or no further division  
possible so record does not exist **(1)**

(c) On each iteration, half the possible matches are eliminated,  
compared with only one for the linear search **(2)**  
*Linear search on average scans n/2 records, compared with log2n which is  
smaller  
“Looks at fewer records” without further explanation -* **(1)**

[9]

**191.** (a) Causes process to repeat indefinitely **(1)** *(NOT repeats until* maintain *is TRUE)*

(b) maintain has two values, TRUE / FALSE **(1), =>** must be Boolean **(1)**n is used as an array subscript **(1) =>** must be integer **(1)** *or n is used as a loop control and can never be non-integer within the algorithm* **(1)  
 *=>*** integer **(1)***(NOT numeric - too vague)*

(c) see table for model solution  
**(1)** *each indicated section completed correctly, including follow–through* ***(7x1)****;  
additional* **(1)** *for**correctly modifying n downwards in penultimate section  
If candidates go completely wrong but clearly deserve some credit marks can be  
awarded on the following criteria, up to a maximum of***(2)** for correct sequence of loop repetitions, including the change from 6 to 5 then 6  
- ie the column for n, including correct exit  
**(2)** for correct completion of the sequence of stations, ie the *org, dest, start, finish*columns

**(2)** for correct completion of *totalkm* column, ie correct lookups and totalling  
(**2)** for correctly executing inner if branches, ie setting *maintain* and resetting  
*totalkm* in correct places  
  
Total **(8)** for all-correct trace  
follow-through marks should be awarded where appropriate

(d) **(2)** for diagram, or explanation, showing that the journeys indicated above  
cover all routes in both directions  
*marks can be awarded for any reasoned answer (indicating achievement or not)  
providing it is consistent with the candidates's trace table*Note: the sequence is  
MK -> SW -> CW -> SW -> TW -> HK -> MK -> QB -> SW etc., which does cover all lines in both directions. Strictly speaking, whether the objective is achieved depends whether journeys to/from MK depot are passenger-carrying / revenue-earning or not.  
Either interpretation is acceptable - the marks are awarded for the explanation.

-

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| n | org | dest | last | start | finish | totalkm | maintain | Remarks |  |
|  | 0 | 3 | 1 |  |  |  |  |  |  |
|  |  |  |  |  |  |  | FALSE |  |  |
|  |  |  |  | MK |  |  |  |  |  |
|  |  |  |  |  | SW |  |  |  |  |
|  |  |  |  |  |  | 15 |  |  |  |
|  | 3 |  |  |  |  |  |  |  |  |
| 0 |  |  |  |  |  |  |  |  | Given |

-

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  |  |  |  |  |  |  |  |  |
|  |  | 4 |  |  |  |  |  | if ignored |  |
|  |  |  |  | SW |  |  |  | if ignored |  |
|  |  |  |  |  | CW |  |  |  |  |
|  |  |  |  |  |  | +27 = 42 |  |  |  |
|  | 4 |  |  |  |  |  |  | N<6 so rpt | **1 mark** |

-

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 |  |  |  |  |  |  |  |  |  |
|  |  | 3 |  |  |  |  |  | if ignored |  |
|  |  |  |  | CW |  |  |  | if ignored |  |
|  |  |  |  |  | SW |  |  |  |  |
|  |  |  |  |  |  | +27 = 69 |  |  |  |
|  | 3 |  |  |  |  |  |  | N<6 so rpt | **1 mark** |

-

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 |  |  |  |  |  |  |  |  |  |
|  |  | 1 |  |  |  |  |  | if ignored |  |
|  |  |  |  | SW |  |  |  | if ignored |  |
|  |  |  |  |  | TW |  |  |  |  |
|  |  |  |  |  |  | +37=106 |  |  |  |
|  | 1 |  |  |  |  |  |  | N<6 so rpt | **1 mark** |

