Selected New Spec Revision Questions

Mark schemes Paper 1

**Q1.**

(a)  **Marks are for AO1 (understanding)**

|  |  |
| --- | --- |
| **Real number** | **Valid? (Yes/No)** |
| 87.000 | Yes |
| 97+12 | No |
| 12.31E+12 | Yes |

**A**. alternative indicators for Yes/No eg Y/N.

**Mark as follows:**

One mark per correct row

**3**

(b)  **Marks are for AO2 (apply)**

<natural> ::= <digit> | <digit> <natural>

**A**. alternative names for <natural>

**A**. recursive and non-recursive cases swapped around

**Mark as follows:**

**1 mark:** correct recursive case

**1 mark:** correct non-recursive case

**MAX 1** if any errors in answer eg missing |

**2**

**[5]**

**Q2.**

(a)  **Mark is for AO2 (analyse)**

Input string is a (valid) postcode followed by additional characters // the input string is not a valid (UK) postcode // the mail will not be put in any of the three vans;

**NE**. The input string is not a valid IP postcode

**A**. Postcode has additional characters at the end

**A**. Postcode is too long

**1**

(b)  **Mark is for AO2 (analyse)**

(The string represents) an IP postcode that is not for a location in the town of Ipswich //

(The string represents) an IP postcode that is for a location near Ipswich //

(The string represents) a postcode for a letter that needs to go in Van B;

**NE**. valid postcode

**1**

(c)  **Mark is for AO2 (analyse)**

(IP / two letters) followed by number, letter, (number, letter, letter) //

(IP / two letters) followed by number between 5 and 9, number, (number, letter, letter) //

IP followed by 0;

**A**. postcodes that only have one letter at the start

**1**

(d)  **Marks are for AO2 (apply)**

\a?\a;\d;(\a|\d)?;\d\a\a; //

\a\a?;\d;(\a|\d)?;\d\a\a; //

\a?\a;\d;(\d|\a)?;\d\a\a; //

\a\a?;\d;(\d|\a)?;\d\a\a;

**Mark as follows:**

**1 mark:**

1. regular expression can start with either one or two letters **R**. if more than two letters allowed

**1 mark:**

2. regular expression has a numeric digit after the initial letters **A**. if more than the correct number of letters allowed

//

regular expression has a numeric digit before it allows a single, optional letter or numeric digit

**1 mark:**

3. regular expression allows a single, optional letter or numeric digit after the first numeric digit in the expression

//

regular expression allows a single, optional letter or numeric digit before the numeric digit followed by exactly two letters at the end of the expression

**1 mark:**

4. regular expression ends with a numeric digit followed by exactly two letters

**MAX 3** if final answer is not correct

**R**. any mark points after 2nd use of | metacharacter

**A**. suitable alternatives to \a and \d e.g. use of [A-Z], [a-z] or [A-Za-z] instead of \a and [0-9] instead of \d

**DPT**. / instead of \

**4**

**[7]**

**Q3.**

(a)  **Mark is for AO1 (knowledge)**

Merge sort;

**1**

(b)  **Mark is for AO1 (understanding)**

4;

**1**

**[2]**

**Q4.**

(a)  **Mark is for AO1 (knowledge)**

n2 // O(n2);

**A**. other ways of indicating n2 e.g. n^2

**A**. On2

**1**

(b)  **Marks are for AO1 (understanding)**

In each pass through the list n items will be examined;

There will be (at most) n passes through the list;

**2**

**[3]**

**Q5.**

(a)  **Mark is for AO1 (knowledge)**

A subroutine that calls itself;

**1**

(b)  **Mark is for AO1 (understanding)**

When target equals node // (When target does not equal node and) node is a leaf // node = target;

**1**

(c)  **Marks are for AO2 (apply)**

|  |  |
| --- | --- |
| **Function Call** | **Output** |
| TreeSearch(Olivia, Norbert) | (Visited) Norbert; |
| TreeSearch(Olivia, Phil); | (Visited) Phil; |
|   |   |

**MAX 2** if any errors eg additional outputs / function calls after output of Phil

**I**. minor spelling and punctuation errors

**3**

**[5]**

**Q6.**

(a)  **Mark is for AO2 (apply)**

-2;

**1**

(b)  **Mark is for AO2 (apply)**

[8, 3];

**I**. missing brackets

**I**. wrong type of brackets

**1**

(c)  **Marks are for AO2 (apply)**

|  |  |
| --- | --- |
| **Calculation** | **Result** |
| U | [1, 1] |
| v = [position of hero] - [position of enemy] | [6, -4]; |
| u.v | 2; |
| EnemyCanSee | True; |

**A**. different answers that have been correctly calculated based on an incorrect answer for 5.2

**3**

(d)  **1 mark for AO1 (knowledge)**

heuristic approach employs a method of finding a solution that might not be the best;

**1 mark for AO1 (understanding)**

algorithm might need to consider visiting less/fewer cells/co-ordinates // algorithm might use knowledge of the domain to cut-down the search space // algorithm might consider visiting certain cells/coordinates first;

**2**

**[7]**

**Q7.**

**Marks are for AO1 (understanding)**

Static data structures have storage size determined at compile-time / before program is run / when program code is translated; dynamic data structures can grow/shrink during execution / at run-time;

//

Static data structures can waste storage space/memory if the number of data items stored is small relative to the size of the structure; whereas dynamic data structures only take up the amount of storage space required for the actual data;

//

Static data structures have fixed (maximum) size; whereas size of dynamic data structures can change;

//

Dynamic data structures (typically) require memory to store pointer(s) to the next item(s); which static data structures (typically) do not need; **NE**. Dynamic data structures use pointers

//

Static data structures (typically) store data in consecutive memory locations; which dynamic data structures (typically) do not;

**[2]**

**Q8.**

(a)  **Marks are for AO2 (analyse)**

1. Stack / data structure is used to store the (user’s) actions; **A**. by implication

2. Each time an action is completed it is pushed/added onto the **top** of the stack;

3. unless it is an undo (or repeat) action;

4. When repeat action is used the top item from the stack is used to indicate the action to complete // when repeat action is used the result of peek function is used to indicate the action to complete; **R**. implication that top item of stack is popped/deleted from stack – unless it is clear it is subsequently pushed/added back to the stack **A**. when repeat action is used a copy of the top item from the stack is pushed/added to the top of the stack

5. When undo action is used the top item is popped/removed from the stack of actions;

**5**

(b)  **Mark is for AO1 (understanding)**

Stack empty (error) // (stack) underflow;

**1**

**[6]**

**Q9.**

(a)     **Mark is for AO2 (apply)
1 mark**: B;

**1**

(b)     **All marks AO2 (analyse)**Nathan was not killed with poison (rule a);

therefore Peter was not in the kitchen (rule c);

therefore Martin was not in the dining room (rule e);

therefore Suzanne was in the dining room (rule b);

therefore Steve murdered Nathan (rule d).

**Mark as follows:**

**1 mark:** Any correct point from the list above;

**1 mark:** Any two further correct points from the list above;

**2**

**[3]**

**Q10.**

(a)     **Mark is for AO1 (understanding)**

|  |  |  |
| --- | --- | --- |
| **Original state** | **Input** | **New state** |
| S3 | 0 | S4 |
| S3 | 1 | S2 |

**1 mark:** Table completed as above

**I** order of rows

**1**

(b)     **All marks AO2 (analyse)**

(0|1)\*((00)|(11))(0|1)\*

**Mark as follows:**

**1 mark:** (0|1)\* at start;

**1 mark:** (00)|(11);

**1 mark:** (0|1)\* at end;

**Or**

**Alternative answer**

(0|1)\*(11(0|1)\*)|(00(0|1)\*)

**Mark as follows:**

**1 mark:** (0|1)\* at start;

**1 mark:** (11(0|1)\*);

**1 mark:** |(00(0|1)\*) at end;

**Maximum 2 marks:** If final answer not correct.

**A** any regular expression that correctly defines the language.

**3**

(c)     **Mark is for AO2 (apply)**

|  |  |
| --- | --- |
| **Rulenumber(given inFigure 2)** | **Could be defined using a regular expression** |
| 1 | Y |
| 2 | Y |
| 3 | Y |
| 4 | N |
| 5 | N |
| 6 | Y |

