AQA Examination-style questions

Section 1 Problem solving

Information hiding and abstraction

1 What is meant by information hiding? State two reasons why information hiding is useful. *(3 marks)*

2 Explain what is meant by (a) abstraction by generalisation and (b) abstraction by representation. *(2 marks)*

3 A seating arrangement is required for a dinner party of foreign ambassadors. It is important that certain ambassadors are not seated at the same table as other ambassadors for diplomatic reasons. The rules are as follows:

Ambassador A must not be seated at the same table as ambassadors D and E

Ambassador B must not be seated at the same table as ambassadors C and E

Ambassador C must not be seated at the same table as ambassadors B and D

Ambassador D must not be seated at the same table as ambassadors A, C and E

Ambassador E must not be seated at the same table as ambassadors A, B and D

(a) Find a suitable representation for this problem that will lend itself to being automated. *(5 marks)*

(b) What is the minimum number of tables that will be required to keep the relevant ambassadors apart? *(2 marks)*

Comparing algorithms

1 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 $O(a^n)$
Algorithm C that is $O(n^2)$ *(1 mark)*

(b) Describe a linear search and explain why it is $O(n)$. *(4 marks)*

(c) Describe a bubble sort and explain why it is $O(n^2)$. *(4 marks)*

AQA, Specimen paper

Turing Machines

1 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.**

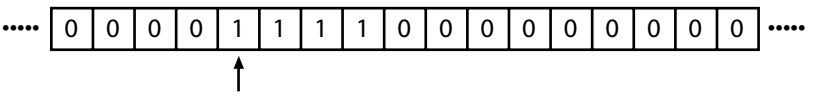


Figure 1

The Turing machine starts in state S_0. The given Turing machine uses the following four rules to perform its action:

$(S_0, 1, S_0, >>)$ means if in state S_0 and the tape head reads a '1' remain in state S_0, move the tape head right one cell.

$(S_0, 0, S_1, 1)$ means if in state S_0 and the tape head reads a '0' move to state S_1, write a '1' to the current cell.

$(S_1, 1, S_1, <<)$ means if in state S_1 and the tape head reads a '1' remain in state S_1, move the tape head left one cell.

$(S_1, 0, S_2, >>)$ means if in state S_1 and the tape head reads a '0' move to state S_2, move the tape head right one cell.

Figure 2 shows the finite state transition diagram for this machine. The Turing machine starts in state S_0 and finishes in state S_2. In the S_2 state the machine stops on a block of '1's with the read/write head on the leftmost '1'.

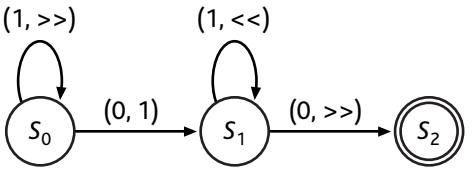
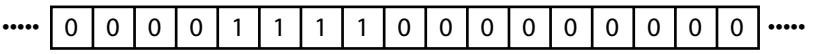


Figure 2

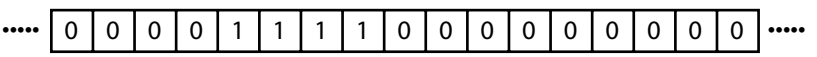
(a) (i) Show the position of the read/write head, using an arrow as in **Figure 1**, when state S_1 is first reached.



(1 mark)

(ii) What symbol will be in the cell that the read/write head is positioned over when state S_1 is first entered and the rule has been applied? *(1 mark)*

(b) Change the tape shown below to the correct set of '0' and '1' symbols for state S_2 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 marks)*



(c) What does this Turing machine calculate? *(1 mark)*

AQA, Specimen paper

Intractable problems

1 A sailor is shipwrecked on an island populated by two groups of natives. The natives in one group consistently lie whilst the natives in the other group always tell the truth.

The natives know which group they belong to but it is not obvious to you. Your survival depends on identifying who are the liars and who are the truth-tellers.

(a) The sailor encounters a native and asks him whether he is a truth-teller but, unfortunately, the sailor is prevented from hearing the native's initial answer by the crashing of a wave on the seashore. The sailor responds, 'Sorry, did you say that you are a truth teller?' 'No, I did not,' was the native's reply. The sailor correctly deduces that the native belongs to the liars' group? Explain how the sailor reached this conclusion. *(1 mark)*

(b) Name the class of logic problems to which (a) belongs? *(1 mark)*

(c) The sailor now meets two natives on the island. The first says, 'Both of us are from the liars group.' Which group is:

(i) The first from? State your reasoning. *(1 mark)*

(ii) The second from? *(1 mark)*

(d) A person on the island who cuts another's hair is labelled a haircutter. The island has just one haircutter. This haircutter cuts the hair of everyone who does not cut their own hair and no one else.

(i) Can the question 'Who cuts the hair of the haircutter?' be answered? State your reasoning. *(2 marks)*

(ii) Name the class of logic problems to which the outcome of the haircutter problem belongs? *(1 mark)*

(e) The sailor asked the leader of the truth-tellers group to supply him with planks of wood with which to build a boat. The sailor drew an 8-by-8 grid of squares in the sand and asked for two planks of wood on the first square, four planks on the second, eight planks on the third, et cetera.

(i) How many planks would have to be placed on the:

fourth square *(1 mark)*

tenth square *(1 mark)*

sixty-fourth square? *(1 mark)*

(ii) One classification that computer scientists use for problems is whether they are tractable or intractable.

