Student responses with examiner commentary

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A-level Computer Science 7517
Paper 2 7517/2]

For teaching from September 2015

For assessment from summer 2017

Specimen Assessment Paper 2 7517/2

Introduction

These resources should be used in conjunction with the Specimen Assessment material (7517/2) from the AQA website. This document illustrates how examiners intend to apply the mark scheme in live papers. While every attempt has been made to show a range of student responses examiners have used responses, and subsequent comments, which will provide teachers with the best opportunity to understand the application of the mark scheme.

A-level
COMPUTER SCIENCE

Student 2

Paper 2

Total Mark 76

TBC am/pm 2 hours 30 minutes

Materials
- There are no additional materials required for this paper.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the bottom of this page.
- Answer **all** questions.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- You may use a calculator.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.

Advice
- In some questions you may be required to indicate your answer by shading a lozenge. If you wish to change your answer make sure that the incorrect answer is clearly crossed through with an x.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Forename(s) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Candidate signature ____________________

Answer **all** questions in the spaces provided.

0 1 **Figure 1** shows how some of the components of a computer system can be connected together.

Figure 1

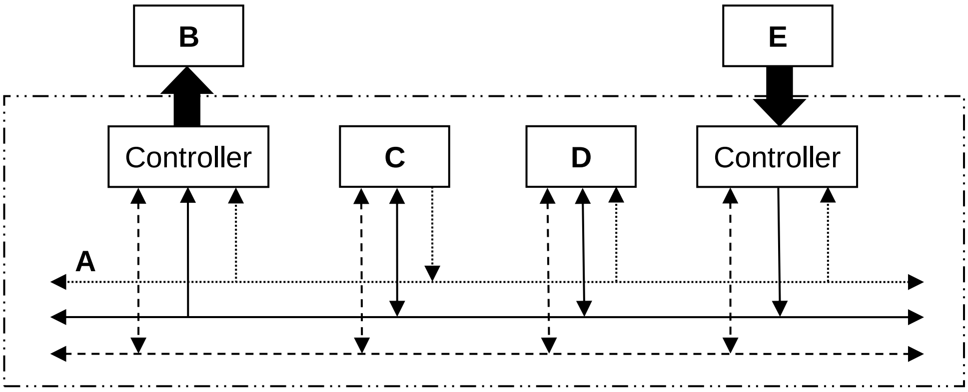


Table 1 lists the names of six components in the column headings and the five letters (**A**-**E**) from **Figure 1** in the row headings.

For each row in **Table 1**, shade **one** lozenge, in the appropriate column, to indicate
As an example, the first row has been completed for you, to indicate that component **A** in **Figure 1** is the Address bus.

[4 marks]

Table 1

	Processor	**Address bus**	**Data bus**	**Main memory**	**Keyboard**	**Visual display unit**
A	○	●	○	○	○	○
B	○	○	○	○	○	● ✓
C	● ✓	○	○	○	○	○
D	~~●~~	○	○	● ✓	○	○
E	○	○	○	○	● ✓	○

4

4
4

The student has correctly identified all four components. Initially, a mistake was made on row D, but the student has corrected this by crossing through the incorrectly shaded lozenge.

0 2 The internal buses in a computer use parallel communication while most peripherals communicate with a computer using serial communication.

0 2 . 1 Explain the differences between the ways in which parallel and serial communication is carried out.

[2 marks]

Parallel communication is faster than serial as parallel sends multiple data bits simultaneously whilst serial only sends one bit at a time. ✓

1

The student has correctly identified the distinction between the number of bits sent simultaneously by each method, so has achieved one mark. The initial statement that parallel communication is faster was not relevant to the question which is about how the communication is carried out. It is also no longer clear that parallel communication is faster than serial as a result of higher clock speeds, lack of cross-talk in serial communications etc.

Most peripherals, such as printers and keyboards, communicate with a computer using a serial connection.

0 2 . 2 Apart from the widespread availability of USB (Universal Serial Bus) ports, explain why peripherals usually use a serial communication method such as USB instead of parallel communication.

[1 mark]

If the peripheral was a long distance away then parallel would not work. ✓

1

This is enough for a mark, as it is just the point that parallel will only work over short distances that is on the mark scheme, but made in reverse.

In communications systems, a distinction is made between the bit rate and the baud rate.

0 2 . 3 Define the term baud rate.

[1 mark]

This is the rate at which data can be sent.

0

This is not enough. To get a mark, the student needs to relate the response to the rate at which the signal on the transmission medium can change.

0 2 . 4 Explain how it is possible for the bit rate to be higher than the baud rate.

[1 mark]

This could be achieved by having four different voltage levels in the system ✓*, with each voltage level representing two bits of data e.g. 0v = 00, 1v = 01, 2v = 10, 3v =11*

1

This is a very detailed explanation; the student has given more detail than is required for the mark.

