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 1

Paper 2

Total Mark 41

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

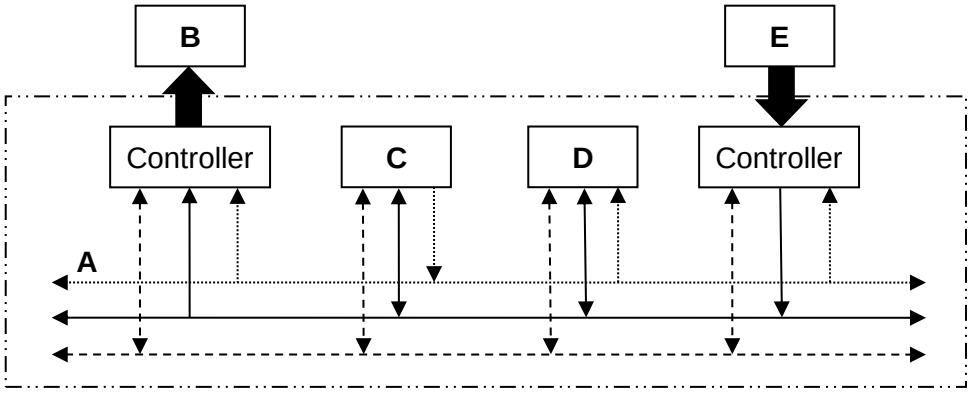


Table 1 lists the names of six components in the column headings and the five letters (**A**-**E**) from **Figure 1** in the row headings.

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	○	○	○	○	● ✓	○

2

2
4

The student has correctly identified the keyboard and VDU, but has confused the main memory and processor. The student should have used the uni-directionality of the address bus and the fact that the processor is the originator of addresses on it to distinguish correctly between these two components.

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 sends data down several wires at a time and so can send many bits at once but serial communication 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, but has not identified that serial communication only uses one wire, so has only made half of the point required to achieve the other mark.

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]

In parallel communication data skew can occur. ✔

1

The response could be extended to explain this is only a problem over longer distances, but there is enough for a mark. It is implicit that the student is stating this does not occur with serial communication.

0 2 . 3 Define the term baud rate.

[1 mark]

Baud rate is the number of bits that can be transmitted in a set amount of time.

0

The student has confused baud rate and bit rate.

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 sending more than one bit per baud.

0

This is not markworthy as it is clear that this must happen from the information in the question. A better response would address how this is achieved from a technical point of view, for example having more than two voltage levels so that each voltage change could encode more than one bit. Some type of modulation is more likely, but an understanding of modulation is not required at A-level.

2
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.

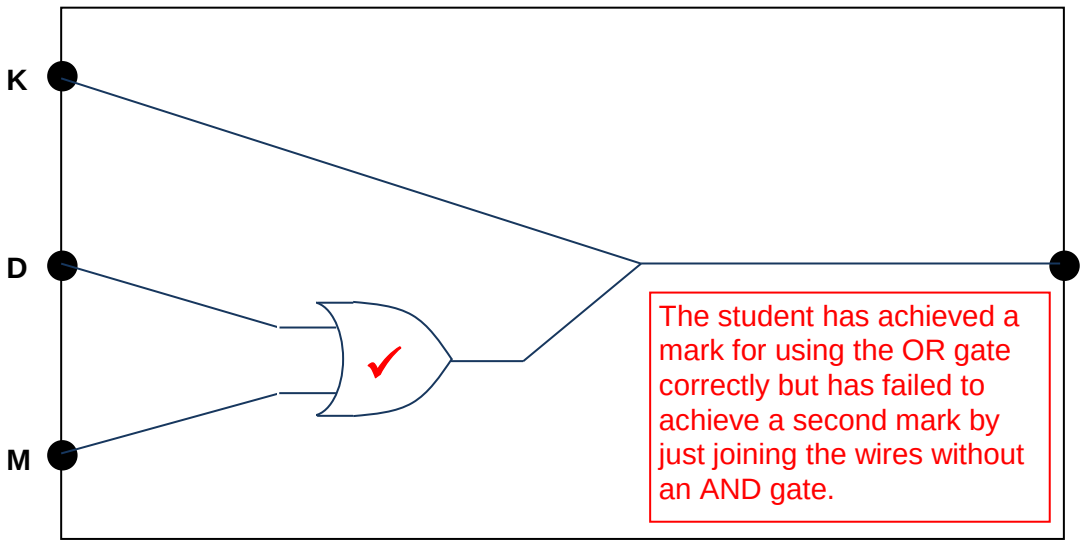
The alarm also has a key **K** that turns the alarm on and off. **K** outputs a TRUE signal when the alarm is switched on and FALSE when the alarm is off.