How would you classify the planks of wood problem? *(1 mark)*

Comment on its implications in space and time. *(2 marks)*

2 (a) Problems such as creating a lesson timetable for classes in a school week are classified as intractable. What does this mean? *(2 marks)*

(b) The fact that school timetabling is an intractable problem doesn't prevent their production. Explain how this is possible? *(2 marks)*

3 Explain what is meant by the Halting Problem. *(2 marks)*

AQA, New question

Regular expressions, BNF and RPN

1 (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> ::5 <integer> | <integer> <operator> <expression>

<integer> ::5 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

<operator> ::5 1 | – | * | /
```

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 marks)

(b) (i) Express the infix expression 5 + 6 * 2 in reverse Polish notation. *(2 marks)*

(ii) Give one advantage of Reverse Polish Notation. *(1 mark)*

AQA, New question

2 State whether or not the following strings match the regular expression `[+\-]?[0-9]+`: (a) `36`, (b) `+`, (c) `-56709`. *(3 marks)*

AQA, New question

AQA Examination-style questions

Section 2 Programming concepts

Programming Paradigms

1 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 inheritence diagram for these classes. *(2 marks)*

(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? *(2 marks)*

(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**. *(6 marks)*

2 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.

(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. *(4 marks)*

(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? *(2 marks)*

3 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. *(1 mark)*

(b) Describe how event-driven programs differ from non-event-driven programs. *(2 marks)*

(c) List two features of an object. *(2 marks)*

(d) Name an object that might be part of a GUI. *(1 mark)*

AQA, 2007

4 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 marks)*

(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? *(2 marks)*

(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. *(6 marks)*

AQA, 2006

5 (a) In object-oriented programming, what is meant by inheritance? *(1 mark)*

(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 marks)*

AQA, 2005

Recursion

1 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? *(1 mark)*

(b) (i) Complete **Table 1** by dry running the procedure call `P(T)` for the tree `T` given below. *(6 marks)*

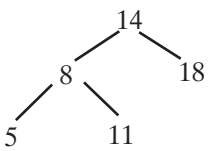
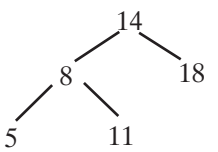


Table 1

Procedure Call		Output
P_1		

(ii) What does the procedure `P` describe? *(2 marks)*

AQA, 2008

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

(a) What is meant by a recursively defined procedure? *(1 mark)*

(b) What is the role of the stack when a recursively defined procedure is executed? *(1 mark)*

(c) Dry run the procedure call **ProcA(11, 1)** using the data in the array, **Items**, by completing the trace table, **Table 2**.

```
Procedure ProcA(Number,Entry)
  If Number <> Items[Entry]
    Then ProcA(Number,Entry+1)
    Else Output(Entry)
  EndIf
EndProc
```

Table 2

Number	Entry	Output
11	1	

	Items
[1]	4
[2]	5
[3]	8
[4]	11
[5]	15
[6]	19
[7]	21
[8]	28
[9]	33

(4 marks)

(d) What is the purpose of this algorithm? *(1 mark)*

(e) Give a situation where this algorithm will fail. *(1 mark)*

(f) Suggest a modification to the algorithm that will prevent it from failing. *(1 mark)*

(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)? *(1 mark)*

AQA, 2007

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

(a) What is meant by recursively defined? *(1 mark)*

(b) Describe how a stack is used in the execution of procedure **Process**? *(2 marks)*

(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
```

Printed Output:

Table

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

(6 marks)

(d) What does procedure **Process** describe? *(1 mark)*

AQA, 2005

4 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 time 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? *(1 mark)*

(b) Why is a stack necessary to execute procedure B recursively? *(1 mark)*

(c) Dry run 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 marks)*

(d) What process does procedure B describe? *(1 mark)*

Lists and pointers

1 (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 marks)*

(ii) Redraw the list after two additional items, Grouse and Snipe, are added. *(2 marks)*

(b) This linked list is said to be a *dynamic structure*. What is meant by the term dynamic structure? *(2 marks)*

(c) Explain how memory was allocated for the two additional data items. *(2 marks)*

Stacks and queues

1 (a) State the principle of operation of a set of data values which behave as a stack. *(1 mark)*

(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.

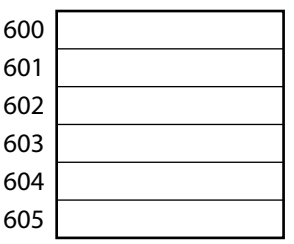


Figure 1

(i) Show on a copy of **Figure 2** the state of the stack after the characters 'A', 'V', 'E', 'R' and 'Y' join the stack. *(1 mark)*

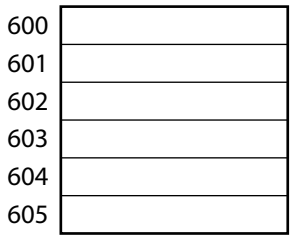


Figure 2

(ii) Two items are removed from the stack. Show on a copy of **Figure 3** the state of the stack. *(1 mark)*

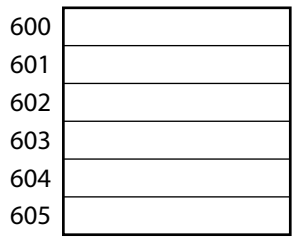


Figure 3

(iii) Two new characters 'S' and 'P' join the stack. Show on a copy of **Figure 4** the final state of the stack. *(1 mark)*

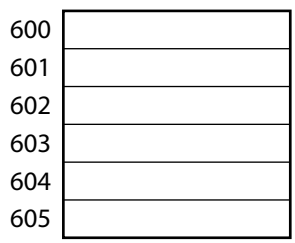


Figure 4

(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. The first item added to the stack was character 'A'.