3/5

0 3 A burglar alarm system is to be implemented that has the following sensors:

- a door sensor **D** that outputs TRUE when the door is open and FALSE when the door is shut
- a pressure mat sensor **M** that outputs TRUE while a weight is detected on it and FALSE when no weight is detected on it.

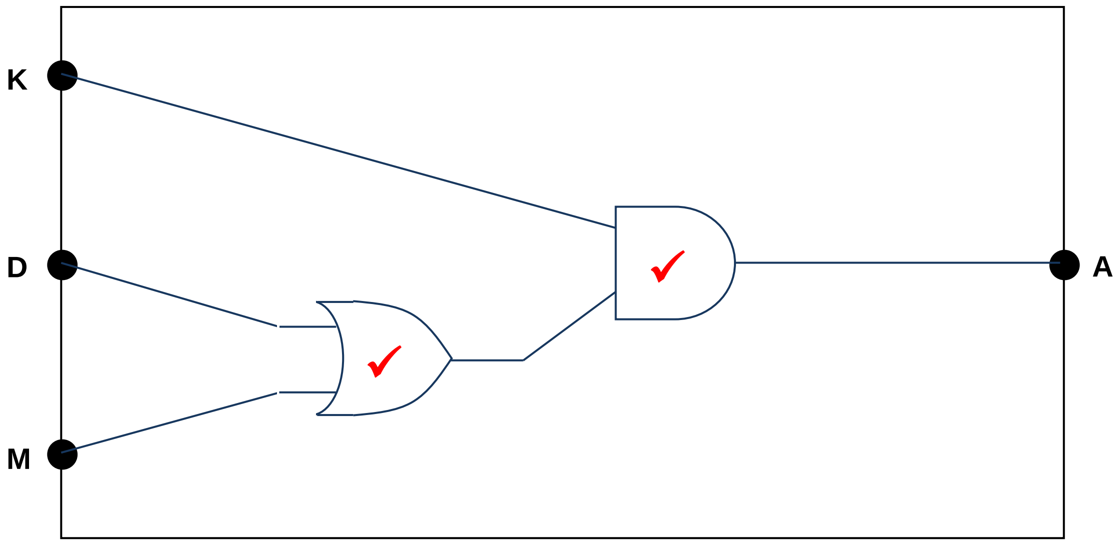
The alarm also has a key **K** that turns the alarm on and off. **K** outputs a TRUE signal when the alarm is switched on and FALSE when the alarm is off.

The alarm output **A** sounds a bell. It should be TRUE if:

- the alarm is on AND
- either of the sensors **D** or **M** are set to the value TRUE.

0 3 . 1 In the space below, draw a logic circuit that will behave as described above for the inputs **D**, **M** and **K** and the output **A**.

[2 marks]



2

0 3 . 2 Write a Boolean expression to represent the logic of this alarm system.

[2 marks]

A = $K \cdot D + K \cdot M$ ✓✓

2

The student has not given the expected response which is slightly simpler (D+M).K but this is a logically equivalent expression so both marks have been awarded. This does not represent the logic of the circuit (which would need 1 OR gate and 2 AND gates), but does represent the logic of the alarm system.

0 3 . 3 In this alarm system, the alarm bell will sound only while the door is open or a weight is placed on the pressure mat. If someone who has stepped on to the mat moves off it, or an open door is closed, the alarm bell will stop ringing.

A D-type flip-flop could be incorporated into the logic circuit so that the alarm bell would continue to sound after a person closed the door or moved off the pressure mat.

Explain how this could be achieved. In your answer refer to:

- why a D-type flip-flop would be suitable for this task
- where the D-type flip-flop would need to be inserted into the circuit
- what additional input the D-type flip-flop would need.

[3 marks]

The flip-flop would need to be inserted at the very end of the circuit ✓*and would be used as it could remember that the alarm had been triggered* ✓ *and keep its output to the bell active.*

2

6
7

“At the very end of the circuit” is just enough for a mark, as from the diagram given it can be seen that this means after the AND gate. Although the term “memory” has not been used, the second part of the description explains that the flip-flop would be memory so a second mark has also been awarded. The student needed to identify that a trigger input would be required for the third mark.

Turn over for the next question

0 4 The phrase “Internet of Things” is used to describe the connection of many everyday devices such as home heating controls, utility meters, cars and environmental sensors to the Internet. It is believed that tens of billions of devices will be connected to the Internet of Things by the end of the decade.

One anticipated use of the Internet of Things is to monitor the food that consumers have inside their fridges. This data could be gathered automatically from consumers’ devices by retailers who sell food. Retailers could use the data to analyse consumer consumption habits or automatically prepare deliveries for customers.

In the context of an Internet connected fridge, discuss the technologies that will be required to make the Internet of Things work.