**1 mark:** All values in the table have been completed correctly.

**1**

(d)     **1 mark for AO2 (analyse) and 1 mark for AO3 (design)**

**1 mark for AO2 (analyse):** There is no non-recursive / base case;

**1 mark for AO3 (design):** <word> ::= <char><word> | <char>;

**2**

**[7]**

**Q11.**

(a)     **Mark is for AO1 (understanding)**

It contains a cycle / cycles;

**1**

(b)     **All marks AO2 (apply)**

|  |  |
| --- | --- |
| **Vertex (inFigure 1** | **Adjacentvertices** |
| **1** | 2,3 |
| **2** | 1,3,4 |
| **3** | 1,2,5 |
| **4** | 2 |
| **5** | 3 |

**Mark as follows:**

**1 mark:** Three correct rows;

**1 mark:** All rows correct;

**I** Order of items within each list / row.

**2**

(c)     **All marks AO1 (understanding)**

Adjacency list appropriate when there are few edges between

vertices / / when graph / matrix is sparse;

when edges rarely changed;

when presence / absence of specific edges does not need to be

tested (frequently);

**Max 2**

**A** Alternative words which describe edge, eg connection, line.

**2**

(d)     **All marks AO2 (apply)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |   |   |   | **Cat** |
| **NoOfCats** | **A** | **B** | **C** | **1** | **2** | **3** | **4** | **5** |
| 5 |   |   |   | 1 |   |   |   |   |
|  | 2 | 1 | 1 |   |   |   |   |   |
|  |   | 1 | 2 |   |   |   |   |   |
|  |   | 2 |   |   | 2 |   |   |   |
|  | 3 | 1 | 1 |   |   |   |   |   |
|  |   | 1 | 2 |   |   |   |   |   |
|  |   | 2 |   |   |   |   |   |   |
|  |   | 1 | 3 |   |   |   |   |   |
|  |   | 2 |   |   |   |   |   |   |
|  |   | 3 |   |   |   | 3 |   |   |
|  | 4 | 1 | 1 |   |   |   |   |   |
|  |   | 2 |   |   |   |   |   |   |
|  |   | 3 |   |   |   |   |   |   |
|  |   | 4 |   |   |   |   | 1 |   |
|  | 5 | 1 | 1 |   |   |   |   |   |
|  |   | 2 |   |   |   |   |   |   |
|  |   | 3 |   |   |   |   |   |   |
|  |   | 4 |   |   |   |   |   |   |
|  |   | 5 |   |   |   |   |   | 1 |

**Mark as follows:**

**1 mark:** A is set the sequence indicated in the table;

**1 mark:** B is set the sequence indicated in the table;

**1 mark:** C is set the sequence indicated in the table;

**1 mark:** NoOfCats is set to 5, Cat[1] is set to 1;

**1 mark:** Cat[2] is set to 2 and Cat[3] is set to 3;

**1 mark:** Cat[4] is set to 1 and Cat[5] is set to 1;

**Info for examiner:** Ignore the empty cells in the sequences - values do not need to be set in the rows indicated in the table.

**6**

(e)     **Mark is for AO2 (analyse)**

To work out which cats will travel together to the show / /

To plan which cats will be in the van on which journey to the cat show / /

To colour the vertices of a graph / /

To create a decomposition of a graph;

**Max 1**

**1**

(f)      **All marks AO1 (knowledge)**

**1 mark (1 from):** The problem can be solved / / algorithm exists for problem;

But it cannot be solved in polynomial time / / but not quickly

enough to be useful;

**Max 2**

**1 mark:** It takes an unreasonable amount of time; to solve;

**A** Too long time but **R** Long time

**2**

(g)     **All marks AO1 (understanding)**

**1 mark:** Use of heuristic; algorithm that makes a guess based on experience;

That provides a close-to-optimal solution / approximation; that only works in some cases; **A** non-optimal

Example of heuristic method eg hill-climbing / stochastic / local improvement / greedy algorithms / simulated annealing / trial and error / any reasonable example;

**1 mark:** Relax some of the constraints on the solution; **A** Solve simpler version of problem

**2**

**[16]**

**Q12.**

(a)     **Mark is for AO1 (understanding)**

False;

**1**

(b)     **Mark is for AO1 (understanding)**

THEN Failed ← True;

**1**

(c)     **All marks for AO1 (understanding)**

L ← M – 1;

**Mark as follows:**

**1 mark:** L;

**1 mark:** ← M – 1;

**Maximum 1 mark:** If not correct

**2**

(d)     **Mark is for AO1 (understanding)**

O(kn);

**A** kn

**1**

(e)     **Mark is for AO1 (knowledge)**

O(log n);

**A** log n

**1**

(f)      **Mark is for AO1 (knowledge)**

O(1);

**A** 1

**1**

(g)     **Mark is for AO1 (knowledge)**

O(n);

**A** n

**1**

(h)     **All marks AO1 (understanding)**

**1 mark:** As the size of the list increases the time taken to search for an item increases; at the same rate; / /

**1 mark:** A linear search looks at each item in the list in turn (until it reaches the end of the list or the item being searched for is found); so if there are n items in the list the worst case would be n comparisons;

**2**

**[10]**

**Q13.**

(a)     **All marks AO2 (apply)**

3 \* 4

**1**

(b)     **All marks AO2 (apply)**

(12 + 8) \* 4;

**1**

(c)     **Mark for AO1 (understanding)**

**1 mark:** Simpler / easier for a machine / computer to evaluate / / simpler / easier to code algorithm

**R** Simpler / easier to understand

Do not need brackets (to show correct order of evaluation / calculation);

Operators appear in the order required for computation;

No need for order of precedence of operators;

No need to backtrack when evaluating;

**A** RPN expressions cannot be ambiguous as Benefit Of Doubt (BOD)

**1**

**[3]**

Mark schemes Paper 2

**Q1.**

**All marks AO1 (understanding)**

|  |  |  |
| --- | --- | --- |
| **Level** | **Description** | **Mark Range** |
| 4 | Description covers all, or almost all, of the points in the indicative guidance and fully reflects the sequence in which steps occur. It includes use of registers, buses and main memory. An excellent level of understanding is shown with no misconceptions. | 4 |
| 3 | Description covers most (ie more than half) of the points in the indicative guidance and completely or almost completely reflects the correct sequence in which steps occur. At least two of the use of registers, buses and main memory are covered. A good level of understanding is shown. Whilst there may be some omissions, there is at most one misconception in the response. | 3 |
| 2 | At least two correct points are made from the indicative guidance and there is some indication of understanding of the correct sequence. Some understanding is shown. | 2 |
| 1 | At least one relevant point has been made. There is not sufficient evidence to conclude that the cycle has been understood. | 1 |

**Guidance – Indicative Response**

•   Contents of Program Counter/PC transferred to Memory Address Register/MAR

•   Address bus used to transfer this address to main memory

•   Fetched value/instruction transferred using the data bus

•   Contents of addressed memory location loaded into the Memory Buffer Register/MBR

•   Transfer content of Memory Buffer Register/MBR to the Current Instruction Register/CIR

**A**. Memory Data Register / MDR for MBR

**I**. Incrementing of program counter, even if incorrect

**NE**. Points made using register transfer notation only eg CIR ← [MBR]

**[4]**

**Q2.**

**All marks AO1 (understanding)**

To execute/carry out the instruction other data may need to be fetched (from main memory);

**A**. During execute phase MBR used to store other data

**A**. Further instructions may need to be fetched before the instruction has finished executing, if pipelining/parallelisation is referenced explicitly in the response

Further memory fetches would overwrite the contents of the MBR // the instruction would be overwritten by further memory fetches // writing the result of executing the instruction back to main memory would overwrite the instruction / MBR contents;

**A**. MBR is not (directly) wired to the (processor) components that will execute the instruction which CIR is

**A**. The MBR is not (directly) wired to the ALU as BOD

**R**. The MBR cannot decode instructions

**[2]**

**Q3.**

**All marks AO1 (understanding)**

Instruction and data can be accessed simultaneously;

Avoid/reduce bottleneck of single data/address bus(es) // avoid/reduce delays waiting for memory fetches;

Avoids possibility of data being executed as code (which is one method that can be exploited by hackers);

