AQA

A-level
Computer Science

7517/2-Paper 2

Mark scheme

June 2018

Version/Stage: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

A-level Computer Science

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To Examiners:

- **When to award '0' (zero) when inputting marks on CMI+**
  A mark of 0 should be awarded where a candidate has attempted a question but failed to write anything credit worthy.

  Insert a hyphen when a candidate has not attempted a question, so that eventually the Principal Examiner will be able to distinguish between the two (not attempted / nothing credit worthy) in any statistics.

- This mark scheme contains the correct responses which we believe that candidates are most likely to give. Other valid responses are possible to some questions and should be credited. Examiners should refer responses that are not covered by the mark scheme, but which they deem creditworthy, to a Team Leader.

The following annotation is used in the mark scheme:

; - means a single mark
// - means an alternative response
/ - means an alternative word or sub-phrase
A - means an acceptable creditworthy answer
R - means reject answer as not creditworthy
NE - means not enough
I - means ignore
DPT - in some questions a specific error made by a candidate, if repeated, could result in the loss of more than one mark. The **DPT** label indicates that this mistake should only result in a candidate losing one mark on the first occasion that the error is made. Provided that the answer remains understandable, subsequent marks should be awarded as if the error was not being repeated.

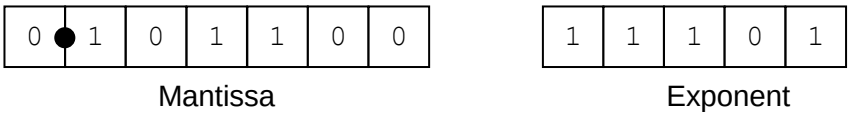
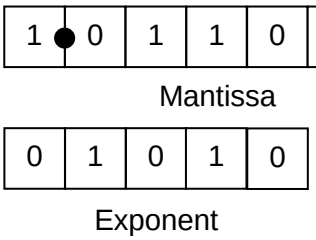
Examiners are required to assign each of the candidate's responses to the most appropriate level according to **its overall quality** and then allocate a single mark within the level. When deciding upon a mark in a level examiners should bear in mind the relative weightings of the assessment objectives.

eg

In the following questions, the marks available are as follows:

Question 4 (max 12 marks)
AO1 (understanding) – 12 marks

Question 6 (max 6 marks)
AO1 (knowledge) – 2 marks
AO1 (understanding) – 4 marks

Q		Marks	
01	1	**Mark is AO2 (apply);** 30A; **R.** if more than one lozenge shaded.	**1**
01	2	**All marks AO2 (apply)**  **1 method mark** for either: • showing correct value of both mantissa and exponent in decimal (mantissa = 0.6875 // 11/16, Exponent = -3) • showing binary point shifted 3 places to left in binary number • indicating that final answer calculated using answer = mantissa x $2^{exponent}$ **1 mark** for correct answer Answer = 0.0859375 // 11/128 **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**
01	3	**All marks AO2 (apply)** **2 marks** for working: Correct (unsigned) representation of 608 in binary: 1001100000; **A.** leading 0s Correct representation of -608 in two's complement binary:10110100000; **A.** leading 1s Showing the correct value of the exponent in decimal (10) or binary (1010) // showing the binary point being shifted 10 places left; **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**