You may wish to consider how the data might be captured, how networking technologies are changing to provide the necessary infrastructure, and how the data gathered by retailers could be stored and processed, from a hardware and software viewpoint.

[12 marks]

The fridge would need to be able to identify which products were inside it and when they would expire or run out. The food could be identified by incorporating a bar code scanner into the fridge [Capturing Point]*, or alternatively if RFID tags were added onto the products these could be scanned automatically as as items were taken in and out because it is wireless.* [Capturing Point] *Some products like fruit might not have a barcode so the person who the fridge belongs to would have to input their details, maybe using a keyboard or a smart phone that connects to the fridge by Bluetooth* [Capturing Point]*. The bar code could be used to look up the expiry dates from a database on the Internet.*

If very many devices were connected to the Internet then more IP addresses would be needed than are currently available, which is being addressed by IPv6 IPv6 [Networking Point]*. Also, it is likely that Internet connections would need to be faster due to the vast amount of data being collected so cable connections might need to be replaced by fibre optic ones which are faster* [Networking Point]*.*

The vast amount of data captured would be “big data” [Storage Point] *which is very hard to deal with. Hardware like parallel processing* [Processing Point] *could be used so that more data could be processed at the same time. Functional programming might be applied* [Processing Point] *to this as it is good at scaling* *to work on parallel systems* [Processing Point].

There would also be a lot of data to store. Probably the company would have a big data storage warehouse that would include lots of hard disks. As the amount of data would grow every day, the company will probably need to keep the data only for a certain period and then delete it to avoid running out of storage capacity [Storage Point].

9

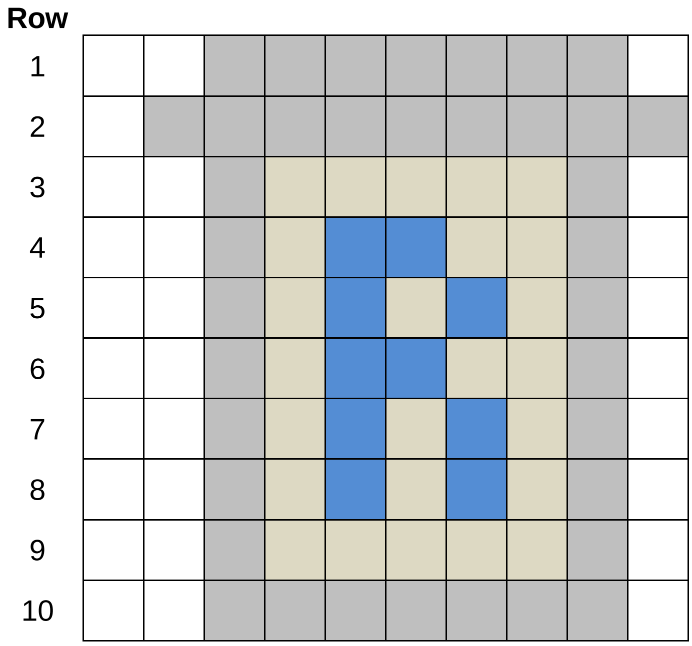
This is a Level 3 response. The student has made 3 capturing points, 2 networking points, 2 storage points and 3 processing points so does not meet the required criteria of having made 3 points per topic area to achieve Level 4. However, as the response covers all four areas and two or three points have been made per area, this happily meets the requirements for Level 3. Level 3 only requires that three areas are covered and in fact four have been, so a mark towards the top end of Level 3 is appropriate.

9
12

Turn over

0 5 The icon in **Figure 2** is represented in a computer's memory as a bitmap image.

Figure 2



Four different colours have been used in the icon.

Row 1 of the icon is represented in the computer's memory as the bit pattern:

1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1

0 5 . 1 What are the bit patterns that have been used to represent a grey pixel and a white pixel?

[1 mark]

Grey pixel: 00 White pixel: 11 ✓ 1

0 5 . 2 State **one** possible 20-bit representation for **Row 4** of the icon in **Figure 2**.

[1 mark]

1	1	1	1	0	0	1	0	0	1	0	1	1	0	1	0	0	0	1	1

1

✓

This is a fully correct response. The pattern 10 has been used for brown pixels and 01 for blue pixels.

0 5 . 3 Calculate the number of bytes required to represent all the pixel data in the icon as a bitmap.

Show your working.

[2 marks]

Answer: *25* ✓

1

The student has given the correct answer but has only achieved one mark because their working is not shown.

0 5 . 4 When the bitmap is saved as a file, the file size is bigger than the answer to **0 5 . 3** . This is because metadata is saved in the file with the pixel data

State **one** item of metadata that would be stored in a bitmap file.

[1 mark]

Width of the image ✓

1

Run-length encoding (RLE) is an example of a compression method that could be used to reduce the amount of memory required to store the icon in **Figure 2**.