Being able to use exclusively ROM for instruction memory prevents the program being modified/hacked; A. Program cannot be accidentally overwritten (by data)

Instruction and data memory can have different word lengths;

Different technologies can be used to implement instruction and data memory;

Different quantities of instruction and data memory means that address lengths can differ between the two // memory address structures can differ;

**NE**. So programs/tasks will run faster

**NE**. More efficient

**Max 2**

**[2]**

**Q4.**

**Mark is for AO2 (apply)**

KAITLEN;

**I**. Case

**[1]**

**Q5.**

**All marks AO1 (knowledge)**

The key must be (at least) as long as the data to be encrypted/plaintext;

The key must not be reused // key must only be used once;

The key must be (truly) random;

The key must be kept securely / not revealed / only known by user(s);

**Max 2**

**[2]**

**Q6.**

**Mark is for AO1 (knowledge)**

Symmetric: The same key is used to encrypt and decrypt;

**A**. Sender and receiver use same key

Asymmetric: Different (but related) keys are for encryption and decryption;

**A**. Sender and receiver use different keys

**NE**. Symmetric uses one key // asymmetric uses two keys

**Max 1**

**[1]**

**Q7.**

(a)  **Mark is for AO1 (understanding)**

3;

**1**

(b)  **Mark is for AO2 (apply)**

1500 (bits per second);

**A**. 3 \* 500

**A**. Value given in response to question part 3.1 multiplied by 500.

**1**

(c)  **Mark is for AO1 (understanding)**

B;

**R**. If more than one lozenge shaded.

**1**

(d)  **All marks AO1 (understanding)**

Data skew might occur if parallel communication used;

**A**. Eliminates risk of desynchronisation (between data signals)

**A**. Bits transmitted simultaneously/together may arrive at different times

**NE**. Bits will not arrive together

The longer the distance the higher the likelihood of data skew;

To avoid problems of cross-talk // interference between individual wires;

Hardware (for serial communication) is cheaper to manufacture // cheaper cabling (for serial communication which is more important over long distances); A. “Easier” for “cheaper”

**NE**. Just statement that fewer wires required without expansion eg lowering cost

**NE**. References to data being corrupted without further explanation eg data skew, cross-talk

**Max 2**

**[5]**

**Q8.**

(a)  **All marks AO2 (apply)**

****

**1 mark:** inputs A and B connected to an AND gate;

**1 mark:** inputs C and D connected to an OR gate;

**1 mark:** output of an AND gate (but not the same one as connected to inputs A and B) connected to X;

**MAX 2** if circuit does not fully represent the logic of the system OR the circuit diagram contains any errors

**3**

(b)  **All marks AO2 (apply)**

X = A • B • (C + D)

**1 mark:** either A • B or C + D somewhere in an incorrect expression

**2 marks:** fully correct expression

**A**. A logically equivalent expression for **2 marks**

**2**

**[5]**

**Q9.**

**All marks AO2 (apply)**

**Marking guidance for examiners**

•   Award marks for working out until an incorrect step has been made.

•   If, in any one step, a candidate is simplifying different parts of an expression simultaneously award all relevant marks for this multiple stage but don’t award any further marks for working in any parts simplified incorrectly. For example, if the expression P .P .(P + Q) + P .P .1 was changed to P .(P + Q) + P .0, the candidate would get one mark for simplifying the first part to P .(P + Q) and could get further marks for correctly simplifying this part of the expression further but should not be awarded marks for simplifying the incorrectly changed part P .0 (ie to 0)

**1 mark:** for final answer: B + C

**MAX 3** for working. Award up to two marks for applying each one of the three techniques (one mark per application):

•   a successful application of De Morgan’s Law (and any associated cancellation of NOTs) that produces a simpler expression.

•   applying an identity other than cancelling NOTs that produces a simpler expression.

•   successfully expanding brackets.

**Note:** A simpler expression is one that is logically equivalent to the original expression but uses fewer logical operators.

**Example Working (1)**

****

**Example Working (2)**

****

**[4]**

**Q10.**

**Mark is for AO1 (knowledge)**

Used to store state (of data input) // used as a memory (unit);

**R**. If stated that maintains state when power turned off

**[1]**

**Q11.**

**All marks AO1 (knowledge)**

Input is: Clock / trigger / enable;

**R**. Set / reset

Used For: State of data input is stored // output is updated to reflect current status of input;

**A**. Synchronise operation of a group of flip-flops

**R**. Changes state/value of flip-flop

**[2]**

**Q12.**

**1 mark for AO1 (knowledge) and 1 mark for AO1 (understanding)**

**AO1 (knowledge): 1 mark:**

An operand is a value/data that will be used by an operation;

**AO1 (understanding): 1 mark:**

The addressing mode indicates how the value in the operand should be interpreted // the addressing mode indicates if the value in the operand is a memory address/register or a data/immediate value;

**A**. In immediate addressing the operand is the value to use and in direct addressing it is a memory address/register number

**NE**. Addressing mode indicates if direct or immediate addressing is used

**[2]**

**Q13.**

(a)  **All marks AO2 (apply)**

|  |  |
| --- | --- |
| **Register Contents** | **Main Memory Location Contents** |
| **R1** | **R2** | **R3** | **R4** | **100** | **101** | **102** |
| 10 | 40 |   |   |   |   |   |
| 50 |   | 50 | 1 |   |   | 1 |
|   |   |   |   |   |   |   |
|   |   |   |   |   |   |   |

**1 mark:** Value of 10 is first value in R1.

**1 mark:** Value of 40 is only value in R2.

**A**. Value in R2 is four times the value in R1, if value in R1 was incorrect

**1 mark:** Value of 50 in both R1 and R3, as the second and final value in R1 and only value in R3.

**A**. Value stored in R1 is five times the initial value in R1, if this was incorrect and R3 contains only 50

**A**. Value stored in R1 is equal to contents of R2 and previous contents of R1 added together, if either of these were incorrect and R3 contains only 50

**1 mark:** Value of 1 stored in both R4 and memory location 102. It should be the only value in R4 but could be preceded by 80 in memory location 102. It must be the final value in memory location 102. This mark should only be awarded if the contents of R1 and R3 are equal, otherwise see accept point below.

**A**. Value of 0 instead of 1 stored in both R4 and memory location 102 if contents of registers R1 and R3 are not equal

**I**. Values of 10 and 50 written in the columns for main memory locations 100 and 101 and value of 80 written above value of 1 in column for memory location 102

**Note: Values do not have to be written in the same rows as in the table above, but must be in the same order ie for R1, the value 10 must be assigned above the value 50. Individual values eg 50 may be written out multiple times.**

**4**

(b)  **Mark is for AO2 (analyse)**

Check if the value stored in memory location 101 is five times the value stored in memory location 100 // check if value in memory location 100 is a fifth of that in memory location 101 (if so, store a 1 in memory location 102 if it is and a 0 if it is not);

**A**. Check if a number is five times another number // a fifth of another number as BOD

**1**

**[5]**

**Q14.**

**All marks AO1 (understanding)**

**Advantages of high-level language (MAX 2):**

Program code is easier to understand/maintain/debug;

Faster development time // programmers can be more productive // one line of HLL code can do the same job as many lines of assembly language;

Programs are (more) portable (to other hardware platforms)

Availability of flow control structures; **A**. Example(s) eg loops, selection

Improved features for supporting modularity; **A**. Ability to use subroutines

Built-in support for data structures; **A**. Example(s) eg arrays, records

Language is problem-oriented;

Support for different paradigms; **A**. Examples eg functional programming

**Disadvantages of high-level language (MAX 2):**

Assembly language code may execute more quickly;

**R**. If response suggests that faster execution is because translation is not required Assembly language code may use less memory;

Assembly language gives direct/better access to computer hardware // enables direct manipulation of memory (contents);

**NE**. “More efficient” for either executes more quickly or uses less memory

Award marks for disadvantages as opposite of advantage points eg a disadvantage of assembly language could be “Program code is harder to understand/maintain”. **BUT** do not award two marks for an advantage and its corresponding disadvantage.