-

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4 |  |  |  |  |  |  |  |  |  |
|  |  | 5 |  |  |  |  |  | if ignored |  |
|  |  |  |  | TW |  |  |  | if ignored |  |
|  |  |  |  |  | HK |  |  |  |  |
|  |  |  |  |  |  | +34=140 |  |  |  |
|  | 5 |  |  |  |  |  |  | N<6 so rpt |  |
| 5 |  |  |  |  |  |  |  |  | **1 mark** |

-

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 2 |  |  |  |  |  | if ignored |  |
|  |  | 0 |  |  |  |  |  | >140 so if executed |  |
|  |  |  | 5 |  |  |  |  |  |  |
|  |  |  |  |  |  |  | True |  |  |
|  |  |  |  | HK |  |  |  |  |  |
|  |  |  |  |  | MK |  |  |  |  |
|  |  |  |  |  |  | +12=152 |  |  |  |
|  | 0 |  |  |  |  |  |  | N<6 so rpt | **1 mark** |

-

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  |  |  |  |  | TRUE so if executed |  |
| 5 |  |  |  |  |  |  |  |  | **1 mark** |
|  |  |  |  |  |  | 0 |  |  |  |
|  |  |  |  |  |  |  | False |  |  |
|  |  | 2 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  | if ignored |  |
|  |  |  |  | MK |  |  |  |  |  |
|  |  |  |  |  | QB |  |  |  |  |
|  |  |  |  |  |  | +28 = 28 |  |  |  |
|  | 2 |  |  |  |  |  |  | N<6 so rpt | **1 mark** |

-

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 6 |  |  |  |  |  |  |  |  |  |
|  |  | 3 |  |  |  |  |  | if ignored |  |
|  |  |  |  | QB |  |  |  | if ignored |  |
|  |  |  |  |  | SW |  |  |  |  |
|  |  |  |  |  |  | +43 = 71 |  |  |  |
|  | 3 |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  | N = 6 so stop repeat loop |  |
|  |  |  |  |  |  |  |  | end while | **1 mark** |

[15]

**192.** (a) Passwords  
Encryption  
Personal Details  
Account details on-line  
Read only  
Firewall  
Any 3 3

(b) Keep data up to date  
Keep data securely  
Provide copies of personal data  
Register data with Registrar  
Keep relevant data  
Only use data for correct purposes   
Permanently delete data when out of date  
Any 3 3

[6]

**193.** (a) (i) Customer Number 1

(ii) VIN or Registration Number 1

(b) Name   
Address/Post Code   
Telephone Number   
Customer Number if not key field in (a)   
Buyer/Seller   
Car Identifier (Registration No or VIN)   
Payment details   
E-Mail address   
Date of birth   
Gender   
New/existing customer   
or any appropriate   
Any 6 3

(c) VIN If not key field in (a)  
Registration No If not key field in (a)  
Make  
Model  
Colour  
Year  
Buying Price  
Selling Price  
Buyers Customer Number  
Sellers Customer Number  
or any appropriate  
Any 6 3

(d) Customer file has record key of car file   
Car file has record of customer file  
or separate sales filewith both keys 2

[10]

**194.** (a) A language that (explicitly) describes the  
properties the desired output must have but does  
not state how the output is to be obtained.

*Rules/properties OK accept “describes what to do but not how to do it”* 1

(b) Expert systems / database queries / parallel  
processing / artificial intelligence 1

[2]

**195.** (a) Elephant 4 2  
Deer 1  
Bear 5  
Rabbit 0  
Cow 2

1 mark for rabbit having a pointer of 0   
1 mark for the others correct

(b) Start = 3 1

Freestorage = 6 1

(c) Check for free space any 5 × 1

Put data into the array at the position indicated by freestorage (animals[6])

Find position where “Monkey” must go in list (between Elephant and Rabbit)

Method for finding position

Alter “elephant” pointer to point to “Monkey”

Make “Monkey” pointer point to “rabbit”

Alter the freestorage pointer to point to next  
space / to indicate no more free space (0 / –1)