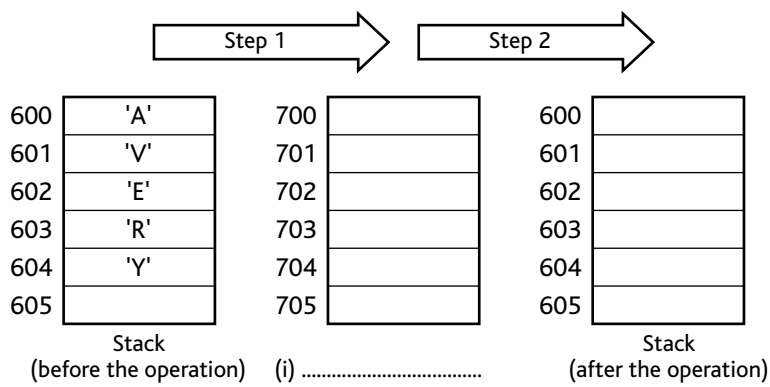


Figure 5

(i) Name the second data structure. Label a copy of **Figure 5**. *(1 mark)*

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

(iii) Describe **Step 2** in **Figure 5**. *(1 mark)*

(iv) Show on a copy of **Figure 5** the final contents of all the memory locations. *(2 marks)*

AQA, 2007

2 **Figure 6** shows an area of 100 memory locations which are used to store string data values.
This area of memory behaves as a queue. The Front and Rear values are used to control changes to the queue. **Figure 6** shows the state of the queue after three values have been added.

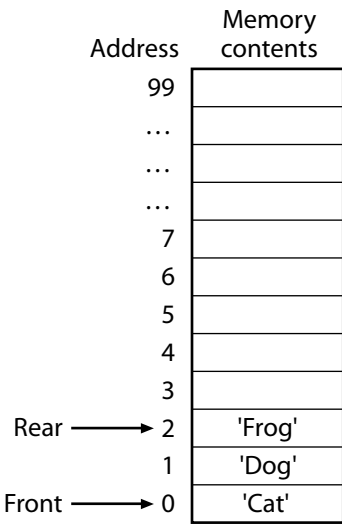


Figure 6

(a) What is the function of the Rear pointer? *(1 mark)*

(b) Which item in the queue will be the first item to leave? *(1 mark)*

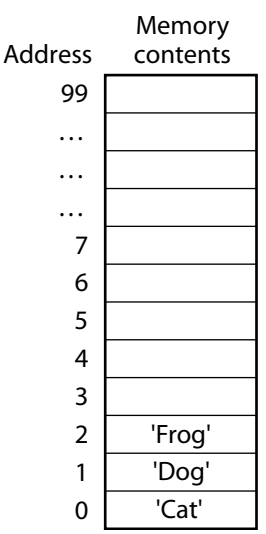


Figure 7

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

Draw on a copy of **Figure 7** the new state of the queue, including the Front and Rear pointers. *(3 marks)*

(d) After extensive data changes the queue will become unusable. Explain why this is so. *(2 marks)*

AQA, 2007

3 (a) In the context of data structures what is meant by the terms (i) FIFO, (ii) LIFO? *(2 marks)*

(b) Queue and stack are examples of data structures. Tick in the following table to indicate whether they are FIFO or LIFO data structures. *(2 marks)*

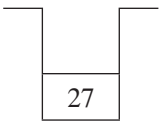
	FIFO	LIFO
Queue		
Stack		

(c) Describe **one** example of the use of a stack. *(2 marks)*

(d) Describe **one** example of the use of a queue. *(2 marks)*

AQA, 2005

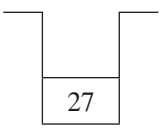
4 A stack is a type of abstract data type (ADT) that is often known as a LIFO data type. A stack with a single element 27 may be drawn as follows:



(a) What is the meaning of the term LIFO? *(1 mark)*

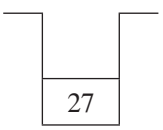
(b) A stack has two operations, **Push** and **Pop**. **Push n** adds item **n** to stack. **Pop** removes one item from the stack. A number of operations are performed, **in sequence**, on the stack drawn above. Using the stack diagrams below show the effect of this sequence of operations.

(i) Push 5



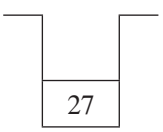
(1 mark)

(ii) Push 9



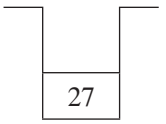
(1 mark)

(iii) Pop



(1 mark)

(iv) Push 6



(1 mark)

(c) Give **one** example of the use of a stack. *(1 mark)*

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

(a) Give a disadvantage of

(i) an array implementation. *(1 mark)*

(ii) a linked list implementation. *(1 mark)*

(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? *(1 mark)*

(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? *(1 mark)*

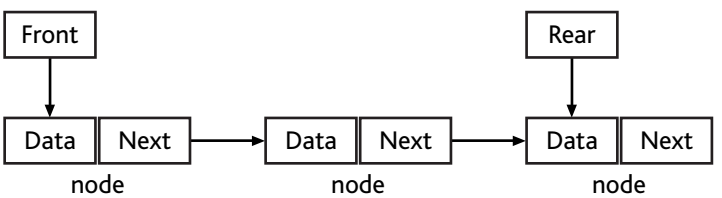


Figure 8

6 (a) Assume a queue is implemented as a linked list using pointers as in **Figure 8**.
Give the **three** steps required to remove a node from the front of the queue and recover the memory space occupied by the node. *(3 marks)*

(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. *(1 mark)*

(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? *(1 mark)*

(ii) Give **one** advantage of array implementation. *(1 mark)*

(iii) Give **two** disadvantages of array implementation. *(2 marks)*

AQA, 2007

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

(a) Give a disadvantage of:

(i) an array implementation; *(1 mark)*

(ii) a linked list implementation. *(1 mark)*

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

(i) an array; *(1 mark)*

(ii) a linked list? *(1 mark)*

AQA, 2006

8 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 marks)*

(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 marks)*

(c) Why are queues in computer systems usually implemented as circular queues? *(2 marks)*

Graphs and trees

1 The following diagram represents a directed graph.

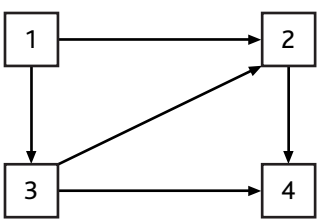


Figure 1

(a) By filling in the following diagram, show how this digraph can be represented as an adjacency matrix. *(3 marks)*