**[4]**

**Q15.**

(a)  **Marks is for AO2 (apply)**

10;

**A**. [10] this time

**1**

(b)  **Mark is for AO2 (apply)**

|  |  |
| --- | --- |
| **Function Call** | **Result** |
| map square a | [1,9,25] |
| filter (<10) b | [1,5] |
| fold (+) 0 c | 18 |

**1 mark** for each correct response in the **Result** column.

**I**. Missing brackets this time or use of incorrect type of brackets

**I**. If returned values are assigned to new lists eg x = [1,9,25]

**A**. [5,1] for row 2 this time

**3**

(c)  **Mark is for AO1 (knowledge)**

A function that takes a function as an argument // returns a function as a result // takes a function as an argument and returns a function as a result;

**A**. “Parameter”, “Input” for “Argument”

**NE**. A function that uses another function

**R**. Explanations that are specifically of the map function

**1**

**[5]**

**Q16.**

**Marks is for AO2 (understanding)**

|  |  |  |
| --- | --- | --- |
| **Level** | **Description** | **Mark Range** |
| 4 | A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. The response covers all four areas indicated in the guidance below and in at least three of these areas there is sufficient detail to show that the student has an excellent level of understanding of the issues and technologies involved. To reach the top of this mark range, an excellent level of understanding must be shown of all four areas. | 10-12 |
| 3 | A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response but the response may only cover two or three of the areas indicated in the guidance below. A good understanding is shown of each of these areas and if only two areas are covered, the coverage of these is excellent. | 7-9 |
| 2 | A limited attempt has been made to follow a line of reasoning by covering at least two of the topic areas in the guidance below. Overall, at least four valid points must have been made which can relate to any of the topic areas in the guidance. | 4-6 |
| 1 | A few relevant points have been made but there is no evidence that a line of reasoning has been followed. The points may only relate to one or two of the four areas from the guidance or may be made in a superficial way with little substantiation. | 1-3 |

**Guidance – Indicative Response**

**1. How it was possible for data to be collected**

WiFi signals can travel outside of property // over wide area // limited control over range

Any WiFi receiver in range can read the data packets **NE**. The receiver in the car can read the packets

No need to physically “tap” into a WiFi connection, unlike a cabled connection

A protocol that does not encrypt the transmissions may have been used // unencrypted data sent. **NE**. Network not secure

**2. Steps to prevent**

Use a protocol that encrypts data transmissions

**A**. Encrypt the transmission

**R**. Password protection

Example of secure protocol eg WPA, WPA2

Disable broadcast of SSID to make network harder to identify (Note: Accept this point even though the SSID would be in other data packets)

Limit power of transmitter so data does not travel outside premises (although in practice this might be hard to achieve)

Use cabled network instead of WiFi.

**R**. MAC address filtering (as cars were not connecting to networks just intercepting transmissions)

**3. Legal and ethical issues**

If the data is being transmitted through the air, who does it belong to, if anyone? // Should data transmitted by WiFi be treated like a broadcast (eg TV) or a private communication (eg telephone call)?

Is it wrong to intercept data if people freely choose to transmit it wirelessly? **A**. Is it ethical to collect data from people without their permission?

Is it legal to intercept data if people freely choose to transmit it wirelessly? What laws apply in this scenario? Is this really hacking?

Are the ethics or laws different for intercepting data transmitted wirelessly than by cable?

Is there a difference between collecting statistical data eg channel number, signal strength, SSID and collecting the payload data?

Was the data just collected or was there an intention to process it as well?

What should the company have done when it realised that the data had been collected? // Should the data have been immediately deleted, or kept so that the company could contact and apologise to people it had collected data from? // What should be done with the data now?

What should the company have done if it inadvertently discovered evidence of illegal activity in the collected data?

Legality/ethicality may depend on the nature of the data gathered // (In the UK) would some of the collected data count as “personal data” (under the Data Protection Act) // could some of the data have been sensitive (accept example eg bank account details, details of minors) **NE**. Data may be private

To what extent is the company financially liable for collecting the data? Or any consequences of its use?

Could the legal situation be different in different countries where the company operated?

Was the collection of data intentional or just an accidental side-effect of a reasonable process?

What was done to ensure (existing) policies are followed?

Should there have been more oversight of code development?

Could intellectual property have been inadvertently stolen?

Is it ethical to collect/store information secretly from people // without them knowing?

Is it ethical to collect data if there is no (legitimate) purpose for doing so?

Were the developers in breach of their contracts with the company / company guidelines?

*Relevant Legislation*

Students may name specific pieces of legislation that could have been breached as part of their response. Determining whether or not a breach has actually occurred would probably require more information than is provided in the question and detailed knowledge of the legislation, which is not required by the specification. Therefore, up to **two points** can be given for students naming relevant pieces of legislation that could have been breached, regardless of whether or not this can be ascertained with certainty. Relevant pieces of legislation include:

•   The Data Protection Act

•   The Computer Misuse Act

•   The Regulation of Investigatory Powers Act

•   The Communications Act

Points should be given for assertions that legislation has definitely been breached, even if this is only a possibility in the context rather than a certainty.

Responses that reference other legislation should be referred to Team Leaders.

**A**. As an alternative to naming the Data Protection Act, a response could instead question whether privacy laws have been breached, or if a breach of privacy has occurred.

**4. Lessons**

Improved training for developers in what is legal / ethical (accept company needs to improve understanding of legal/ethical issues)

Need to review guidelines that developers are expected to follow

Need for scrutiny of code / supervision by people outside of development team

Developers could be required to check each other’s code

Developers could be required to log changes made to code and reason

Should only collect data that is absolutely necessary // that has a clear purpose // need to review collected data to see why it is being collected and stored // need to fully consider the purpose of any data collection before doing it

Could/should remove equipment for Wi-Fi data capture used in cars to collect mapping data.

**NE**. Further testing should be carried out unless there is a clear explanation of the mechanism by which testing will check that the software has no additional functionality is described eg inspection of collected data files to verify purpose of contents

**[12]**

**Q17.**

(a)  **All marks AO2 (apply)**

**Method (MAX 1):**

A multiplication by 20 000;

A multiplication by 16;

A multiplication by 30;

**Answer:**

1200

**A**. 1171.875 (expressed to at least 4 significant figures) this time

**If answer is correct and some working has been shown, award all marks, even if working would not have gained credit on its own.**

Accept 30\*16\*20000/8/1000 for **2 marks** or any other reasonable calculation that would arrive at the correct answer, even if the final answer is not stated.

**2**

(b)  **All marks AO1 (understanding)**

**1 mark:**

As a result of Nyquist’s theorem // the sample rate must be at least twice the frequency of the (highest frequency component in the) original signal;

**1 mark for any point in this list:**

•   20 000 is less than double of 14 500

•   14 500 is more than half of 20 000

•   the sample rate would need to be at least 29 000 Hz

•   with a sample rate of 20 000 Hz frequency components of over 10 000 Hz will not be reproduced faithfully

**Max 2**

**[4]**

**Q18.**

**2 marks for AO1 (knowledge) and 2 marks for AO1 (understanding)**

**AO1 (knowledge): Representation (MAX 2):**

Music represented as sequence of MIDI (event) messages;

**A**. Music represented as sequence of instructions

**R**. Music represented as sequence of notes

One example of data that might be contained in a message:

•   Channel

•   Note on / note off

•   Pitch / frequency / note number

•   Volume / loudness

•   Velocity

•   Key pressure / aftertouch

•   Duration / length

•   Timbre

•   Instrument

•   Pedal effects

•   Pitch bend

•   Note envelope;

MIDI messages are usually two or three bytes long;

First byte of each MIDI message is a status byte (others are data bytes);

Bit rate is 31,250 bits per second;

MSB value of 1 indicates status byte, 0 indicates data bytes;

Status bytes are divided into a command and a channel number (4 bits for each);

Sixteen channels are supported;

**AO1 (understanding): Advantages of MIDI (MAX 2):**

More compact representation;

Easy to modify / edit notes // Easy to change values eg octave for entire score //easy to change instruments;

Simple method to compose algorithmically;

Musical score can be generated directly from a MIDI file;

No data lost about musical notes // through sampling; **A**. “better quality” but only if there is some explanation of this eg “no error introduced during sampling”, “no background noise recorded”