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]



The student has achieved a mark for using the OR gate correctly but has failed to achieve a second mark by just joining the wires without an AND gate.

1

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

[2 marks]

A = $D + M \cdot K$ ✓

1

A mark has been awarded for the ORing of inputs D and M, but the omission of brackets around D + M has changed the logic of the expression as AND has a higher precedence than OR, so the second mark is not awarded.

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 could be used as it will work as a memory ✓ *and remember that the alarm has been triggered and so should keep ringing. It would need to go into the circuit after the OR gate.*

1

3
7

A mark has been awarded for recognising that the flip-flop would act as a memory for the circuit. However, there is not enough in the explanation of where the flip-flop should be inserted. The student could not achieve this mark as the circuit drawn would not work. The fact that a trigger input would also be needed has not been mentioned.

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]

As items are put into the fridge, they will need to be identified. This could be done by using a bar code scanner which would then lookup the product [Capturing Point] *information in a database, probably thorough the Internet. If things don’t have a barcode then their details may need to be typed in on something like a touch screen.* [Capturing Point]

If there were lots of devices sending and receiving data that a faster network would be needed. This would probably need to be wireless as it would be difficult to wire up lots of devices all around the house.

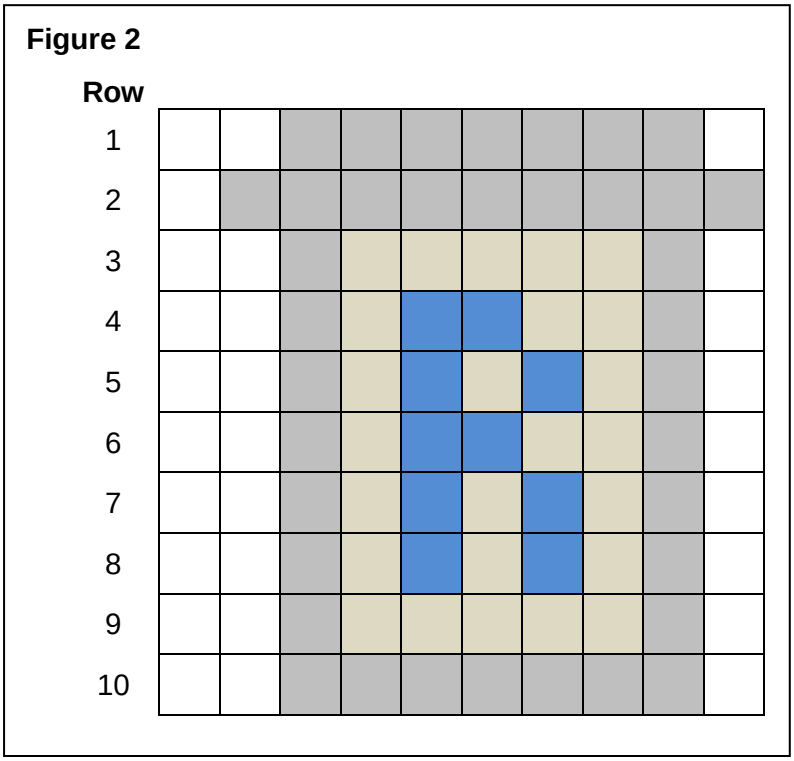
For the retailers, there would be a lot of data to deal with if many customers used the service. This would mean they would need to use powerful hardware to process it all. To store the data quickly they may want to use SSDs instead of hard disks as they are quicker [Storing Point] but this would be more expensive as there is a lot of information hard disks would work out cheaper [Storing Point]. **4**