This may be answered as a pseudocode algorithm but any  
method that makes the steps clear is acceptable

[9]

**196.** (a) See trace table 10

(b) Insertion sort 1

(c) Time taken 1

to move many items / to make space for one insertion. 1

[13]

Trace table

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Comment** | **count** | **rp** | **max** | **cp** | **temp** | **numbers** | | | |
|  |  |  |  |  |  | **1** | **2** | **3** |  |
| Global values on call |  |  | 3 |  |  | 13 | 25 | 24 |  |
| rp:=1 |  | 1 |  |  |  |  |  |  | 1 mark for assigning and incrementing rp and assigning cp |
| repeat |  |  |  |  |  |  |  |  |  |
| rp:=rp+1 |  | 2 |  |  |  |  |  |  |  |
| cp:=1 |  |  |  | 1 |  |  |  |  |  |
| while rp>cp do |  |  |  |  |  |  |  |  |  |
| if numbers[rp] > numbers[cp] then |  |  |  |  |  |  |  |  |  |
| temp:= numbers[rp] |  |  |  |  | 25 |  |  |  | 1 mark for temp |
| for count:=rp to cp+1 step- 1 | 2 |  |  |  |  |  |  |  | 1 mark for count starting from 2 and numbers [2] correct (no need to show count dropping to 1) |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| numbers[count]:= numbers[count-1] |  |  |  |  |  |  | 13 |  |  |
| endfor | 1 |  |  |  |  |  |  |  |  |
| numbers[cp]:=temp |  |  |  |  |  | 25 |  |  | 1 mark for copying temp to numbers[1] |
| endif |  |  |  |  |  |  |  |  |  |
| cp:=cp+1 |  |  |  | 2 |  |  |  |  | 1 mark for incrementing cp (carry forward error) |
| endwhile |  |  |  |  |  |  |  |  |  |
| until rp=max |  |  |  |  |  |  |  |  |  |
| rp:=rp+1 |  | 3 |  |  |  |  |  |  | 1 mark for rp incremented |
| cp:=1 |  |  |  | 1 |  |  |  |  | And cp assigned 1 |
| While rp>cp do |  |  |  |  |  |  |  |  |  |
| if numbers[rp] > numbers[cp] then |  |  |  |  |  |  |  |  |  |
| endif |  |  |  |  |  |  |  |  |  |
| cp=cp+1 |  |  |  | 2 |  |  |  |  | 1 mark for cp incremented |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| endwhile |  |  |  |  |  |  |  |  |  |
| if numbers[rp] > numbers[cp] then |  |  |  |  |  |  |  |  |  |
| temp:= numbers[rp] |  |  |  |  | 24 |  |  |  | 1 mark for numbers[3] copied to temp |
| for count:=rp to cp+1 step-1 | 3 |  |  |  |  |  |  |  | 1 mark for count starting from 3 and numbers [3] |
| numbers[count]:= numbers[count-1] |  |  |  |  |  |  |  | 13 | correct (no need to show count dropping to 2) |
| endfor | 2 |  |  |  |  |  |  |  |  |
| numbers[cp]:=temp |  |  |  |  |  |  | 24 |  | 1 mark for numbers[2] assigned 24 |
| endif |  |  |  |  |  |  |  |  | And cp incremented |
| endif |  |  |  |  |  |  |  |  |  |
| cp:=cp+1 |  |  |  | 3 |  |  |  |  |  |
| endwhile |  |  |  |  |  |  |  |  |  |
| until rp=max |  |  |  |  |  |  |  |  |  |

**197.** Cost/more cable needed  
skew – individual bits may travel at different speeds within the wires/bits  
out of sync inductive distortion between parallel signals   
Not routing problems or lost or corrupted data/bits Any 2

[2]

**198.** Packet – Data split into packets  
 Each packet finds its own route Any 2  
 From computer to computer / node to node  
 Could be by example such as internet

[2]