0 5 . 5 Describe the principle used by RLE to compress a file and explain why RLE is an appropriate compression method for compressing images such as icons.

[3 marks]

Run length encoding is a method of data compression that identifies sequences of the same data item ✓ *and shortens these by recording the data item and a count of how many times it occurs in the sequence.* ✓ *It is suitable for images because images are often large files.*

2

The student had given a good description of RLE, worth two marks. However the reason that has been given is about why images are often compressed, not why RLE is a suitable method for this. A better response would be that images often contain areas that are the same colour and so long sequences of identical data values.

6
8

0 6 **Figure 3** shows the structure of an example machine code instruction, taken from the instruction set of a particular processor.

Figure 3

<table>
<tr><th colspan="7">Opcode</th><th colspan="8" rowspan="2">Operand(s)</th></tr>
<tr><th colspan="6">Basic Machine Operation</th><th>Addressing Mode</th></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
</table>

0 6 . 1 How many different basic machine operations could be supported by the instruction set of the processor used in the example in **Figure 3**?

[1 mark]

64 ✓ 1

Figure 4 shows an assembly language program together with the contents of a section of the main memory of the computer that the program will be executed on.

The assembly language instruction set that has been used to write the program is listed in **Table 2**.The lines of the assembly language program have been numbered to help you answer question parts **0 6 . 2** to **0 6 . 4**.

Figure 4

Line	**Command**
1	`MOV R2, #100`
2	`LDR R3, 101`
3	`ADD R2, R2, R3`
4	`LSL R3, R2, #1`
5	`HALT`

Memory Address (in decimal)	**Main Memory Contents (in decimal)**
100	23
101	10
102	62
103	18

0 6 . 2 What value will be stored in register `R2` immediately after the command in line 1 has been executed?

[1 mark]

Student has used the wrong addressing mode, loading contents of address 100 instead of the number 100.

23 0

0 6 . 3 What value will be stored in register `R2` immediately after the program has executed the commands from line 1 through to line 3?

[1 mark]

Student understood ADD instruction but has used the wrong addressing mode in the previous part. However, the functionality of adding 10 is correct so the mark is awarded.

33 ✓ 1

0 6 . 4 What value will be stored in register `R3` after the complete program has finished executing?

[1 mark]

The student has added one instead of doing a logical shift left.

34 0

Table 2

`LDR Rd, <memory ref>`	Load the value stored in the memory location specified by `<memory ref>` into register `d`.
`STR Rd, <memory ref>`	Store the value that is in register `d` into the memory location specified by `<memory ref>`.
`ADD Rd, Rn, <operand2>`	Add the value specified in `<operand2>` to the value in register `n` and store the result in register `d`.
`SUB Rd, Rn, <operand2>`	Subtract the value specified by `<operand2>` from the value in register `n` and store the result in register `d`.
`MOV Rd, <operand2>`	Copy the value specified by `<operand2>` into register `d`.
`CMP Rn, <operand2>`	Compare the value stored in register `n` with the value specified by `<operand2>`.
`B <label>`	Always branch to the instruction at position `<label>` in the program.
`B<condition> <label>`	Conditionally branch to the instruction at position `<label>` in the program if the last comparison met the criteria specified by the `<condition>`. Possible values for `<condition>` and their meaning are: • EQ: Equal to. • NE: Not equal to. • GT: Greater than. • LT: Less than.
`AND Rd, Rn, <operand2>`	Perform a bitwise logical AND operation between the value in register `n` and the value specified by `<operand2>` and store the result in register `d`.
`ORR Rd, Rn, <operand2>`	Perform a bitwise logical OR operation between the value in register `n` and the value specified by `<operand2>` and store the result in register `d`.
`EOR Rd, Rn, <operand2>`	Perform a bitwise logical exclusive or (XOR) operation between the value in register `n` and the value specified by `<operand2>` and store the result in register `d`.
`MVN Rd, <operand2>`	Perform a bitwise logical NOT operation on the value specified by `<operand2>` and store the result in register `d`.
`LSL Rd, Rn, <operand2>`	Logically shift left the value stored in register `n` by the number of bits specified by `<operand2>` and store the result in register `d`.
`LSR Rd, Rn, <operand2>`	Logically shift right the value stored in register `n` by the number of bits specified by `<operand2>` and store the result in register `d`.
`HALT`	Stops the execution of the program.

Interpretation of `<operand2>`

`<operand2>` can be interpreted in two different ways, depending upon whether the first symbol is a `#` or an `R`:

- `#` - use the decimal value specified after the `#`, eg `#25` means use the decimal value 25.
- `Rm` - use the value stored in register `m`, eg `R6` means use the value stored in register 6.

The available general purpose registers that the programmer can use are numbered 0 to 12.