This response is at the bottom of Level 2. Three topic areas have been covered (collecting data, networking, storing data) but quite superficially. With regard to collecting data, two valid points have been made, about the use of bar codes and an alternative for products with no barcodes. The student could have developed this further by covering the use of RFID tags and how to determine weights and use by dates. With regard to networking, the response is too superficial. More specific areas such as the type of connection, protocols, IP addresses etc need to be dealt with. With regard to storing data, two valid points have been made - the relative advantages of SSDs and hard disks. However, the student has not covered processing at all or recognised that this would amount to “big data” or that functional programming might be one valid approach to processing from a software point of view. This fits Level 2 which states that at least two topic areas are covered and at least four points made. It does not reach the threshold for Level 3 which requires that three areas are covered and two or three points are made per area.

4
12

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*	*1*	*0*	*1*	*0*	*1*	*0*	*0*	*0*	*1*	*1*

0

The student has correctly represented the white and grey pixels and has consistently used the bit pattern 10 for brown pixels. However, the two blue pixels have been encoded inconsistently as 01 and then 10, so the mark cannot be awarded.

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]

*10 * 10 * 4*

Answer: *400*

0

The student has calculated the number of pixels by multiplying the number of pixels in each direction together, but has mistakenly multiplied this by 4 as there are 4 colours in the image, instead of recognising that 4 colours require 2 bits per pixel. In addition there is no division by 8 to get an answer in bytes.

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]

Colour depth ✔

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 looks at the data in a file and counts how many times each piece of data occurs. This is suitable for images because often in an image there are big areas that are the same colour. ✔

1

3
8

In the first sentence this response recognises that RLE counts the number of times that a data item occurs, but it does not achieve a mark as it fails to recognise that these must be in a sequence. The second sentence is good enough for a mark about why RLE is suitable for images, as big areas is considered to be a weak but acceptable alternative to the idea of sequences of pixel values.

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

Figure 3

Opcode							Operand(s)							
Basic Machine Operation						Addressing Mode								
0	1	1	0	1	0	1	0	0	1	0	1	0	1	1

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]

63

By mistake, the student has calculated the highest number representable in 6 bits instead of the number of possible values.

0

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]

100 ✔

Student has correctly recognised the addressing mode being used.

1

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]

201

Student understood ADD instruction but has used the wrong addressing mode for Line 2 so added 101 on instead of 10.

0

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

[1 mark]

402 ✔

The correct answer is 220, but the answer given is acceptable as it is the result of logically shifting 201 (incorrect) left one bit position.

1

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

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]

A compiler works by translating the entire program from the source language into machine code before it can be executed. This means that the program will execute more quickly. ✔

1

There is no mark for the first sentence as this is just a brief explanation of how a compiler works, which has not been asked for. The second sentence is enough for a mark, though it would have been nice to see a fuller explanation of this. A second reason would need to be given for a further mark.

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 different Internet users will have different computers and devices which may have different types of processor in them. ✔