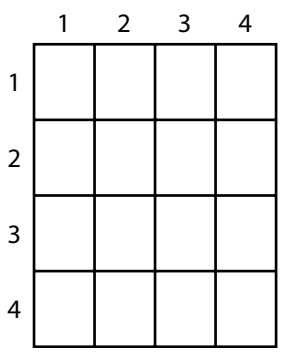


Figure 2

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

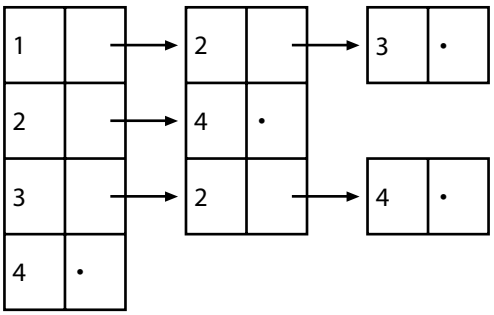


Figure 3

(i) Give one advantage of the adjacency list implementation. *(1 mark)*

(ii) Give one advantage of the adjacency matrix implementation. *(1 mark)*

(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? *(1 mark)*

(ii) Explain why you chose this implementation. *(2 marks)*

AQA, Specimen paper

Searching and sorting

1 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, Table 1.

```
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
```

Table 1

Number	Lower	Upper	Current

Value returned _____ *(8 marks)*

(b) What is the purpose of this algorithm? *(1 mark)*

AQA, 2007

2 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? *(1 mark)*

(ii) Explain your answer. *(1 mark)*

(b) (i) What is the maximum number of items accessed when searching for a particular item from the given list using a binary search? *(1 mark)*

(ii) Explain your answer. *(1 mark)*

(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 below. *(5 marks)*

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

Count1	Count2	Temp	A				
			[1]	[2]	[3]	[4]	[5]
–	–	–	23	45	16	12	31
1	1						

(5 marks)

(ii) What is the purpose of this algorithm? *(1 mark)*

(iii) Suggest one way the algorithm could be improved. *(1 mark)*

AQA, 2006

3 A recursively-defined procedure X with three integer parameters is defined below. *x* DIV *y* calculations 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 mark)*

(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 marks)

(ii) What process does procedure X describe? *(2 marks)*

4 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?

(ii) Explain your answer.

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

(ii) Explain your answer. *(4 marks)*

5 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+1) ← Temp
            Flag ← True
          End
      X ← X+1
    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. *(2 marks)*

(b) What algorithm does the procedure P describe? *(1 mark)*

(c) What is the purpose of Flag in this procedure? *(1 mark)*

Simulation

1 (a) Explain what is meant by computer simulation. *(1 mark)*

(b) Why are computer simulations used? *(1 mark)*

(c) Give an example where computer simulation might be used. *(1 mark)*

2 Ships arrive at a small harbour currently with one berth. A ship can only unload its cargo when it is moored at a berth.

(a) What are the entities and their attributes of this system? *(3 marks)*

(b) What are the possible states, events and activities of this system? *(3 marks)*

(c) Draw a life cycle diagram for the ships and the berth. *(2 marks)*

(d) Assume a ship arrives every 2 hours and it takes 3 hours to moor and unload. Using a table with suitable headings, show the state of the system after 10 hours. *(6 marks)*

(e) List three possible variables of this system. *(3 marks)*

AQA Examination-style questions

Section 3 Real numbers

1 The binary pattern 1011 1111 0010 could be interpreted in a number of different ways.

(a) State its hexadecimal representation. *(1 mark)*

(b) State its value in denary if it represents a two's complement integer. *(2 marks)*

(c) State its value in denary if it represents an unsigned fixed-point number with four bits after the binary point. *(3 marks)*

(d) The system stores floating-point numbers in normalised form using two's complement, with an 8-bit mantissa and a 4-bit exponent. State the value of 1011 1111 0010 in denary if it represents a normalised two's complement floating-point number. *(3 marks)*

(e) Give two advantages of normalised floating-point format over fixed-point format. *(2 marks)*

AQA, 2008

2 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 marks)*

(b) (i) State its value in denary if it represents a two's complement floating-point number with an 8-bit mantissa followed by a 4-bit exponent. *(3 marks)*

(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 mark)*

(iii) Why should floating-point numbers be stored in normalised form? *(1 mark)*

AQA, 2005

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

(a) State its hexadecimal representation. *(1 mark)*

(b) State its value in denary if it represents an unsigned fixed-point number with four bits after the binary point. *(3 marks)*

(c) State its value in denary if it represents a two's complement integer. *(2 marks)*

(d) The system stores floating-point numbers in normalised form using two's complement, with an 8-bit mantissa and a 4-bit exponent.

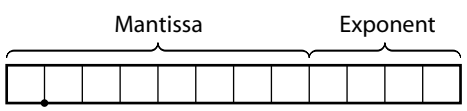


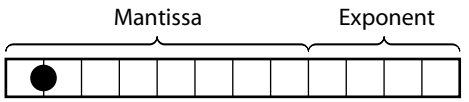
Figure 1

(i) State the value of 1011 1110 0100 in denary if it represents a two's complement floating-point number. *(3 marks)*

(ii) This floating-point number is said to be normalised. How does the bit pattern indicate that this number is normalised? *(1 mark)*

AQA, 2005

4 (a) 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 marks)

(ii) Why should floating point numbers be stored in normalised form? *(1 mark)*

5 (a) The number 0111 0010 1011 1101 is stored in twos complement notation in 16 bits with the most 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 2^{16} and 2^{32}	Between 2^{2} and 2^{-2}	$<2^{-2}$

(2 marks)

(b) The number 0110 0001 0100 1000 is stored in the **same format**. Convert this number into denary. *(3 marks)*