Question 6 continues on the next page

Turn over ▸

Programs written in a high-level language can be compiled or interpreted.

Companies that develop computer programs to sell usually compile the final version of a program before distributing it to customers.

0 6 . 5 Explain why the final version of a computer program is usually translated using a compiler.

[2 marks]

This is done so that the final user does not need to buy translation software ✓ *and also to stop users seeing the source code which may the company will want to keep secret.* ✓

2

The JavaScript programming language can be used to write programs that are executed in a web browser on any Internet user's computer.

0 6 . 6 Explain why programs written in the JavaScript language, to be executed in a web browser, are interpreted rather than compiled.

[2 marks]

This is because, if there are any errors in a program, it will still execute until the point where the error is.

0

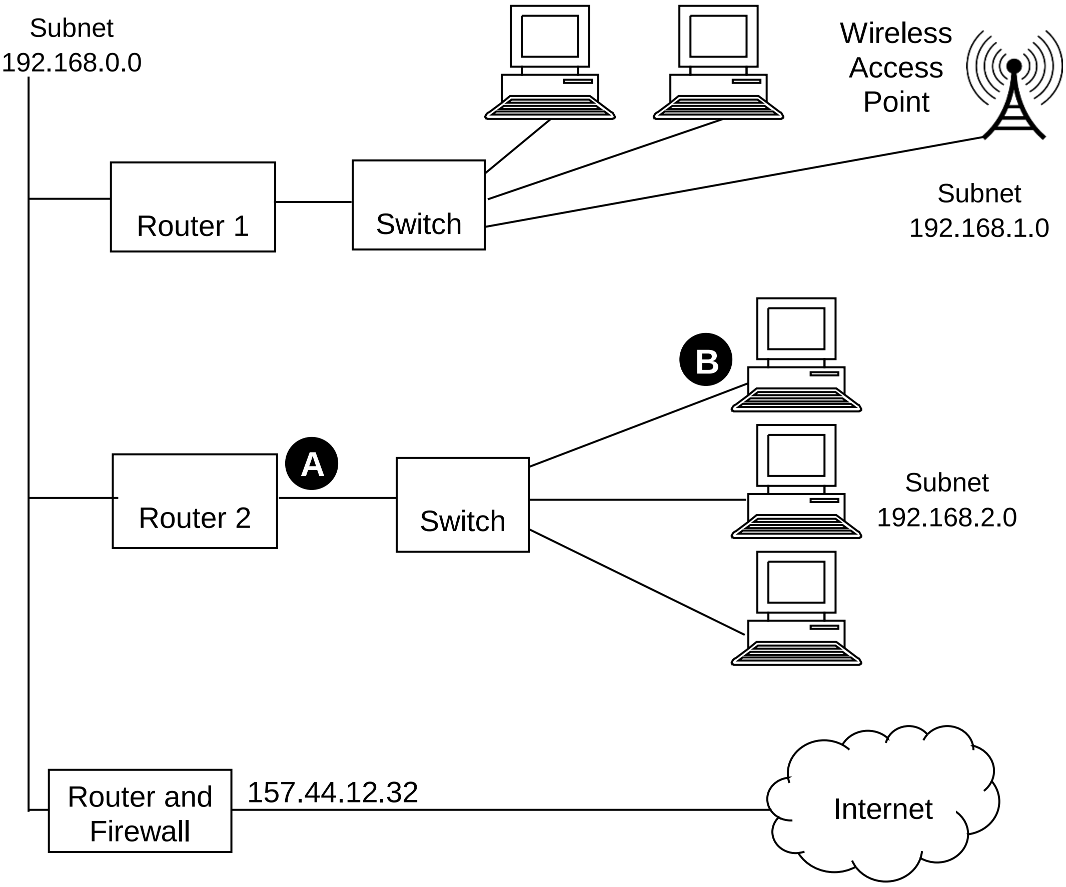
The student has missed the point of the question, giving a general response about why an interpreter might be chosen instead of relating it to the context of the question. A better response would explain the programs would be executed on a range of computers which might have different types of processor so compiled machine code could not be used.

4/8

0 7

Figure 5 shows the physical topology of a local area network (LAN) and its connection to the Internet. The LAN uses the IPv4 protocol.

Figure 5



0 7 . 1 State suitable IP addresses for:

[2 marks]

The 'Router 2' port labelled **A**: *192.168.2.1* ✓

The computer network interface card labelled **B**:*192.168.2.2* ✓

2

0 7 . 2 State **one** advantage of the star topology over the bus topology, and explain how this is achieved.

[2 marks]

One advantage is that it will be more secure. ✓

1

A mark is awarded for the advantage, but the reason has not been given so the second mark cannot be awarded.