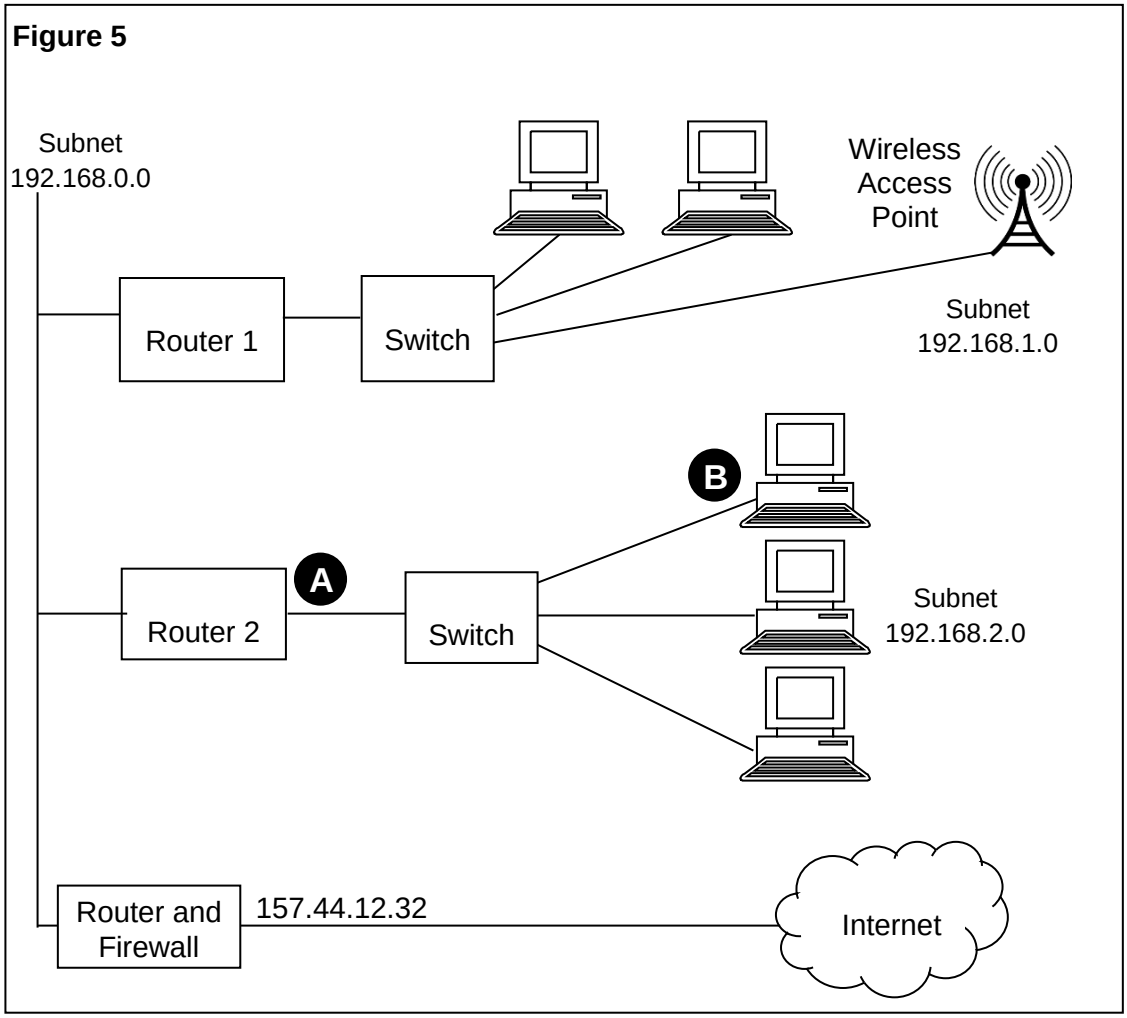
1

The student has identified the issue with programs that must run in a browser, but has not tied this in to the fact that a compiled program would be in machine code and therefore could only run on a specific type of processor, so the response is worth one but not two marks.

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:

The 'Router 2' port labelled **A**: *192.168.2.255*

The computer network interface card labelled **B**: *192.168.2.4* ✓

Both addresses are on correct subnet but 255 cannot be used in the last octet so only one is valid.

[2 marks]

1

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

[2 marks]

The network speed will not slow down when more computers send data at the same time as ✓ *each is connected to the server by its own cable* ✓

2

The student has identified an advantage and explained how this would be achieved, so two marks are awarded.

Question 7 continues on the next page

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 will listen to see if any transmissions are taking place ✓ and if not then it will start transmitting. ✓ If two computers transmit at the same time, a collision will occur. This will be detected and one of the computers will stop transmitting. This computer will then wait a random amount of time before transmitting again.

2

This is a Level 1 response, worth 2 marks. The student has made two valid points and almost made a third valid point about the back-off time being random, but an explanation of why the time is random is required for this mark and was not given. There is some confusion with the CSMA/CD method where the student has written about a collision being detected – the CSMA/CA method does not detect collisions. A third mark could have been achieved straightforwardly by explaining that the computer would continue to wait to transmit if another transmission was in progress.