**[4]**

**Q19.**

**All marks AO1 (understanding)**

**1 mark:** The 'Router and Firewall' port labelled **A**: 192.168.0.x where x is not 0 or 255;

**1 mark:** The 'Router 2' port labelled **B**: 192.168.2.x where x is not 0 or 255;

**[2]**

**Q20.**

**All marks AO1 (understanding)**

**Physical:** The (physical) layout/arrangement/architecture of the cabling/wiring/connections (between the devices/computers on the network);

**A**. The (physical) layout/arrangement/architecture of the devices/computers/network

**NE**. How the devices/computers are connected to each other

**NE**. “Setup” for layout

**NE**. List of topologies eg bus, star

**Logical:** How the data/packets flows around a network // architecture of the communication mechanism in a network;

**A**. The type of protocol used

**NE**. How a network operates/behaves

**[2]**

**Q21.**

**All marks AO1 (understanding)**

**Client-server (MAX 2):**

Resources stored on the server;

**R**. Responses which suggest that everything must be done on the server

Clients access resources from server // server provides these resources in response to client requests;

**A**. Server provides services to client

Centralised / improved security management // centralised login system // centralised administration // administration will be easier;

Configuration/setup more complex // configuration/setup requires greater expertise;

**Peer-to-peer (MAX 2):**

Resources stored on each individual computer/device/peer;

Any computer/device/peer can access resources from any other // any computer/device/peer can share resources with any other // files can be distributed across the computers on the network;

Each computer/device/peer has equal status // a computer can act as both client and server;

Management of security / administration could be more difficult;

Computers communicate directly with each other // there is no dependence on a server;

**NE**. Computers connected directly to each other, no server

***In both sections, reject points about how computers are connected to each other.***

***Accept responses that use examples of resources eg files, web pages***

**Max 4**

**[4]**

**Q22.**

(a)  **Mark is for AO2 (analyse)**

CarRegNo and JobDate;

**A**. Just both these attribute names written with no further explanation

**R**. “CarRegNo or JobDate”

**1**

(b)  **1 mark for AO2 (analyse) and 1 mark for AO1 (understanding)**

**AO2 (analyse) – 1 mark:**

A person may own more than one car // a person may bring different cars to the garage;

It might be desired to store details of an owner when the car they own is not yet known;

**A**. A car might be owned by more than one person (at different times)

**A**. Easier to transfer car from one owner to another

**AO1 (understanding) – 1 mark:**

Avoid storing owner details once for each car they own / multiple times;

Avoid having to input owner details once for each car they own;

To transfer car between owners would only have to change one attribute in the car relation;

Minimise data duplication // no unnecessary repeated data; **A**. Reduce for minimise

Eliminate data redundancy; **A**. Reduce/minimise for eliminate

Eliminate data inconsistency // improve consistency // avoid inconsistency problems;

Eliminate update anomalies; **A**. Example in context

Eliminate insertion anomalies; **A**. Example in context

**NE**. Fewer errors when updating/inserting/deleting without concrete example or good explanation

**NE**. Saving space/memory

**NE**. Easier to query

**2**

(c)  **All marks AO2 (analyse)**

**1 mark** for any one correctly drawn relationship **OR**

**2 marks** for three relationships drawn correctly

**MAX 1** if more than three relationships drawn and any are incorrect



**2**

(d)  **1 mark for AO2 (analyse) and 2 marks for AO3 (programming)**

Mark Scheme

**AO2 (analyse) – 1 mark:**

**1 mark** for correctly identifying the table in the data model that needs to be updated (Job) and the condition that should be used to identify the correct record in the table to update (JobID = 206).

**Note:** The AO2 mark for analysing the data model should be awarded regardless of whether correct SQL syntax is used or not as it is for data modelling, not syntactically correct SQL programming

**AO3 (programming) – 2 marks:**

**1 mark** for correct SQL syntax in two of the three clauses (UPDATE, SET, WHERE) **OR**

**2 marks** for fully correct SQL

Example Solution

UPDATE Job

SET JobDuration = "01:30"

WHERE JobID = 206

Additional Guidance

**AO3 marks:**

**A** Any type of quotation marks or hashes for delimiters for JobDuration or no delimiters

**A**. The value 206 if it is delimited by any type of quotation mark

**A**. Any sensible format for the time data eg "01.30", "1:30", "1:30.00" etc.

**A**. Time given as a decimal ie 1.5

**A**. Table name given before fieldname

**I**. Quotation marks around fieldnames

**I**. Any attempt to also change value of InGarage

**3**

(e)  **All marks AO3 (programming)**

**Method 1:**

INSERT INTO PartUsedForJob

VALUES (206,12,2)

**Method 1:**

INSERT INTO PartUsedForJob (JobID, PartID, QuantityUsed)

VALUES (206,12,2)

**1 mark** for correct INSERT INTO clause

**1 mark** for correct VALUES clause

**MAX 1** if SQL not fully working eg because of extra clauses

**A**. List of fields in any order for method 2, but to get the VALUES mark in method 2, order of fields list in INSERT INTO must match order of values in VALUES

**A**. The value(s) 206 and 12 if they are delimited by any type of quotation mark

**2**

(e)  **3 marks for AO2 (analyse) and 2 marks for AO3 (programming)**

Mark Scheme

**AO2 (analyse) – 3 marks:**

**1 mark** for correctly analysing the data model and identifying the tables that data needs to be extracted from (Part, PartUsedForJob) and the fields that need to be extracted (PartID, Description, Price, QuantityUsed), and including these and no other tables or fields in the query **A**. Including the table Job which is not needed, as long as it is correctly linked in by a condition

**1 mark** for correctly identifying how the data in the required tables should be combined to produce the desired result (the linking condition - PartUsedForJob.PartID = Part.PartID)

**1 mark** for identifying the correct conditions to use within the model for the JobID field (JobID = 93) and for using the correct logical operators between all of the conditions (if a linking condition is also used)

**Note:** The AO2 marks for analysing the data model should be awarded regardless of whether correct SQL syntax is used or not as they are for data modelling, not syntactically correct SQL programming

**AO3 (programming) – 2 marks:**

**1 mark** for correct SQL in two or three of the four clauses (SELECT, FROM, WHERE, ORDER BY) **OR**

**2 marks** for fully correct SQL

Example Solutions

**Example 1**

SELECT PartID, Description, Price, QuantityUsed

FROM Part, PartUsedForJob

WHERE JobID = 93

  AND PartUsedForJob.PartID = Part.PartID

ORDER BY PartID

**Example 2**

SELECT PartID, Description, Price, QuantityUsed

FROM Part INNER JOIN PartUsedForJob ON

PartUsedForJob.PartID = Part.PartID

WHERE JobID = 93

ORDER BY PartID

**Overall MAX 4 if solution does not work fully**

Additional Guidance

**AO2 marks:**

Mark(s) can be awarded for the correct logical conditions even if the required tables are not identified as being used by the query

Ignore unnecessary clause PartUsedForJob.JobID = Job.JobID

**AO3 marks:**

Accept table names before fieldnames separated by a full stop.

Accept use of Alias/AS command eg FROM Part AS P then use of P as the table

name but note that command Alias is not required eg FROM Part P.

Accept INNER JOIN written as one word ie INNERJOIN or just as JOIN

Accept ORDER BY written as one word ie ORDERBY.

Accept ASC at end of ORDER BY clause.

Accept insertion of spaces into fieldnames.

Accept use of " or ' as delimiters around number 93.

Ignore unnecessary brackets.

**DPT** for unnecessary punctuation – allow one semicolon at the very end of the statement, but not at the end of each clause.