**199.** Store table of user-ids and student names  
Record user – id of person who is on particular machine  
Record web – sites visited by machine  
Cross-referencing allows trace back to individual  
Depending on the candidates school set up various combinations are possible  
but the two points are (i) being able to record Internet activity and (ii) linking  
this to an individual 2

Not simply “by audit trace/trail” since auditing system given in question

[2]

**200.** Hackers – can Change  
 Delete  
 Insert  
 data and programs without authorisation Good desc 2 Poor desc 1

Reduced by passwords etc 1

Emanations – Signals from monitors/transmission lines etc picked up by outside sources  
 Industrial espionage Good desc 2 Poor desc 1

Use TEMPEST compliant measures  
Reduced by (metal/conducting) mesh round sensitive areas /Faraday cage  
Encryption of data before transmission Any 1

[6]

**201.** (a) A server provides services required by client computer/workstation/  
terminal/client application (NOT USER, NOT CLIENT on its own);  
such as printing, file/data storage, file server, communications-e-mail  
server, Web access server, Internet server, ISP, database, controlling  
logging in;  
*(any one example providing services required by....)* 2

(b) Any 4 points @ 1 each

NO MARKS FOR A POINT WHICH REFERENCES JUST DATA  
WHEN IT SHOULD REFERENCE A PROGRAM

BACKING STORE IS NOT ACCEPTABLE AS A SUBSTITUTE  
FOR DISK (MUST BE A DIRECT ACCESS DEVICE)

ACCEPT PARTITIONS AS A SUBSTITUTE FOR PAGES  
(BUT NOT PORTIONS)

A **memory management technique**;  
**transparent** to the user/programmer which permits;  
-the execution of a process/processes where the total virtual  
**address space** **exceeds the physical MAIN memory capacity;**  
-execution of a program **which is not entirely in main memory/  
less than the full** virtual **address space of** **a process resident in  
physical memory/ execution of partially loaded processes**/  
lets user **think there is more main memory/RAM;**

**Disk** is used as **RAM;**  
**Physical memory** is conceptually **divided into** a number of fixed  
size **pages/segments;**The virtual address space of a **program/process** **is divided** into a  
number of fixed size **pages**;  
**Page table** indicates which pages of a process are loaded and where;  
The program and data reside on **disk** and are **swapped** into memory  
and out of memory as required.(DISK THRASHING);  
NB Allow an answer which uses segmentation. No marks for answers  
describing overlay techniques

*Not computer fooled into thinking more main memory* MAX. 4

[6]

**202.** (i) Bits are sent one after another/bits sent one at a time/bits sent singly/  
bits sent along single wire(line) 1

(ii) Bits transferred simultaneously/Bits transferred down  
many wires at the same time 1

*Not single stream of bits For bit of data/bits of data ignore “of data”*

[2]

**203.** (a)



2

(b) (i) A class is a set of objects that share a common structure  
and a common behaviour;  
A class is a set/collection of objects with same attributes/properties/characteristics/fields &  
methods(accept procedures or functions for methods)  
/behaviours/operations/code;

*Not set of objects with same data* 1

(ii) Inheritance is a relationship/link among classes wherein one class  
shares the structure and behaviour of another class;  
It is where one class is derived from another class.  
It is where one class uses attributes/properties/etc/ from another class;  
It is where one class uses methods/procedures/etc from another class;  
It is where one class inherits from a parent class(hierarchy must be clear 1

(c)



1 mark for clock in root position. 1 mark for both  
Analogue and Digital clocks in leaf positions.  
1 mark for correct arrow-headed lines.