(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 marks)*

AQA Examination-style questions

Section 4 Operating systems

Role of an operating system

1 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 mark)*

(b) Name three types of resource managed by the operating system. *(3 marks)*

AQA, 2003

Operating system classification

1 What is the main difference between a desktop operating system and an operating system for an embedded computer system? *(2 marks)*

2 Desktop operating systems run on client computers in a client–server system. How do server operating systems differ from desktop operating systems? *(2 marks)*

3 Give three criteria that you would use to decide whether a computer-operated device requires an operating system. *(3 marks)*

4 Give three requirements that a real-time operating system must satisfy. *(3 marks)*

AQA, New questions

Section 5 Databases

1 A chef keeps her recipes on a single-table database system. **Figure 1** shows the Recipe Table.

Recipe ID	Dish	Recipe ingredients (including quantity)	Preperation Time	Cooking Time	Number of Servings	Cooking Instructions
1	Hummus	250g chickpeas 6 clove 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	5 minutes	none	4	Mix all salad ingredients together. Season with salt and pepper. Dress with vinaigrette.
3	Casserole	500g chickpeas	10 minutes	2 hours	4	Cook chickpeas until nearly soft. Add cubed potatoes and tomatoes. .....
: :	: :	: :	: :	: :	: :	: :

Figure 1

The chef's only supplier provides her with an online price list for her ingredients. **Figure 2** shows the PriceList Table.

FoodItemID	FoodItemName	PackSize	Price
Tom001	Tomatoes	400g	£0.55
Chi002	Chickpeas	250g	£0.75
Cuc003	Cucumber	single	£0.50
:	:	:	:

Figure 2

(a) (i) Which of the above two tables is **not** in First Normal Form? *(1 mark)*

(ii) Why? *(1 mark)*

(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 price list details.

Database theory states that database tables should be *fully normalised*.

(i) What does *fully normalised* mean? *(2 marks)*

(ii) Why is it desirable that tables are fully normalised? *(1 mark)*

(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 mark)*

(ii) FoodItem *(1 mark)*

(iii) RecipeIngredient *(4 marks)*

(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. *(5 marks)*

AQA, 2007

2 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? *(1 mark)*

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 licensed

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 marks)*

(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 *(3 marks)*

(ii) CREATE TABLE SoftwareInstallation *(4 marks)*

(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. *(4 marks)*

AQA, 2007

3 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.

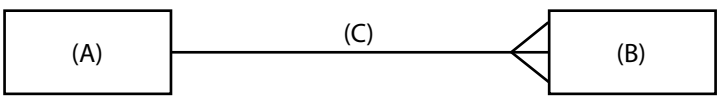


Figure 3

(2 marks)

(ii) Name this type of diagram. *(1 mark)*

(b) Complete the following Data Definition Language (DDL) statements to create the fully normalised tables necessary to implement the database.

CREATE TABLE HardwareItem

CREATE TABLE EquipmentLoan *(6 marks)*

(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. *(6 marks)*

AQA, 2006

4 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, MaximumMark)

(a) Draw an Entity–Relationship (E–R) diagram for the tables:

(i) Student and WorkDone *(1 mark)*

(ii) Student and MarkAwarded *(1 mark)*

(iii) LifeCyclePhase and MarkAwarded *(1 mark)*

(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; *(1 mark)*

(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. *(5 marks)*

AQA, 2005

5 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, DataOfBirth)

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 mark)*

(ii) GalaRace and GalaRaceSwimmer *(1 mark)*

(iii) Stroke and GalaRace *(1 mark)*

(iv) Gala and Swimmer *(1 mark)*

(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. *(1 mark)*

(ii) The SwimmerNo for each swimmer in race with RaceNo = 5 and gala with GalaNo = 2, presented in ascending order of TimeRecordedForRace. *(3 marks)*

(iii) The surname of the winner of each race in gala with GalaNo = 4. *(3 marks)*

6 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 Acession Number to each copy of a book in the library.

BookLoan (AccessionNumber, BorrowerNumber, DateDueBack)

- 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)

Borrower(BorrowerNumber, Surname, Initials, Address)

(a) Draw an entity relationship diagram for the tables:

(i) Borrower and BookLoan *(1 mark)*

(ii) Book and Borrower *(1 mark)*

(b) Using the SQL commands SELECT, FROM, WHERE, and any others considered appropriate, write and SQL statement to query the database tables for each of the following:

(i) The title of the book with ISBN "1-57820-082-2". *(2 marks)*

(ii) The name of the author and ISBN of a book with the AccessionNumber 1234. *(4 marks)*

(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?

(1 mark)

7 A hospital stores details of its wards, patients and their medical condition in a database in a 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 complete entity relationship diagram shown in **Figure 4**, as an aid, show the degree of **three** more relationships which exist between the given entities.

Figure 4

(3 marks)

(b) Using the following format

TableName(<u>PrimaryKey</u>, Non-keyAttribute1, Non-keyAttribute2, etc)

describe tables, stating all attributes, for the following entities underlining the primary key in each case.

(i) Ward *(1 mark)*

(ii) Patient *(2 marks)*

(iii) MedicalCondition *(2 marks)*

(iv) PatientMedicalCondition *(2 marks)*

(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 marks)*

AQA Examination-style questions

Section 6 Communications and networking

Communication methods

1 (a) **Figure 1** represents 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.