Question 7 continues on the next page

Turn over ▶

Laptop computers connect to the network using WiFi. They use carrier sense multiple access with collision avoidance (CSMA/CA) to determine when to transmit data.

0 7 . 3 Describe how the CSMA/CA method is used.

[6 marks]

A computer wanting to transmit data will check to see if any data signals are already being sent. ✓ If a signal is present then the computer will wait ✓ until there is no signal before starting to transmit. ✓ If two computers send at the same time a collision might occur but wireless networks cannot detect this. Therefore, the receiver has to send an acknowledgement back to the transmitter when the data has been correctly received. ✓ If no acknowledgement arrives, the receiver will know that it must retransmit the data. ✓

5

This is a good response that covers all parts of the process and shows a good level of understanding so that it falls into Level 3. There is no explanation of how long the sender will wait before attempting a retransmission so the mark awarded is 5 instead of 6.

Each packet of data transmitted around the LAN includes a checksum, which is used for error detection.

0 7 . 4 Describe how the checksum is used for error detection.

[3 marks]

The checksum is calculated when the data is transmitted and again when it is received. ✓ *If the two results differ than an error has been detected so the data will need to be corrected or transmitted again.* ✓

2

The student has not explained that the checksum is calculated from the data so the third mark cannot be awarded.

10

13

0 8 A particular computer uses a **normalised** floating point representation with an 8-bit mantissa and a 4-bit exponent, both stored using **two's complement**.

Four bit patterns that are stored in this computer's memory are listed in **Figure 6** and are labelled **A**, **B**, **C**, **D**. Three of the bit patterns are valid floating point numbers and one is not.

Figure 6

A	0 ●	1	0	1	1	1	0	0	1	0	1	0
	Mantissa								Exponent			
B	0 ●	0	0	1	1	0	1	0	0	1	0	1
	Mantissa								Exponent			
C	1 ●	0	0	0	0	0	0	0	0	1	1	1
	Mantissa								Exponent			
D	1 ●	0	1	1	1	1	1	1	1	0	0	0
	Mantissa								Exponent			

0 8 . 1 Complete **Table 3**. In the Correct letter (**A**-**D**) column shade the appropriate lozenge **A**, **B**, **C** or **D** to indicate which bit pattern in **Figure 6** is an example of the type of value described in the Value description column.

Do **not** use the same letter more than once.

[3 marks]

Table 3

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

3

Question 8 continues on the next page

Turn over ▶

0 8 . 2 The following is a floating point representation of a number:

0 ●	1	0	1	1	0	0	0

Mantissa ✓

0	1	0	1

Exponent

Calculate the decimal equivalent of the number. Show how you have arrived at your answer.

[2 marks]

Answer: *22* ✓

2

Two marks have been awarded. Indicating that the binary point is moved five places to the right is sufficient for the working mark. As with all such questions showing all the working is more secure.

0 8 . 3 Write the normalised floating point representation of the negative decimal value -6.75 in the boxes below. Show how you have arrived at your answer.

[3 marks]

1001.01 ✓✓

←

Answer:

1 ●	*0*	*0*	*1*	*0*	*1*	*0*	*0*

Mantissa

0	*0*	*1*	*1*

Exponent ✓

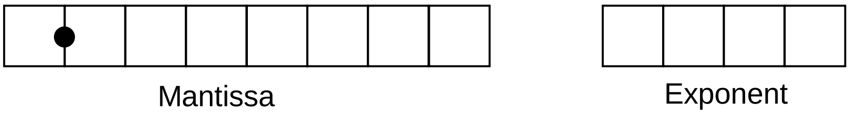
3

There is just enough in the working for all three marks to be awarded. The student has managed to write down -6.75 in fixed point directly and has indicated that the binary point is moved three places left. This latter point could have been made clearer in the working so that both working marks were more secure.

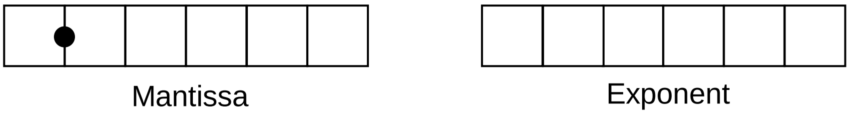
Turn over ▸

An alternative two's complement format representation is proposed. In the alternative representation 6 bits will be used to store the mantissa and 6 bits will be used to store the exponent.

Existing Representation (8-bit mantissa, 4-bit exponent):



Proposed Alternative Representation (6-bit mantissa, 6-bit exponent):



0 8 . 4 Explain the effects of using the proposed alternative representation instead of the existing representation.

[2 marks]

The range would be decreased and the representation would be more accurate.

0

This student has made the comparison the wrong way around so no marks can be awarded. In fact, the range would be increased and the precision reduced.

8
10

Turn over for the next question

0 9 A school stores information about its sports day in a relational database.