*Must be correctly vertically aligned for these two marks* 3

[7]

**204.** (a) (i) A method of connecting/linking computers/networks together which are geographically remote/wide(large) geographic area/country wide/using satellites/using telephone lines;

*Not microwaves  
Not specific distances, e.g. 1 km* 1

(ii) Modem converts digital signals into tones/analogue signals and vice versa;  
Or  
Modem converts incoming tones/analogue signals into digital signals;  
and vice versa;

*Accept correct diagram* 2

(iii) Any one reason

Sending a number of pictures over a communications link can be  
time consuming;  
Sending a number of pictures over a communications link can  
also be costly in telephone connection charges;  
Digitised colour pictures take up too much storage space on  
portable computer’s backing store/requires a lot of memory  
(RAM or backing store);  
Could lose link; MAX. 1

(iv) Picture divided up into cells/pixels;  
A fixed number of bits allocated to each cell/pixel;  
bit pattern/number to indicate colour/greyscale;  
Cells mapped onto a block of memory;  
which records the bit pattern for each cell/pixel; MAX. 3

(v) Any one purpose

using to send messages/e-mail/communicate;  
to consult on-line databases/knowledge bases;  
to order equipment;  
to book flights/consult flight timetables;  
videoconferencing possible;  
make data more widely available/publicise their work/  
expedition, e.g. Web site on Internet;

*Not backup already in question* MAX. 1

(b) Each mark is for an appropriate data type

Record

TagCode: String / Text /Character array/ Array of Char/ Pic X(6)/Pic 9(6) / BCD/LongInteger;

*Not character field*

BodyLength: Real/Floating Point/Fixed Point/Single/Float;

Weight : Integer;

Sex : user-defined sub-range type with just two values, e.g. ‘A’..’B’,  
0..1/EnumeratedType/Boolean/YesNo/TrueFalse;

LongTail Boolean/YesNo/TrueFalse/user-defined sub-range type, e.g. ‘A’..’B’,  
0..l/EnumeratedType;

End 5

(c) Starting list of numbers 260 210 270 180 230

|  |  |
| --- | --- |
| **Variable j** | **List of weights after each iteration of Repeat loop** |
| 1 | 210 260 180 230 270 |
| 2 | 210 180 230 260 270 |
| 3 | 180 210 230 260 270 |
| 4 | 180 210 230 260 270 |

*Once trace has gone wrong do not award any more marks  
If mirror image then mark first row incorrect but follow through rest .  
If candidate has traced algorithm correctly but made a typographic slip.  
E g consistently written 170 instead of 180 then mark first instance  
wrong and then follow through rest* MAX. 4

(d) Introduce a Boolean variable NoMoreExchanges which is set equal  
to True before For loop;  
it is set equal to False inside For loop if an exchange of elements  
of array Animals takes place;  
use the value of NoMoreExchanges to terminate the RepeatUntil  
loop if no more exchanges have taken place;

*Introduce Counter reset to e.g. zero   
Increment Counter if an exchange takes place;  
Use value of counter to terminate*

 3

[20]

**205.** (a)



*No marks for Id on its own.  
No marks for Name, Address on their own. But abreviations for Producer,  
etc which are clear are allowed* MAX. 4

(b) (i) **Producer** (ProducerID, ProducerName)

*No extra attributes* 1

(ii) **Venue** (VenueId, VenueName, VenueAddress/Address)

*No extra attributes*

(iii) \_\_\_\_\_1\_\_\_\_\_\_\_\_ 1  
**Client** (ClientId, ClientName, AgentId)

*Max 1 if extra attributes* 2

(iv) \_\_\_\_\_\_\_\_\_1\_\_\_\_\_\_\_ 1  
**VenueHired**(ProducerId,ApptDate, VenueId)

*1 for correct primary key* 3

OR

\_\_\_\_\_\_\_\_\_1\_\_\_\_\_ 1  
**VenueHired**(VenueId,ApptDate, ProducerId)

*1 for correct primary key  
For each extra attribute lose mark from allocation except primary key mark  
Accept Date and Time* MAX. 1

(v) \_\_\_\_\_\_\_\_\_\_\_\_1\_\_\_\_\_\_\_\_\_\_\_  
**ClientAuditionAppointment** (ClientId,ApptDate, ApptTime, ProducerId)  
 and/or VenueID