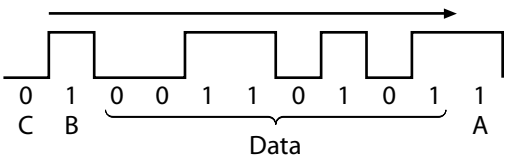


Figure 1

(i) bit A *(2 marks)*

(ii) bit B *(2 marks)*

(iii) bit C *(2 marks)*

(b) What is meant by:

(i) baud rate, *(1 mark)*

(ii) bit rate, *(1 mark)*

(iii) bandwidth? *(1 mark)*

(c) The baud rate and the bit rate of a communication channel may be different. Explain how this can occur. *(2 marks)*

AQA, 2005

2 (a) State what is meant by **serial transmission** of data. *(1 mark)*

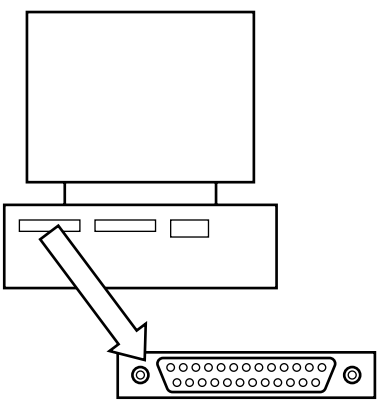


Figure 2

(b) (i) **Figure 2** 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. *(2 marks)*

(ii) When would it be **inappropriate** to use parallel data transmission, even when the communicating device has a parallel port? *(1 mark)*

(c) Define asynchronous data transmission. *(1 mark)*

AQA, 2008

3 A stand-alone computer system is set up with *parallel data transmission* to a printer.

(a) What is parallel data transmission? *(1 mark)*

(b) What is meant by handshaking in this context? *(2 marks)*

4 (a) Explain the modes of network operation:

(i) Baseband *(2 marks)*

(ii) Broadband *(2 marks)*

(b) Bus local area networks such as Ethernet operate in baseband mode. Wide area networks operate in broadband mode. Give two reasons why wide area networks are operated in broadband mode. *(2 marks)*

5 One method of sending data to a printer is by using parallel transmission.

(a) What is meant by parallel data transmission? *(1 mark)*

(b) Parallel transmission should **not** be used over long distances.

(i) Why not? *(1 mark)*

(ii) How should data be transmitted over long distances? *(1 mark)*

Networks

1 (a) Explain why the performance of a bus local area network such as Ethernet degrades with increase in network traffic. *(2 marks)*

(b) Explain how switched Ethernet overcomes this problem. *(2 marks)*

AQA, 2002

2 **Figure 1** shows the TCP/IP protocol stack applied to a LAN (Local Area Network).

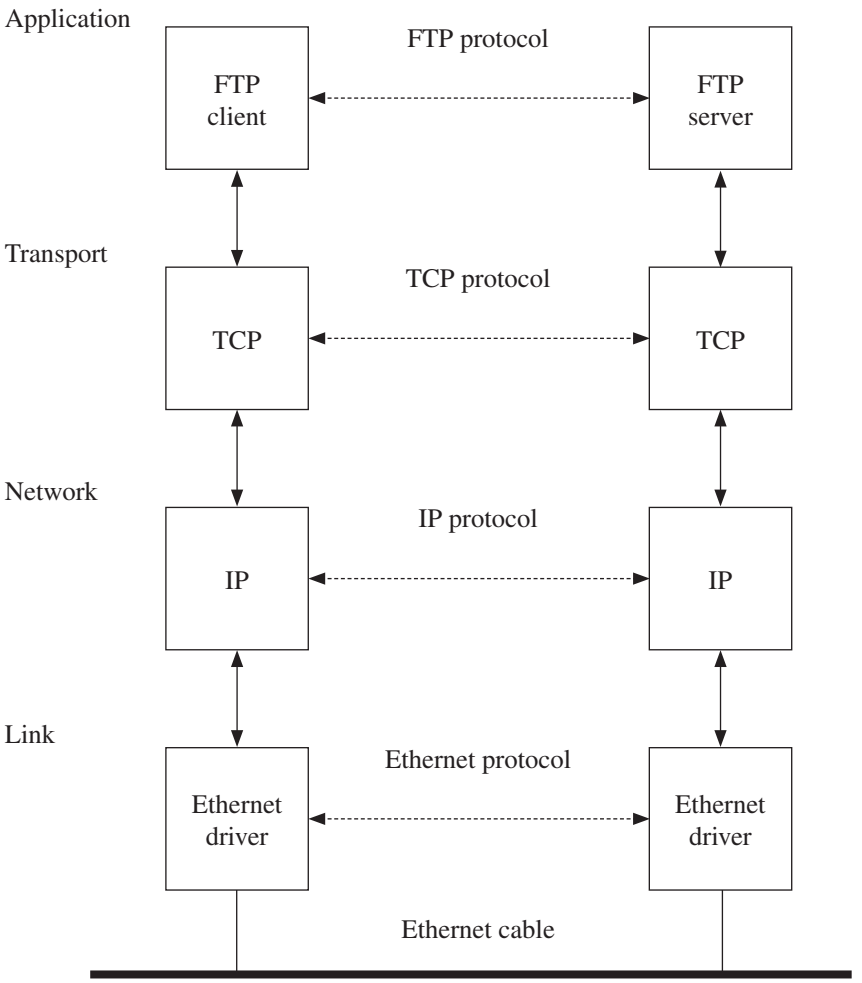


Figure 1

(a) What is a protocol? *(1 mark)*

(b) What is the topology of this local area network? *(1 mark)*

(c) State a suitable type of network cable for the physical connections of this LAN. *(1 mark)*

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. *(2 marks)*

(e) Which part of your IP addresses identifies
(i) the LAN; *(1 mark)*
(ii) the host on this LAN? *(1 mark)*

(f) The Ethernet protocol layer uses Ethernet MAC (Media Access Control) addressing to route Ethernet frames. What is an Ethernet MAC address? *(1 mark)*

(g) Describe two tasks performed by the TCP protocol layer. *(2 marks)*

(h) Give one example of another type of application found in the Application layer. *(1 mark)*