**DPT** for fieldname before table name.

For the **DPT** points, the penalisation is in terms of number of clauses of SQL code not marks ie if fieldname is before table name in two out of four clauses of SQL then this could count as three clauses of correct SQL

**Refer responses using nested SQL queries to team leaders.**

**Refer responses using RIGHT JOIN OR LEFT JOINT to team leaders.**

**5**

(f)  **All marks AO2 (analyse)**

**1 mark:** Create a new relation to identify which make/model(s) of car each part can be fitted to;

**A**. Use of a relation name that clearly identifies the purpose eg PartToFitMakeModel instead of an explanation

**A**. If it is just stated that a new relation is creation if the attributes in the relation make its purpose clear

**NE**. A relation to link the Part and Car relations

**2 marks from:**

Store the attributes PartID, Make and Model in the new relation;

**I**. Inclusion of additional attributes

Make the PartID, Make and Model / all the attributes the entity identifier;

**A**. The creation of a new field as an entity identifier for this relation if it is explained that a constraint would also need to be added to ensure that it is not possible to record twice in the relation that a particular part could be fitted to a particular make and model of car

Accept answers by example, such as: PartToFitMakeModel(PartID, Make, Model)

**Alternative Response**

**1 mark:**

Create two new relations, one to associate an entity identifier with each make and model of car (eg MakeModelID) and one to link the parts to this new relation

**A.** If it is just stated that new relations will be created if the attributes in the relations make their purpose clear

**2 marks from:**

Store the attributes Make and Model with a new entity identifier (eg MakeModelID) in one of the new relations;

Store the PartID in the other new relation together with the entity identifier from the first new relation (eg MakeModelID);

Make the PartID and MakeModelID the entity identified in the second new relation;

**A**. The creation of a new field as an entity identifier for this relation if it is explained that a constraint would also need to be added to ensure that it is not possible to record twice in the relation that a particular part could be fitted to a particular make and model of car

Accept answers by example, such as: UniqueMakeModel(MakeModelID, Make, Model) and PartToFitMakeModel(PartID, MakeModelID)

**A**. Table or entity for relation.

**A**. Field for attribute.

**A**. Primary key for Entity Identifier.

**3**

**[18]**

**Q23.**

(a)  **Mark is AO1 (understanding)**

C;

**1**

(b)  **Mark is AO1 (understanding)**

B;

**1**

(c)  **All marks AO2 (apply)**

****

**1 method mark** for either:

•   showing correct value of both mantissa and exponent in denary

(mantissa = -0.625 // -5/8, Exponent = 3)

•   showing binary point shifted 3 places to right in binary number ie 1011.0000 or in the positive equivalent 0101.0000

•   indicating that final answer calculated using

answer = mantissa x 2exponent

**1 mark** for correct answer

Answer = −5

**If answer is correct and some working has been shown, award two marks, even if working would not have gained credit on its own.**

**2**

(d)  **All marks AO2 (apply)**

**2 marks** for working:

Correct representation of 58.5 in fixed point binary: 111010.1; **A**. leading 0s.

Showing the correct value of the exponent in denary (6) or binary (110) // showing the binary point being shifted 6 places;

**MAX 2**

**1 mark** for correct mantissa and exponent together:



**If answer is correct and some working has been shown, award three marks, even if working would not have gained credit on its own.**

**Working marks can be awarded for work seen in the final answer eg correct exponent.**

**3**

(e)  **Mark is for AO2 (apply)**

0.05 // 13.8 – 13.75;

**A.** Award BOD mark if correct method has been shown i.e. 13.8 – 13.75 but candidate has then made an error performing the subtraction operation

**R.** −0.05 unless the accept point above also applies

**1**

(f)  **Mark is for AO2 (apply)**

0.36(%);

**A.** 0.0036 // 0.05 ÷ 13.8

**A.** Follow-through of incorrect answer to question part 11.5

**A.** Award BOD mark if correct method has been shown but candidate has then made an error performing the division operation

**1**

**[9]**

**Q24.**

**All marks AO1 (understanding)**

|  |  |
| --- | --- |
|  | **Correct Name from List** |
| **B** | Visual display unit; |
| **C** | Processor; |
| **D** | Main memory; |
| **E** | Keyboard; |

**1 mark** per correct answer

**A** If same response used more than once

**[4]**

**Q25.**

(a)     **All marks AO1 (knowledge)**

**1 mark:** Serial sends one bit at a time / after each other whereas parallel sends multiple bits simultaneously / at same time/

**A** "data" for "bits" in the context of parallel transmission

**1 mark:** Serial uses a single wire / cable / path / line whereas parallel uses several / multiple wires / cables / paths / lines;

**A** serial requires fewer wires

**R** answers that refer to multiple channels achieved by sharing bandwidth

**R** unless both sides of a point are made.

**2**

(b)     **Mark is for AO1 (understanding)**

Parallel communication can only be used over short distances / / distance between computer and peripheral too great to use parallel communication / / data skew might occur if parallel communication used;

To avoid problems of cross-talk / / interference between individual wires;

Hardware (for serial communication) is cheaper to manufacture;

**A** fast transmission rate may not be required;

**Max 1**

**1**

(c)     **Mark is for AO1 (knowledge)**

Number of signal changes per second / / rate at which signals can change; **A** voltage changes for signal changes

**1**

(d)     **Mark is for AO1 (understanding)**

Each signal level / signal change represents more than

one bit (of data) / / channel supports more than two different signal levels / voltages / / use of modulation / coding technique eg phase modulation;

**N.E.** Send more than one bit at a time

**Must be clear that there are more than two signal levels;**

**1**

**[5]**

**Q26.**

(a)     **All marks AO2 (apply)**

****

**1 mark:** inputs D and M connected to an OR gate;

**1 mark:** inputs K and output of OR gate connected to AND gate plus output connected to A;

**A** a logically equivalent circuit

**2**

(b)     **All marks AO2 (apply)**

A = (D + M) · K

**1 mark:** D + M somewhere in expression, even if full expression incorrect

**1 mark:** fully correct expression

**A** A logically equivalent expression

**2**

(c)     **1 mark for AO1 (understanding), 1 mark for AO2 (application) and 1 mark for AO1 (knowledge)**

**AO1 (understanding):1 mark:** Flip-flop will store the state of its input / / Flip-flop acts as memory;

**AO2 (application):1 mark:** Insert into circuit between the output of the OR gate and the AND gate / / after the AND gate;

**AO1 (knowledge):1 mark:** Clock signal / / trigger / / signal to indicate when the value (of the input) should be stored / read;

**3**

**[7]**

**Q27.**

**All marks AO2 (apply)**

|  |  |  |
| --- | --- | --- |
| **Level** | **Description** | **MarkRange** |
| 4 | A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. The response covers all four areas indicated in the guidance below and in at least three of these areas there is sufficient detail to show that the student has a good level of understanding of the technologies required.A good level of understanding would be indicated by three substantiated points being made per area. To reach the top of this mark range, a good level of understanding must be shown of all four areas. | 10 – 12 |
| 3 | A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response but the response may only cover three of the areas indicated in the guidance below, with two or three substantiated points being made per area. | 7 – 9 |
| 2 | A limited attempt has been made to follow a line of reasoning by covering at least two of the topic areas in the guidance below.Overall, at least four valid points must have been made which can relate to any of the topic areas in the guidance. | 4 – 6 |
| 1 | A few relevant points have been made but there is no evidence that a line of reasoning has been followed. The points may only relate to one or two of the four areas from the guidance or may be made in a superficial way with little substantiation. | 1 – 3 |

**Guidance – Indicative Response**

**1. Fridge capturing data from food**

RFID well suited as completely automatic short-range wireless transmission so no user involvement

•        tag does not contain a power source but is energised by reader in fridge

•        this causes wireless transmission of data stored in memory on tag to reader

Alternatively, scan barcode / QR code as food put into fridge

Barcode less suitable than RFID as only identifies product not use by date and must be manually scanned

Problem of how to deal with untagged produce – possible use of voice recognition or touch screen interface

Can identify products and potentially track use by dates, but how to work out how much of the product is left – refrigerators redesigned with load cells to weigh items automatically?

**2. Networking technologies**

IPv4 does not have a big enough address space for the number of devices, hence introduction of IPv6

Higher bandwidth Internet connections required for so many devices

•        copper-based transmission systems replaced with fibre optic

Need for a standard (application layer) protocol for devices

Security issues with many devices connected to Internet that could be hacked

Would data be communicated to retailers directly from each device or through a server in the home?

Need to consider how to deal with interference between wireless devices, collisions etc with many more devices communicating

**3. The data gathered and storage**

Automatic collection of data from devices will produce vast amounts of data

This volume of data would be classified as big data

May also be classified as big data due to the velocity of data collection with so many devices

Storage could be cloud based for flexibility or close to processing cores for speed

Velocity at which data generated would make solid state storage appropriate as has fast access speeds but volume of data and lower cost per megabyte of hard disk storage may mean hard disks more likely to be used

Need to consider how long to keep data for in context of

•        Storage capacity available

•        Complying with relevant laws about privacy

**4. Processing**

Volume of data means parallel processing or distributed processing architectures required

Volume of data collected makes it unsuitable for processing by traditional relational databases

Functional programming is one approach that could be used

Functional programming appropriate as works well on parallel processing systems as programs do not specify order of execution

Would software that managed contents of the fridge be run as embedded system in fridge or in the cloud / by the retailer?