*1 for correct primary key  
Accept Date and Time* 3

(c) **Select** *ClientId, ClientName, Client/Agent.AgentId, AgentName*

1 1  
**From** *Client, Agent***Where** *Client.AgentId = Agent.AgentId*  
 1 1

*Mark only first Select... if more than one  
1 for 4 correct attributes  
1 for correct table name in front of AgentId* 6

[20]

**206.** Ill trained/ inexperienced users  
Fire/Explosion  
Burglary  
Hardware Failure  
Software Failure  
Viruses  
Hackers  
Disgruntled Employees  
Any 3  
1 mark for each risk + 1 mark each suitable defence

[6]

**207.** (a) user connected to system  
data not necessarily updated immediately 3

(b) user connected to system  
data updated immediately  
in each case 2 marks for good description,  
1 mark for incomplete description + 1 for suitable example 3

[6]

**208.** See trace table below. Sections corresponding to marks are shaded.

1 mark for newstring, message and procedure call correct. 1 mark for x and piece correct. 1 mark for outstring correct. 1 mark for changing x and a. 1 mark for tracing the second call to docharacter. 1 for section correct. 1 mark for third call correct. 1 mark for endprocs all correctly traced. 1 mark for outputs correct



[9]

**209.** Computer  
Modem/ISDN line  
communications software / e-mail software  
bank’s software  
**not** telephone line Any 3 × 1

[3]

**210.** (i) Integrity describes the consistency of data before and after processing 1 **Data that has not been accidentally or maliciously corrupted** **is said to have integrity.** 1

(ii) Any method which achieves the above is acceptable  
Good description 2Muddled description 1 2+2

[4]

**211.** (i) Mouse; joystick; Modem link - single stream of bits down single wire **Not** speaker

(ii) Local printer, scanner, hard drive, - several streams of data down several wires simultaneously  
*Only use printer* ***once***

For each, 1 mark for example 1 mark for description 2 × 2

[4]

**212.** Hardware and 2software conventions (rules)  
used to control the transmission of data 2

[4]

**213.** (a) A database where the data is structured as a series of tables/entities and the 1DBMS provides tools for joining tables together and selecting items from 1within tables

(b) bar code, location, edition, size, weight, editors, pages, publisher, author,  
number of copies, category, buying price, selling price, hard or  
paperback, year of publication   
**(Do NOT allow ISBN or TITLE)** Any 4 × 1

(c) Book many to one publisher  
1 mark for diagram 1 mark for relationship 2

(d) Order book identifier, order no  
Customer order identifier, name + address or customer id  
Sales person sale identifier, staff no  
Sale order identifier, sale no  
Any other sensible entity for a bookshop Entity 1  
 Relationship 1  
 Key field 1

[11]

**214.** (a) program designed to replicate itself (and spread on its own),  
preferably without anyone aware of its existence.  
Damage files / hardware or amuse user Any 2 × 1

(b) For each method given  
 2 marks for good description  
 1 mark for confused description  
Methods can be drawn from any of the four groups. Any 4 × 2

Preparation/ prevention - Write protect all floppy disks; make  
regular back ups; restrict use of floppy disks; Scan new software  
source disks with anti- virus software on a stand alone/ non- network  
computer; networks restrict floppy drives.

Detection - Be aware of evidence for known viruses e.g. date virus;  
look for unexpected signs of virus activity: unexpected disk accesses:  
changes to program **files:** presence of unusual files in directories.

Containment - Disconnect an infected machine if necessary; stop  
immediately a computer’s activity on detection of any of the above;  
scan any new software to be installed on the computer network for  
viruses; restrict the use of floppy disks on networked computers.

Recovery - Replace infected files with clean back ups; scan all files  
on computer with virus software;” Tracing possible sources of  
infection” if qualified appropriately could appear in more than  
one category,

(c) could be a new virus not known to the virus detection software;  
a virus which loads before the virus detection system is itself loaded;  
may be able to hide its activity from the protection software by  
residing in the boot sector of a disk.