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 worked out from the data ✓ when it is received and if the sum is incorrect an error is identified.

1

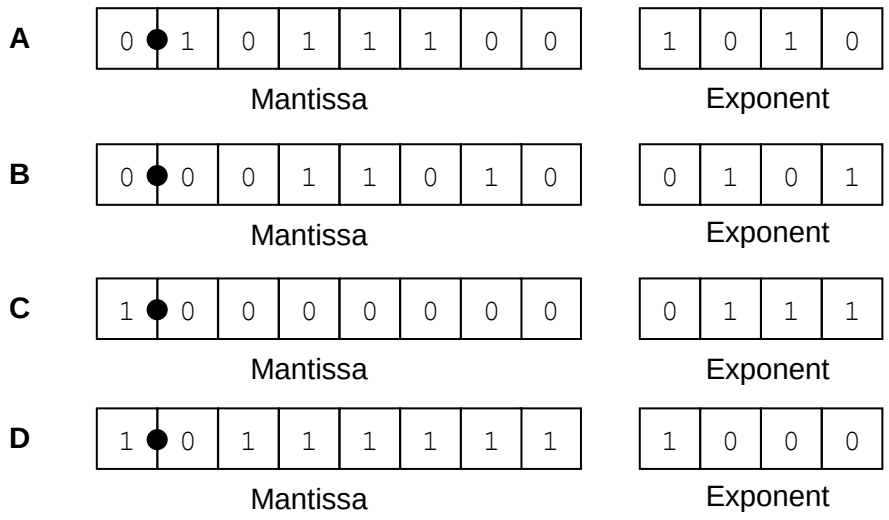
The student has achieved one mark for recognising that the checksum is calculated from the data. However, there are no more marks as it has not been identified that this happens at transmission and reception and that the two are compared to detect an error.

6
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



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]

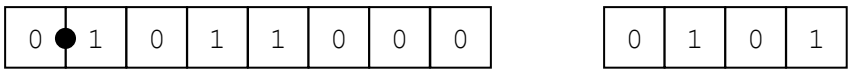
Table 3

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** ○

2

The student has recognised that D is a negative number, but has not identified that in fact C is the correct answer on the second row as it also has a negative mantissa and has a higher value in the exponent so would produce a more negative number.

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



Mantissa Exponent

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

[2 marks]

Mantissa = 1/2 +1/8 + 1/16 = 11/16 *Exponent = 4 + 1 = 4*

*Value = 11/16 * 2^4* ✓ *= 11* **1**

Answer: *11*

A mark has been awarded for recognising the correct way to work out the answer, despite the fact that the exponent used is incorrect (4 instead of 5). It is important to show working so that marks can be awarded even if the final answer is incorrect.

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]

-8	4	2	1	1/2	1/4
1	0	1	0	1	1

Exponent = 3

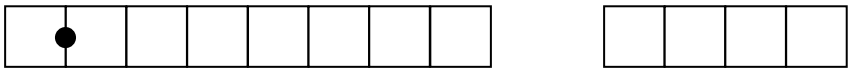
Answer:

Mantissa Exponent ✓ **1**

A mark has been awarded for the correct exponent. The student has made a mistake when calculating the mantissa by representing minus six correctly and then adding on ¾, so producing a representation of -5.25 instead of -6.75. It is safer to use the method of writing out +6.75 then flipping the bits and adding 1 to arrive at the correct fixed point representation of -6.75.

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 additional bits in the exponent would allow bigger numbers to be represented. ✓ **1**

5
10

This is enough for one mark, although a better response would have recognised that smaller numbers could be represented as well as the exponent could also be more negative. For the second mark, the student also needed to address the reduced precision of the proposed representation.

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)

0

Only part of the primary key has been identified so no mark awarded.