(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. *(1 mark)*

AQA, 2005

3 A network has the following topology.

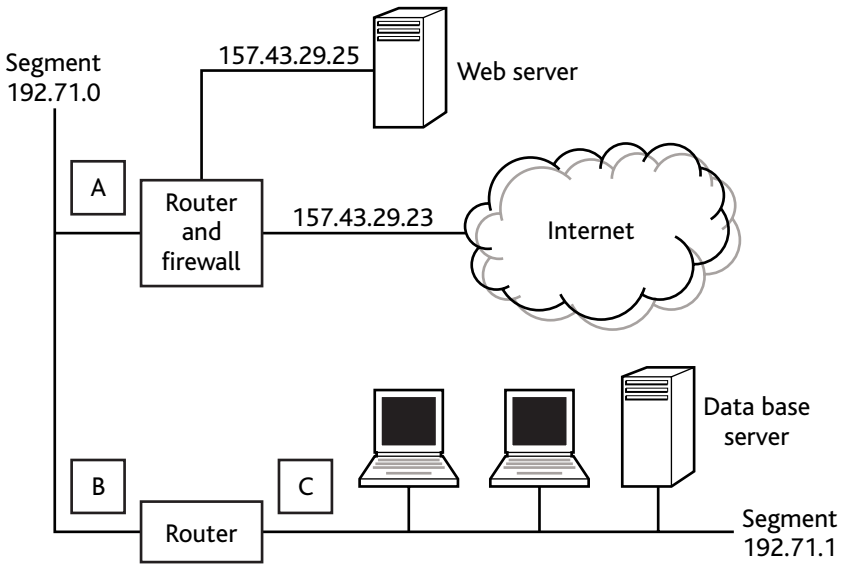


Figure 2

Suggest suitable IP addresses for the routers to replace the labels A, B and C.

AQA, 2005

Server-side scripting

1 A server-side script, Process.asp, processes the data posted by the web browser rendering the HTML shown in **Figure 1**.

```
<html>
  <head>
    <title>Two Ways of Sending Data</title>
  </head>
  <body>
    <a href="Process.asp?myname=Fred">Click here</a>
  <p>
    <form method="post" action="Process.asp">
    Please enter your name:
    <input name= myname" size=10>
  </p>
  <p>
    <input type=submit value=send>
    </form>
  </p>
  </body>
</html>
```

Figure 1

Process.asp is shown **Figure 2**.

```
<html>
  <head>
    <title>Form and Query String processing</TITLE>
  </head>
  <body>
    <%
      AVariable = Request ("myname")
      Response.Write AVariable
    %>
  </body>
</html>
```

Figure 2

(a) What is the value assigned to the variable `AVariable` when this script executes if the user:

(i) clicks the hyperlink in **Figure 1**? *(1 mark)*

(ii) clicks the SEND button after typing the name James? *(1 mark)*

(b) What value is sent to the user's browser when the user:

(i) clicks the hyperlink in **Figure 1**? *(1 mark)*

(ii) clicks the SEND button after typing the name James? *(1 mark)*

AQA, 2003

Internet Security

1 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? *(1 mark)*

(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? *(1 mark)*

(ii) Which key can Jill use to decrypt the message sent by Jack? *(1 mark)*

(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? *(3 marks)*

(ii) If Jack digitally signs the message sent to Jill, how can Jill verify Jack's digital signature? *(4 marks)*

AQA, 2007

2 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? *(1 mark)*

(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? *(1 mark)*

(ii) Which key does B have to use to decrypt the message? *(1 mark)*

(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. *(3 marks)*

(ii) What are the steps needed to check that B's message is authentic? *(4 marks)*

AQA, 2006

3 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. *(1 mark)*

(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? *(2 marks)*

(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? *(2 marks)*

AQA Examination-style questions

Section 7 Systems development

Analysis

1 List three stages of the systems life cycle. *(3 marks)*

AQA, New question

2 (a) List three fact-finding techniques that a systems analyst might use during analysis. *(3 marks)*

(b) Explain why each technique is useful. *(3 marks)*

AQA, New question

3 A specification describes what the system to be built should do. Design describes how the system should do it.

It is not always obvious whether something is specification or design. Are the statements that follow part of a specification or a design?

(a) The user should be shown a text description of the selected product.

(b) The X component sends a request to the Y component to add the new customer.

(c) The list of products will be presented to the user in a Combobox for selection.

(d) The user must choose one or more products from the list. *(4 marks)*

AQA, New question

Testing

1 A programmer is asked to write a routine `CalcHireFee (StartDateTime, EndDateTime, Mileage, OverdueHours)` to calcualte the hire fee for a booking. `EndDateTime` is the pre-arranged hire end date and time. If the car is returned after that time, the late hours are counted to the next whole hour as `OverdueHours`.

Each row of the table contains a set of values to be used to test the routine `CalcHireFee`. For each row, **tick** the relevant column (one column only) to show whether it is normal, erroneous or boundary data. **Circle** the values you regard as boundary or erroneous values.

StartDateTime	EndDateTime	Mileage	OverdueHours	Normal	Erroneous	Boundary
01/12/07 06:00	01/12/07 15.30	15	2			
06/12/07 18:00	12/12/07 09:00	237	3			
04/12/07 23:00	04/12/07 08:30	5	2			
03/12/07 08:00	03/12/07 09:00	0	0			
01/12/07 06:00	01/12/07 15:30	0	1.5			
01/12/07 06:00	01/12/07 15:30	0	–2			
04/12/07 08:30	05/12/07 23:00	57	0			
01/12/07 06:00	01/12/07 15:30	15	3			

2 A programmer has been asked to write a routine which will calculate a person's age **in years** from the date of birth supplied as a parameter to the routine and today's date, taken from the system. *(6 marks)*

The date of birth is supplied in the format dd/mm/yyyy and has already been checked by the system to be a valid date before it is passed to the routine.

No person is expected to be over 120 years old.

Suggest suitable values for each of the types of test data, *normal*, *boundary* and *erroneous*, and explain why you have chosen these values.

(a) **two** values of normal data and reason for choice. *(3 marks)*

(b) **three** values to check a boundary and reason for choice. *(4 marks)*

(c) **one** value of erroneous data and reason for choice. *(2 marks)*

3 Imagine you have just taken the job of programmer for AQA Solutions, a large software development company. You are assigned the task of corrective maintenance of software, which was developed by a programmer who no longer works for AQA Solutions.