Virus checker needs to be switched off before installing software Any 2 × 1

[12]

**215.** (a)

|  |  |  |  |
| --- | --- | --- | --- |
| Low | High | Middle | Found |
|  |  | *5* |  |
| *6* |  | *8* |  |
|  | *7* | *6* |  |
| *7* |  | *7* | true |

1 mark for each entry above (as far as first incorrect entry)  
**mark row by row**

max **(7)**

(b) *binary search/chop;  
iterative (no synonyms)*(specific searches not on AS syllabus - *search* sufficient for mark)

[8]

**216.** Random access files

(a) *even spread;  
few collisions;  
quick to compute;  
generates all addresses in range;*

One mark per point max **(2)**

(b) *too many additions and deletions;  
so records are not at their home address / in overflow area;  
so search times become too long;*

One mark per concept max **(3)**

[5]

**217.** (a) Network connecting together geographically remote computers  
(separate sites/connected by phone lines/satellites/Internet) 1

(b) Rules **(1)** used to define the ways in which different **(1)**  
computer networks/computers may be connected to each other.  
(For rules do not accept standard) 2

(c) Need common standard **(1)** / because machines/networks different.  
(Needs idea of transmission) /toenable successful communication 1

[4]

**218.**

|  |  |  |  |
| --- | --- | --- | --- |
| Repeat S****Q Until Qempty | Queue emptied  to a stack | Elements taken from front of queue and placed/pushed on stack | 1  1 |
| Repeat Q****S Until S empty | stack emptied  to a queue | Elements popped/taken from top of stack placed in queue | 1  1 |
| Or suitable diagram |  |  | 1 |

[4]

**219.** (a) (i) A class is a set of objects which share a common structure and a common  
behaviour / Object type that defines a data structure /fields /properties and  
the methods /procedures /functions that act on these fields 1

(ii) Inheritance is a relationship among classes wherein one class shares the structure/data structure /fields /properties and behaviour/methods/procedures/functions/actions of another class  
Or  
Inheritance is when a class has the same characteristics as its parent class 1

(b) 3



[5]

**220.** (a) 

Labelling must clearly indicate term 3

(b) 

Must clearly indicate subsets 2

(c) A procedure which is defined in terms of/ calls itself /re-entrant 1

(d) State of machine/return address/parameter **(1)**  
needs to be stored/held **(1)**  
to enable a previous execution of T to be resumed **(1)**

Or  
so that each call to T **(1)**  
can pass **(1)**  
a new value of the parameter **(1)** 3

(e)



 10

(f) In-order traversal 1

[20]

**221.** (a) 10011101110 1

(b) bans (must be lower case) 1

(c) 

swap **b** and **n** is worth 2 marks 2

(d) 26bits 1

(e) (i) ASCII **(1)**  
 UNICODE **(1)**  
 EBCDIC **(1)**  
 Baudot **(1)** 1

(ii) Frequency of appearance of characters in plain text/most common  
characters **(1)**  
Those characters which appear most frequently should be near the  
top of the tree. **(1)** 2

(iii) In plain text message where the average length of tree code **(1)** is less 2  
than **(1)** that of the fixed length code.  
no of occurrences of character  
Yes, provided that (sum of frequency of occurrence multiplied by bits  
saved per character is





(ii) *Real numbers used for scientific calculations:*   
Floating point **(1)**  
Mantissa \* **(1)  
(1) (1)** 2Exponent

Or Mantissa and exponent **(1)**  
move point **(1)**  
correct no of places **(1)** 4

(iii) *Scanned picture:*  
Bit-map **(1)**  
*Any 2 points @ 1 each*Picture divided up / pixels **(1)**  
Colour/greyscale of each part **(1)**  
Coded in bits/binary **(1)** 3

[20]

**222.** (a)  5

(b) (i)  2



2



4

 3



4

[20]