02	**1**	**2 marks for AO1 (knowledge) and 1 mark for AO1 (understanding)** **2 marks AO1 (knowledge):** Image is represented as / composed of objects; Properties (of objects) are stored //objects have properties; **A.** "shapes" or "instructions" for "objects" (this time only) **NE.** "formulae" for objects **A.** "attributes" for "properties" **1 mark AO1 (understanding):** A property of the black rectangle is given; eg • fill colour • outline/edge colour • x coordinate of a specific point eg top right-hand corner • y coordinate of a specific point eg top right-hand corner • outline/edge width • width • height **A.** if a property is given without it being directly related to the black rectangle. **A.** coordinates of a specific point eg top right-hand corner for one mark only if x and y not referenced **R.** properties that are too vague eg position, colour, coordinates (without further explanation), points (without reference to coordinates) **Marks should be awarded if student has asserted that rectangle drawn as a wide line.**	**3**
02	**2**	**All marks AO2 (apply)** 50 x 50 x 2 / 8 = 625 (bytes) **2 marks** for the correct answer with some working shown **OR** **1 mark for one of:** • multiplying 50 by 50 in the working // 2500 in the working • multiplying by 2 in the working • giving the correct solution of 625 (bytes) with no working shown	**2**
02	**3**	**All marks AO1 (knowledge)** A run is a sequence/series of pixels of the same colour // the number of consecutive pixels of the same colour would need to be counted; (Pairs of values would be stored), which would consist of a run length and the colour of the pixels in the run; Example of how the specific row of pixels would be compressed eg 7 Yellow, 4 Blue, 9 Yellow; **A.** assignment of numeric values to colours **A.** "row" for "run" as **BOD** **Max 2**	**2**

<table>
<tr><td>02</td><td>4</td><td>All marks AO1 (understanding)

Runs will be of shorter length // the image (in the second figure) contains a lot more different colours; A. colour depth is higher in the second image
(For short runs) the additional run length data may (largely) cancel out (or even outweigh) the reduction in storage of pixel colour data;

A. responses given in reverse ie why first figure was compressed more effectively</td><td>2</td></tr>
<tr><td>03</td><td>1</td><td>All marks AO2 (apply)

<table>
<tr><th colspan="3">Inputs</th><th colspan="3"></th><th colspan="2">Outputs</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th><th>H</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></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></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
</table>

1 mark: Column D correct or column E or column F correct
1 mark: Column G correct
1 mark: Column H correct

Max 2 if any incorrect values in table</td><td>3</td></tr>
<tr><td>03</td><td>2</td><td>All marks AO2 (apply)

$B \cdot C + A \cdot (B \oplus C)$

1 mark: $B \cdot C$ or $B \oplus C$ somewhere in expression
1 mark: A is ANDed with $B \oplus C$
1 mark: Fully correct expression
A. award second mark even if brackets around $B \oplus C$ are missing
A. use of AND, OR, XOR instead of symbols
A. $(\overline{B} \cdot C) + (B \cdot \overline{C})$ for $(B \oplus C)$

If a student has written an expression but then tried to simplify it and made an error then mark the original expression that the student has written down and ignore the simplification.</td><td>3</td></tr>
<tr><td>03</td><td>3</td><td>Mark is for AO2 (analyse)

It adds together its inputs // it is a full adder circuit;
N.E. half-adder, adder</td><td>1</td></tr>
</table>

04 **All marks AO1 (understanding)** **12**

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 three areas indicated in the guidance below and in at least two of these areas there is sufficient detail to show that the student has a good level of understanding. To reach the top of this mark range, a good level of understanding must be shown of all three areas.	10-12
3	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response which shows a good level of understanding of at least two areas indicated in the guidance below.	7-9
2	A limited attempt has been made to follow a line of reasoning and the response has a mostly logical structure. At least four points have been made. Either a good level of understanding of one area from the guidance has been shown or a limited understanding of two areas.	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 areas from the guidance or may be made in a superficial way with little substantiation.	1-3

Guidance – Indicative Response

For each guidance point, if the student expands on the point to explain in what way the measure will improve performance then this can be considered to be a second point. For example:

- "Using a processor with more cores" is one point.
- "Using a processor with more cores which will be able to execute multiple instructions simultaneously" is two points.

Note that just "faster" is not enough to count as an expansion point without an explanation of why.