The details of the track events are stored using the three relations in **Figure 7**.

Figure 7

Athlete (AthleteNumber, Forename, Surname, Class, Gender, DateOfBirth)

Race (RaceNumber, Gender, Distance, Type, StartTime)

RaceEntryAndResult (RaceNumber, AthleteNumber, TimeSet)

Each athlete who takes part in a race is given a unique AthleteNumber. Athletes can run in more than one race. If they do, they keep the same AthleteNumber for the entire day.

Many races are run throughout the day. An example race would be the boys 80m hurdles, the third race of the day, which starts at 13:30. The entry in the Race table for this race is shown in **Table 4**:

Table 4

RaceNumber	Gender	Distance	Type	StartTime
3	Boys	80	Hurdles	13:30

When an athlete is entered into a race, a record of the entry is created in the RaceEntryAndResult table. Initially, the TimeSet is recorded as 00:00.00 (meaning 0 minutes, 0 seconds, 0 hundredths of a second) to indicate that the race has not yet been run. After the race has been run, if the athlete successfully completes it, then their TimeSet value is updated to record the time that they achieved in minutes, seconds and hundredths of a second. The TimeSet value remains at 00:00.00 for athletes who fail to complete the race.

The primary keys in the Athlete and Race relations have been identified in **Figure 7** by underlining them. The correct primary key for the RaceEntryAndResult relation has not been identified.

0 9 . 1 In **Figure 8** below, underline the appropriate attribute name(s) to identify the correct primary key for this relation.

[1 mark]

Figure 8

RaceEntryAndResult(RaceNumber, AthleteNumber, TimeSet) ✓

1

0 9 . 2 Relations in a database should usually be fully normalised.

Define what it means for a database to be fully normalised.

[2 marks]

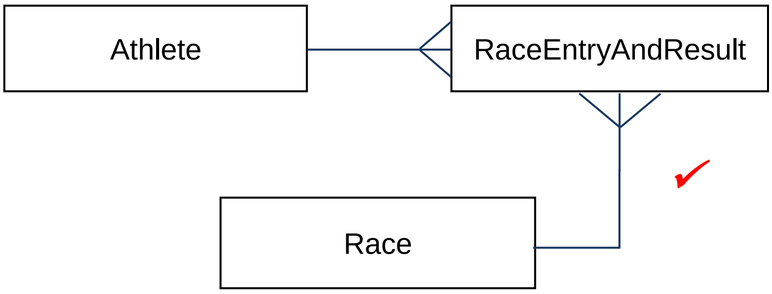
A database is fully normalised when all of the fields in the primary key depend on the whole primary key ✓ *and no other fields.* ✓

2

The response does not cover First Normal Form, ie that data must be atomic, but two points have been made so full marks are awarded.

0 9 . 3 On the incomplete Entity-Relationship diagram below show the degree of the **three** relationships that exist between the entities.

[2 marks]



1

The student has only drawn two relationships so only one mark can be awarded. It is possible that the student read the number of marks from the question instead of the instruction and so believed only two relationships were required (one per mark).

Athlete number 27 is to be entered into race number 6.

0 9 . 4 Write the SQL commands that are required to make this entry.

[2 marks]

INSERT INTO RaceEntryAndResult ✓

VALUES (6, 27, 0) ✓

2

The response is acceptable for two marks. The 0 is not strictly in time format, but enough understanding has been shown for this mark to be awarded.

Question 9 continues on the next page

Turn over ▸

Figure 7 is repeated below.

Figure 7 (repeated)

Athlete(<u>AthleteNumber</u>, Forename, Surname, Class, Gender, DateOfBirth)

Race(<u>RaceNumber</u>, Gender, Distance, Type, StartTime)

RaceEntryAndResult(RaceNumber, AthleteNumber, TimeSet)

Athlete number 27 sets a time of 0:18.76 (0 minutes, 18 seconds, 76 hundredths of a second) for race number 6.

0 9 . 5 Write the SQL commands that are required to update the athlete's entry for this race, to store this time in the TimeSet field.

[3 marks]

UPDATE RaceEntryAndResult

SET TimeSet = 0:18:76

WHERE RaceNumber = 6 ✓✓

2

The two AO3 (programming) marks are awarded for correct SQL syntax in all three clauses. The omission of a condition in the WHERE clause for the athlete number is not significant enough to prevent the award of these marks. However, without the second condition the AO2 (analysis) mark is not awarded.

The competition organisers want to produce a list of all of the athletes who took part in race number 6 with the athlete who won (set the lowest time) at the top and the other athletes below the winner in the order in which they finished.

Only athletes who finished the race should be included in the list.

The following information should appear for each athlete: AthleteNumber, Forename, Surname and TimeSet.

0 9 . 6 Write an SQL query to produce the list.