Retailers may develop a standard API to interface with devices

**[12]**

**Q28.**

(a)     **Mark is for AO2 (apply)**

Grey Pixel: 00

White Pixel: 11;

**Must have both correct to achieve mark**

**1**

(b)     **Mark is for AO2 (apply)**

**1 mark** for either:

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

or:

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

**1**

(c)     **All marks AO2 (apply)**

**Working 1 mark:**

20\*10 / / 2\*10\*10 / / 200;

Division of a number of bits by 8 to convert to bytes (even if number is not 200);

**1 mark:**

25 (bytes);

**2**

(d)     **Mark is for AO1 (understanding)**

**1 mark (Max)** for any of the items in this list, or a description of any of them:

•        image width

•        image height

•        colour (bit) depth / / bits per pixel

•        number of colour planes

•        colour table / palette

•        number of colours in palette

•        number of important colours

•        colour channel bitmasks

•        colour channel gamma correction

•        file size

•        image size

•        type of compression used

•        pixel density / / pixels per metre (**A** any other measurement unit)

•        offset to pixel data within file.

**A** Any other valid answer (there are many possibilities)

**1**

(e)     **2 marks for AO1 (knowledge) and 1 mark for AO1 (understanding)**

**AO1 (Knowledge): How it works (2 marks):**

**1 mark:** Identifies sequences of identical data values / colour pixels;

**1 mark:** Represents these as one data value / pixel colour together with a count of how many such values are in the sequence;

**AO1 (Understanding): Why suitable for icons (Max 1 mark):**

Images / icons often contain sequences of pixels that are the same colour;

RLE is a lossless compression method, so the quality of the image will not be affected (which is important for icons);

**3**

**[8]**

**Q29.**

(a)     **Mark is for AO1 (understanding)**

64 / 26;

**1**

(b)     **Mark is for AO2 (apply)**

100;

**1**

(c)     **Mark is for AO2 (apply)**

110;

**A** The response given to question part (b) with 10 added on.

**1**

(d)     **Mark is for AO2 (apply)**

220;

**A** The response given to question part (c) multiplied by 2.

**1**

(e)     **All marks AO1 (understanding)**

So that source code cannot be accessed by users;

So that it is more convenient for users to run it / / users do not need to have an interpreter;

So that the program will execute more quickly;

**Max 2**

**2**

(f)      **All marks AO1 (understanding)**

**1 mark:** Can't know what type of processor will be in user’s computer / / Internet users have range of computers / devices with different processors; **A** References to just different types of computer / device rather than specifically processors

**1 mark:** A compiled program will only execute on a processor of specific type / family / with same instruction set / / A program run using an interpreter can execute on a computer with any type of processor;

**R** No compiler exists

**2**

**[8]**

**Q30.**

(a)     **All marks AO1 (understanding)**

**1 mark:** The ‘Router 2’ port labelled **A** 192.168.2.x where x is not 0 or 255;

**1 mark:** The computer network interface card labelled **B** 192.168.2.y where y is not 0 or 255 or x from the previous response;

**2**

(b)     **All marks AO1 (understanding)**

**1 mark for advantage and 1 mark for reason. Must give the advantage to get the reason mark.**

**1 mark: (any 1 from)** Improved security; as data only travels down one link / / is not sent throughout network / / is not sent to all nodes;

Improved reliability; as if one link fails the other links / nodes are not affected;

**1 mark: (any 1 from)** Speed of link remains constant / / speed not affected by number of connections / collisions / / faster connection; as no collisions / links not shared;

**A** cable for link

**R** responses about terminal / computer failure

**2**

(c)     **2 marks for AO1 (knowledge) and 4 marks for AO1 (understanding)**

|  |  |  |
| --- | --- | --- |
| **Level** | **Description** | **Mark Range** |
|   3 | A detailed, coherent, description of the basic mechanism that shows a good level of understanding. To score six marks, either the description of the basic mechanism must be comprehensive, or, there may be one or two minor errors or omissions in the description of the basic mechanism but these are compensated for by also describing some aspects of CTS/RTS or the back-off mechanism. | 5 – 6 |
|   2 | An adequate description, including at least three points from the lists below. Some aspects of the basic mechanism may be missed out. The description is logically organised so that it makes sense when read as a whole and therefore demonstrates a reasonable understanding of how the system works. | 3 – 4 |
| 1 | A small number of relevant points have been recalled (in this case award one mark per point, up to a maximum of two from lists below). However, the structure of the response, or lack of it, fails to demonstrate an understanding of the mechanism used. | 1 – 2 |

**Basic mechanism:**

•        computer monitors / listens for (data signal)

•        if (data) signal present / another transmission in progress then continue to wait

•        when no (data) signal present start to transmit

•        wait to receive acknowledgement packet (to confirm data received and not corrupted)

•        if no acknowledgement received (within reasonable time period) then:

o        wait a random time period

o        then retransmit.

**CTS / RTS (if implemented):**

•        before starting to transmit, computer sends a Request to Send (RTS) to access point

•        access point will respond with a Clear to Send (CTS) signal to only one computer at a time

•        only the computer that receives the CTS signal will transmit.

**Back-off mechanism:**

•        waiting period is random to reduce likelihood of two computers transmitting at the same time again / / to reduce likelihood of another collision

•        if a collision occurs again then wait a longer random time before attempting to transmit again

•        use of exponential back-off algorithm to determine wait time.

**6**

(d)     **1 mark for AO1 (knowledge) and 2 marks for AO1 (understanding)**

**AO1 (knowledge): 1 mark:** Checksum (is a number / value which) is calculated from / / is a hash of the data in the packet (before it is transmitted);

**AO1 (understanding): 1 mark:** Checksum recalculated when packet is received;

**AO1 (understanding): 1 mark:** If checksum received in packet matches recalculated checksum then data received correctly / / If checksum received in packet differs from recalculated checksum then data has been corrupted;

**3**

**[13]**

**Q31.**

(a)     **All marks AO1 (understanding)**

**1 mark** per correct response:

|  |  |
| --- | --- |
| **Value description** | **Correct letter(A-D)** |
| A positive normalised value. | A |
| The most negative value that can be represented. | C |
| A value that is not valid in the representation because it is not normalised. | B |

If a letter is used more than once then mark as correct in the position where it is correct (if any).

**3**

(b)     **All marks AO2 (apply)**

****

|  |  |
| --- | --- |
| Mantissa | Exponent |

**1 method mark** for either:

•        showing correct value of both mantissa and exponent in denary (Mantissa = 0.6875 / / 11 / 16, Exponent = 5)

•        showing binary point shifted 5 places to right in binary number

•        indicating that final answer calculated using answer = mantissa x 2exponent

**1 mark** for correct answer

Answer = 22

**If answer is correct and some working has been shown, award two marks, even if working would not have gained credit on its own.**

**2**

(c)     **All marks AO2 (apply)**

**2 marks** for working:

Correct representation of 6.75 in fixed point binary:

110.11; **A** leading 0s.

Correct representation of -6.75 in two's complement fixed point binary: 1001.01; **A** leading 1s.