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]

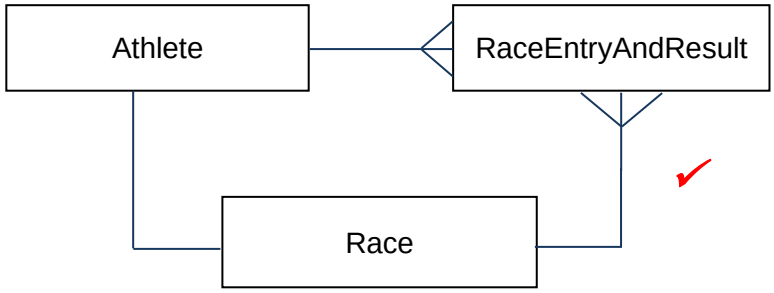
A database is fully normalised when all of the data in it is atomic, ie it cannot be broken up and further. ✔

1

The student has recognised one version of the correct condition for First Normal Form but has not included any reference to conditions required for Second or Third Normal Form, so only one mark is 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

Two of the three relationships correctly identified so only one mark awarded.

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 ✔

1

VALUES (27, 6)

The correct table has been identified, however the order of the values does not match the table and nothing has been done in relation to the initial time, so only one mark awarded.

Question 9 continues on the next page

Figure 7 is repeated below.

Figure 7 (repeated)

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

Race(RaceNumber, 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 TimeSet = "0:18.76"

FROM RaceEntryAndResult

WHERE AthleteNumber = 27 AND RaceNumber = 6 ✓ **1**

The correct table (RaceEntryAndResult) and update conditions (AthleteNumber=27, RaceNumber=6) have been identified, so a mark is awarded for this even though the syntax is incorrect, as this mark is for AO2 (analysis). There are no marks for the SQL code itself as the syntax is incorrect; the student has confused the use of SQL for data manipulation with its use for querying.

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

✓

2

There is one AO3 (programming) mark for the correct use of SQL syntax in the three clauses; since the ORDER BY clause is missing the second AO3 mark, which requires all four clauses, cannot be awarded.
There is one AO2 (analysis) mark for correctly identifying the tables that need to be used and the fields to output. Many of the required conditions have been missed, for linking the tables and also for ensuring that students who did not finish are not listed, so no more AO2 marks can be awarded.

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]

This would cause a problem if the two users tried to update the same record ✓ *as only the updates made by one of them would be saved. The problem can be overcome by locking the tables so that when a user accesses a record in a table no other users can access data from the table until the record is closed.*

1

One mark is award for the identification of the correct condition. However, the use of table locks is not considered to be a solution as it would be impractical, restricting access to the data far too frequently. A better solution would have been to use record locks or a transaction queuing system for simultaneous updates.

7
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 _*public*_ key. The message will be decrypted by **B** using _ *private* __ key.

0

No marks can be awarded as the student has not identified who the keys belong to.

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 will mean that the identity of the sender and when the message was sent can be checked. ✔

1

One mark has been awarded for verifying the identity of the sender. The student needed to cover checking that the message had not been tampered with to achieve the second mark. A digital signature could not be used directly to check when a message was sent.

1/4

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)
$A \cdot \overline{A} = 1$	●
$A + B = \overline{\overline{A} \cdot \overline{B}}$	● ✓
$A + 1 = 1$	● ✓
$A \cdot (A + B) = A$	○
$A + (A \cdot B) = B$	○
$A \cdot 1 = 1$	○

2

Two responses are correct. The top response, which has been incorrectly shaded may have been confused with the identity $A + \bar{A} = 1$.

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]

$A + B + B \cdot \bar{A}$
$= A + B \cdot A$
$= B \cdot 0$
$= 0$

0

No marks can be awarded. The student has mistakenly believed that the NOT operators over the first A and B could be cancelled, or has partially applied DeMorgan's laws but forgotten to change the operator from OR to AND . Subsequently, B+B has been simplified to B but this cannot be done as the AND operator between the B and NOT A has higher precedence than the OR operator between the two Bs.

2/6

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	*4*

Tail has been identified incorrectly; it should be [2, 3, 4].

0

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 was applied to each of the items in the list in turn. ✔

1

One mark has been awarded as the basic purpose of the map function has been identified. To gain further marks, the student would need to have described how the recursion mechanism worked.

2
5

END OF QUESTIONS

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