[5 marks]

SELECT AthleteNumber, Forename, Surname, TimeSet

FROM Athlete, RaceEntry ✓

WHERE RaceNumber = 6 AND TimeSet<>0 ✓

ORDERBY TimeSet ✓✓

4

Both AO3 (programming) marks can be awarded as there is correct SQL syntax in all four clauses and the query is very close to being fully correct. Writing “ORDER BY” incorrectly as one word is acceptable. Two of the AO2 (analysis) marks can be awarded. The third cannot as the linking condition between the two tables is missing.

The database system is to be extended for use in an inter-school athletics league. Users at any school in the county will be able to access the system to input the results of races.

It is possible that two users might try to access or update the system at the same time.

0 9 . 7 Explain the conditions under which simultaneous access to a database could cause a problem, and how this could be dealt with.

[3 marks]

The problem would occur if the two people tried to open the same record at the same time. One way to deal with this would be to have a queue of all accesses to the database ✓ *and to deal with each one in turn.* ✓

2

The first point made is not sufficient for a mark – simultaneous access only causes a problem if two records are updated simultaneously, not if they are merely read simultaneously. Then, two good points are made about the use of a transaction system and how transactions in a queue are dealt with in a FIFO manner.

14
18

1 0 Two computers, **A** and **B**, are involved in a secure communication that uses asymmetric encryption. **A** is sending a message to **B**.

Each computer has a public key and a private key.

1 0 . 1 Complete the missing words in the following paragraph.

[2 marks]

A will encrypt the message using _*A's public*_ key. The message will be

decrypted by **B** using _ *B's private* ✓__ key.

1

The student has failed to understand that the keys must be used in pairs ie a message encrypted with one of B's keys must be decrypted with the other of B's keys. However, the second response is correct so one mark is awarded.

The security of the communication could be improved by the addition of a digital signature.

1 0 . 2 State **two** benefits of including a digital signature.

[2 marks]

A digital signature is a hash value calculated from the data to be transmitted that is the encrypted. The hash is recalculated when the data is received and if the recalculated hash does not match the transmitted one then it can be detected that the message has been tampered with. ✓

1

The student has explained how a digital signature works rather than addressing the question. However, there is a clear implication that a benefit would be that tampering with a message could be detected so one mark can be awarded.

$\frac{2}{4}$

1 1 . 1 **Table 5** lists six Boolean equations. Three of them are correct, the others are not. Shade the lozenges next to the **three** equations are correct.

[3 marks]

Table 5

Equation	Correct? (Shade three)
$A \cdot \overline{A} = 1$	○
$A + B = \overline{\overline{A} \cdot \overline{B}}$	● ✓
$A + 1 = 1$	● ✓
$A \cdot (A + B) = A$	● ✓
$A + (A \cdot B) = B$	○
$A \cdot 1 = 1$	○

3

1 1 . 2 Use Boolean algebra to simplify the following expression:

$$\overline{\overline{A} + \overline{B}} + B \cdot \overline{A}$$

Show your working.

[3 marks]

$= A \cdot B + B \cdot \bar{A}$ ✓
$= B \cdot (A + \bar{A})$ ✓
$= B \cdot 0$
$= 0$

2

Two marks are awarded for a correct application of DeMorgan's laws and then recognising that B is a common term in both parts of the expression. However, the student has then gone wrong by equating A+NOT A with 0 instead of 1, so has not arrived at a correct answer.

$\frac{5}{6}$

Turn over for the next question

1 2 In a functional programming language, a recursively defined function named `map` and a function named `double` are defined as follows:

```
map f []      = []
map f (x:xs)  = f x : map f xs

double x      = 2 * x
```

The function `map` has two parameters, a function `f`, and a list that is either empty (indicated as `[]`), or non-empty, in which case it is expressed as `(x:xs)` in which `x` is the head and `xs` is the tail, which is itself a list.

1 2 . 1 In **Table 6**, write the value(s) that are the head and tail of the list `[ 1, 2, 3, 4 ]`.

[1 mark]

Table 6

Head	*1*
Tail	*2, 3, 4* ✓

Brackets missed around tail but this is still acceptable.

1

The result of making the function call `double 3` is `6`.

1 2 . 2 Calculate the result of making the function call listed in **Table 7**.

[1 mark]

Table 7

Function Call	**Result**
`map double [ 1, 2, 3, 4 ]`	*2, 4, 6, 8* ✓

1

The mark has been awarded despite the fact that the result has not been written in list notation, ie the square brackets are missing.

1 2 . 3 Explain how you arrived at your answer to question **1 2 . 2** and the recursive steps that you followed.

[3 marks]

The double function is executed on each of the items in the list. ✓ *It was first applied to the head* ✓ *and then a recursive call was made to apply it to the rest of the list.* ✓

3

5
5

END OF QUESTIONS

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