Showing the correct value of the exponent in denary (3) or binary (11) / / showing the binary point being shifted 3 places;

**Max 2**

**1 mark** for correct mantissa and exponent together:



              Mantissa



        Exponent

**If answer is correct and some working has been shown, award three marks, even if working would not have gained credit on its own.**

**Working marks can be awarded for work seen in the final answer eg correct exponent.**

**3**

(d)     **All marks AO1 (understanding)**

**1 mark:** Reduced precision;

**1 mark:** Increased range; **A** can represent larger / smaller numbers

**2**

**[10]**

**Q32.**

(a)     **Mark is for AO2 (apply)**

RaceEntryAndResult(RaceNumber, AthleteNumber, TimeSet)

**1 mark** for underlining both RaceNumber and AthleteNumber.

**1**

(b)     **All marks AO1 (knowledge)**

**Any 2 from:** Data is atomic / / no repeating groups (of attributes);
**R** No repeated columns / attributes / data / values

No partial (key) dependencies / / No (non-key) attribute depends on part of the primary key but not the whole of it / / all non-prime attributes are (functionally) dependent on the whole of every candidate key / / (non-key) attributes depend on the whole key;

No non-key dependencies / / No transitive dependencies / / (non-key) attributes depend on nothing but the key;

Every (non-key) attribute is dependent upon the key;

Every determinant is a candidate key;

**A** ‘field’ for ‘attribute’

**A** ‘part’ for ‘partial’

**MAX 2**

**2**

(c)     **All marks AO2 (analyse)**

**1 mark** for any one correctly drawn relationship **OR**

**2 marks** for all three relationships drawn correctly



**2**

(d)     **All marks AO3 (programming)**

**Method 1:**

INSERT INTO RaceEntryAndResult
VALUES (6,27,"00:00.00")

**Method 2:**

INSERT INTO RaceEntryAndResult (RaceNumber, AthleteNumber, TimeSet)
VALUES (6,27,"00:00.00")

**Method 3 (Default Time Assumed):**

INSERT INTO RaceEntryAndResult(RaceNumber, AthleteNumber)
VALUES (6, 27)

**1 mark** for correct INSERT INTO clause

**1 mark** for correct VALUES clause

**A** default time delimited by any type of quotation mark or hashes or no delimiter

**A** any sensible variation on the default time eg "0:00", "00:00:00", or just 0

**A** the values 6 and 27 if they are delimited by any type of quotation mark

**A** list of fields in any order for method 2, but to get the VALUES mark in method 2, order of fields list in INSERT INTO must match order of values in VALUES

**2**

(e)     **1 mark for AO2 (analyse) and 2 marks for AO3 (programming)**

**AO2 (analyse) – 1 mark:**

**1 mark** for correctly identifying the table in the data model that needs to be updated (RaceEntryAndResult) and the conditions that should be used to identify the correct record to in the table to update – with both conditions linked by the correct logical operator

**Note:** The AO2 mark for understanding the data model should be awarded regardless of whether correct SQL syntax is used or not as they are for data modelling, not syntactically correct SQL programming

**AO3 (programming) – 2 marks:**

1 mark for correct SQL syntax in two of the three clauses (UPDATE, SET, WHERE)

**OR**

**2 marks** for correct SQL syntax in all three clauses – to get two marks, there must be fully correct SQL syntax and all three clauses must be present, but it might be possible that the AO2 mark was not awarded eg if OR was used instead of AND

Example Solution

UPDATE RaceEntryAndResult
SET TimeSet = "00:18.76"
WHERE AthleteNumber = 27 AND RaceNumber = 6

Additional Guidance

**AO3 marks:**

**A** any type of quotation marks or hashes for delimiters for TimeSet or no delimiters
**A** the values 27 and 6 if they are delimited by any type of quotation mark
**A** any sensible format for the time data eg "18.76", "18:76", "0:18:76" etc.

(f)      **3 marks for AO2 (analyse) and 2 marks for AO3 (programming)**

**AO2 (analyse) – 3 marks:**

**1 mark** for correctly understanding the data model and identifying the tables that data needs to be extracted from and the fields that need to be extracted, and including these and no other tables or fields in the query

**1 mark** for correctly identifying how the data in the required tables should be combined to produce the desired result (the linking condition)

**1 mark** for identifying the correct conditions to use within the model for the RaceNumber and TimeSet fields to retrieve the required data and for using the correct logical operators between all of the conditions

**Note:** The AO2 marks for understanding the data model should be awarded regardless of whether correct SQL syntax is used or not as they are for data modelling, not syntactically correct SQL programming

**AO3 (programming) – 2 marks:**

**1 mark** for correct SQL syntax in two of the four clauses
(SELECT, FROM, WHERE, ORDER BY)

**OR**

**2 marks** for correct SQL syntax in all four clauses – to get two marks, there must be fully correct SQL syntax and all four clauses must be present, but there could be mistakes in the marks awarded for AO2 e.g. an incorrect or missing condition

Example Solutions

**Example 1**

SELECT AthleteNumber, Forename, Surname, TimeSet
FROM Athlete, RaceEntryAndResult
WHERE RaceNumber = 6
AND TimeSet "00:00.00"
AND Athlete.AthleteNumber = RaceEntryAndResult.AthleteNumber
ORDER BY TimeSet

**Example 2**

SELECT AthleteNumber, Forename, Surname, TimeSet
FROM Athlete INNER JOIN RaceEntryAndResult
    ON Athlete.AthleteNumber = RaceEntryAndResult.AthleteNumber
WHERE RaceNumber = 6
AND TimeSet "00:00.00"
ORDER BY TimeSet

Additional Guidance

**AO2 marks:**

Mark(s) can be awarded for the correct logical conditions even if the required tables are not identified as being used by the query
Accept alternatives for not equal to that are correct in the context of the data model eg > or !=
Accept any sensible variation on the default time eg "0:00", "00:00:00", or just 0
Ignore unnecessary clause Race.RaceNumber = RaceEntryAndResult.RaceNumber

**AO3 marks:** Accept table names before fieldnames.
Accept use of Alias/AS command eg FROM Athlete AS A or FROM Athlete A then use of A as table name.
Accept INNER JOIN written as one word i.e. INNERJOIN.
Accept ORDER BY written as one word i.e. ORDERBY.
Accept ASC at end of ORDER BY clause.
Accept insertion of spaces into fieldnames.
Accept use of ", ' or # as delimiters for times.
Accept use of " or ' as delimiters for around number 6.
Ignore unnecessary brackets.
**DPT** for unnecessary punctuation – allow one semicolon at the very end of the statement, but not at the end of each clause.
**DPT** for fieldname before table name.

**Refer responses using nested SQL queries to team leaders.**

**5**

(g)     **All marks AO1 (understanding)**

**Problem Conditions (1 mark):**

When two users try to update the same record simultaneously;

**How dealt with (2 marks):**

Alternative 1 - Record Locks

Maintain information about which records are currently being accessed;

When a user tries to access a record, consult this information and only permit access if record is not currently being used / / only permit read access to a record that is already open;

Alternative 2 - Transaction Queuing

Updates / database changes are (grouped as transactions and) queued;

Database software processes transactions in FIFO order from queue;

**Award 1 mark for ‘use of record locks’ if no other marks awarded for how dealt with.**

**3**

**[18]**

**Q33.**

(a)     **All marks AO1 (understanding)**

**1 mark:** A will encrypt the message using **B's public;** key.

**1 mark:** The message will be decrypted by B using **B's private;** key.

**2**

(b)     **All marks AO1 (understanding)**

**1 mark:** Detect (unauthorised) changes to message;

**1 mark:** Authenticate sender's identity / / confirm who sent it;

**2**

**[4]**

**Q34.**

(a)      **All marks AO1 (understanding)**

|  |  |
| --- | --- |
| **Equation** | **Correct?(Shade three)** |
| A ·  = 1 |   |
| A + B =  |  |
| A + 1 = 1 |  |
| A · (A + B) = A |  |
| A + (A · B) = B |   |
| A · 1 = 1 |   |

**If more than three lozenges shaded then take the number of incorrect answers from the number of correct answers to arrive at the total mark**

**3**

(b)     **All marks AO2 (apply)**

Example solution:



= A · B + B·

= B·( + )

= B · 1

= B

**In any attempted solution award:**

**1 mark** for an application of DeMorgan's law

**1 mark** for an application of a Boolean identity or expanding the brackets

**1 mark** for correct answer

**A** alternative methods of solution but must use Boolean algebra not truth table

**3**

**[6]**

**Q35.**

(a)     **Marks is for AO1 (understanding)**

|  |  |
| --- | --- |
| Head | 1 |
| Tall | [2,3,4] |

**1 mark** for both head and tail correct.
**I** if brackets are missing in tail.

**1**

(b)     **Mark is for AO2 (apply)**

[ 2, 4, 6, 8 ];

**I** if brackets are missing in tail.

**1**

(c)     **All marks AO1 (understanding)**

**1 mark:** Explaining that map applies the function double to each list element;

**1 mark:** Explaining that map applies double to the head of the list;

**1 mark:** and then a recursive call is made on the tail of the list;

**3**

**[5]**