(a) During the beta testing phase, several bugs have been reported.

(i) What is beta testing? *(1 mark)*

(ii) Name **four** types of information you expect to find in maintenance documentation and explain how each would assist you in your task of correcting the reported bugs. *(8 marks)*

(b) Explain **three** programming techniques that the original programmer could have used that would make it easier for you to correct the original programmer's software. *(3 marks)*

(c) Name **two** types of testing, other than beta testing, you should use before you declare your task successfully completed. *(2 marks)*

AQA, 2007

4 A payroll program is being designed which will calculate the pay for hourly-paid employees.

A programmer is asked to write a function `CalculateGrossPay (Hours, PayRate)`. The function will take as parameters the number of whole hours an employee has worked in the week and the basic rate of pay of the employee. The first 35 hours a week are paid at the basic rate of pay. Hours over 35 are paid at the premium rate of 1.5 times the basic rate of pay. No employee is paid for more than 48 hours in any week. Choose **three** suitable sets of test data for the parameter `Hours` which between them adequately test the functionality of this function. Justify your choice in each case. *(6 marks)*

AQA, 2007

5 A snack dispensing machine is being designed which will give change when a customer inserts more money than the cost of the snack chosen. The machine only accepts £2, £1, 50p, 20p, 10p and 5p coins. All snacks cost a multiple of 5p. The machine should give the change in as few coins as possible. A programmer is asked to write a routine `CalculateCoinage(Change)`. The routine will take, as a parameter, the amount of change to be returned. The routine will then calculate how many of each coin are required. Choose **three** suitable sets of test data for the parameter `Change` which adequately test the functionality of this routine. Justify your choice in each case. *(6 marks)*

6 State two reasons why a software system will require maintenance. *(2 marks)*

AQA, 2006

7 It is often said that correcting faults gets more and more expensive as the development cycle proceeds. Name **three** different types of testing that could be used in the early stages of software development. *(3 marks)*

AQA, 2006

8 Several testing strategies are used during the software development stages of a new system. Black box testing is one example. Name **two** others that can be used. *(2 marks)*

AQA, 2005

9 Software is used extensively in the control and monitoring of systems that have the potential to cause loss of life if the system fails.

(a) Briefly describe **two** different types of control or monitoring software which could endanger life if they fail. *(2 marks)*

(b) A software system failed shortly after entering service with the customer even though it passed all phases of testing successfully including *acceptance testing*.

(i) What is meant by acceptance testing? *(1 mark)*

(ii) Excluding testing, design flaws or hardware failure, give **another** possible explanation for the failure of this software system. *(1 mark)*

(iii) Name **one** other type of testing that could have been applied to the developed system to discover potential problems. *(1 mark)*

10 The program shown in **Figure 1** computes the result of dividing an integer x by an integer y using integer division, e.g. 6 divided by 4 = 1 remainder 2. The result is displayed on a VDU using the program statement

```
Write (`Answer= `, ComputeResult (s, t));
```

```
Program IntegerDivision:
Var s, t;

Function ComputeResult(x, y);
  Var r, q;
  Begin
    r := x;
    q := 0;
    While r > y
      Do
        Begin
          r := r - y;
          q := q + 1
        End;
    ComputeResult := q
  End;

Begin
  Write(`Input s: `);
  Read(s);
  Write(`Input t: `);
  Read(t);
  Write(`Answer5 `, ComputeResult (s, t));
End.
```

Figure 1

(a) When s = 6 and t = 3 the answer displayed on the VDU is 1. This is wrong. It should be 2.

(i) Which testing strategy, **white box** or **black box**, is the most apporpriate to use to discover why the wrong result is calculated? Justify your answer.

Strategy *(1 mark)*

Justification *(1 mark)*

(ii) What correction should be made to the function **ComputeResult** to make it work correct with s = 6 and t = 3? *(2 marks)*

(b) When s = 2 and t = 0 the program fails to produce any output at all and does not terminate. State why this happens. *(1 mark)*

(c) The following specification was supplied to the programmer by a customer:

A function is required which divides x by y using integer division giving q, the number of times that y fits exactly into x, and remainder r such that

x = y* (result q) + (remainder r)

How should this specification be changed to prevent the program error that occurred, as described in part (b) above, from arising again? *(1 mark)*

(d) The error in the program, as described in part (a) above, was the programmer's fault. The error described in part (b) was the fault of the customer who supplied the specifications. Explain why acceptance testing may not have revealed the error described in part (b). *(1 mark)*

Implementation

1 A Local Authority (LA) wants to promote healthy eating amongst the pupils in its schools.

- The cafeterias in the schools offer main meals served on plates, fruit and pre-packed sandwiches, snacks and drinks.
- When arriving at a checkout, pupils must have a range of foods to provide a balanced diet.
- Any food the pupil bought earlier in the day should be considered when deciding whether the food chosen is acceptable.

Currently, the pupils keep a diary of the food they eat each day, which gets checked on a weekly basis. This is very time-consuming and the LEA decides that a computer system is to be installed in the cafeterias to aid the checking of pupils' choices.

(a) When the system is ready for installation in the LEA schools, what method of conversion should be used? Justify your choice. *(2 marks)*

(b) Describe **three** tasks that have to be carried out in order to convert from the old to the new system. *(3 marks)*

AQA, 2006

2 A company wishes to replace its existing data processing system with a more up-to-date system. After consultation, two alternative methods for converting from the old to the new system are proposed, *parallel* and *phased*.

(a) What is meant by:

(i) parallel conversion? *(1 mark)*

(ii) phased conversion *(1 mark)*

(b) State two tasks that may have to be carried out when converting from the old to the new system. *(2 marks)*

(c) The company wishes to assess how maintainable the new system will be. Give three questions for the company to put to the developers of the new system to help in this assessment. *(3 marks)*