1. Server Hardware

Replace the processor with one which has more cores

Replace the processor with one which has more cache memory // increase the amount of cache memory

Replace the processor with one which runs at a faster clock speed **NE.** faster processor

Use a parallel processor architecture // use more processors which can work in parallel

Use a processor with a bigger word size

Use a processor that makes (better) use of pipelining

Install more RAM // main memory // primary memory

		Use RAM // main memory // primary memory with a faster access time Replace HDDs with SSDs // Replace HDDS with HDDs that can read data at a faster rate Defragment the HDD Replace the motherboard with one which has buses which run at a faster clock speed Replace the motherboard with one which has more lines in the data bus Use the Harvard architecture Distribute the processing across multiple servers **2. Network** Replace the network cable with cable that has a higher bandwidth // replace copper cable with fibre-optic cable **A.** Ethernet cable for fibre-optic **NE.** higher bandwidth network Replace any wireless/WiFi connections with wired ones Replace the network cards with ones that can transmit data at a higher bitrate Consider the overall network design eg how the network is divided into subnets **A.** split the network into subnets Use a star topology (instead of a bus) Consider using a more efficient protocol for the data across the network Add additional wireless access points **3. Database and Software** Use a more efficient technique for controlling concurrent access to the database // replace record/table locks with serialisation/timestamp ordering/commitment ordering Replace the database software with software that uses more efficient algorithms for tasks **A.** examples eg replace linear search with binary search Use the index feature of the database to speed up searching on fields that are commonly used for this purpose Rewrite the database software in a language that is suitable for concurrent execution // use a functional programming language for the database software Ensure the software is compiled rather than executed by an interpreter // rewrite the software in assembly language/machine code Review the conceptual model of the database to see if it contains any inefficiencies such as data redundancy that could be eliminated **A.** normalise the database design Consider if it would be appropriate to sacrifice normalisation of the conceptual model to improve performance Use a non-relational database system **A.** examples eg NoSQL Distribute the data across multiple servers Try to reduce the amount of other (unrelated) software that might be running on the database server at the same time Try to reduce the number of database accesses that need to be made simultaneously // run some tasks at quiet times/overnight Purge / archive data that is no longer necessary/in use	

05	**1**	**Mark is for AO1 (understanding)** **1 mark:** Correct binary pattern (below): 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0	**1**
05	**2**	**Mark is for AO2 (apply)** 30 // (2^5)-2; **A.** 32, 2^5, 31, (2^5)-1 (this time only)	**1**
05	**3**	**1 mark for AO1 (understanding) and 3 marks for AO1 (knowledge)** **Purpose (1 mark – AO1 (knowledge)):** To automate the configuration of hosts connecting to a (TCP/IP) network // to allocate IP addresses/subnet mask/default gateway to hosts; **A.** "computer" or suitable alternative term for "host" **Why used (1 mark – AO1 (understanding)):** Reduces the need for expert knowledge when configuring a host // reduces the time required to configure hosts // facilitates efficient use of a limited pool of IP addresses // avoids errors with a relevant example such as duplicating IP addresses or programming incorrect subnet mask; **A.** enables reuse of IP addresses **NE.** "avoiding errors" without an example **Contents of communication (Max 2 marks – AO1 (knowledge)):** 1. Host sends request to discover a (DHCP) server; **A.** host sends request for configuration 2. (DHCP) server(s) offer configuration to host; **NE.** server gives IP address to host 3. Host accepts offer of configuration from (a DHCP) server (by echoing the accepted configuration back to the server); 4. (DHCP) server confirms that configuration has been allocated to host; **A.** "IP Address" for "configuration" but **N.E.** "subnet mask", "default gateway" for this mark point **Award one mark for any one correct point OR two marks for any two correct points, made in the correct order.**	**4**
05	**4**	**All marks AO1 (understanding)** Traffic arriving on the HTTP(S) port // the port used for web services // port 80/8080/443 (from outside the network) // HTTP(S) traffic (from outside the network); Must be forwarded (by the External Router) to the IP address of the Web Server // IP address 192.168.16.12;	**2**

06 **1** **2 marks for AO1 (knowledge) and 4 marks for AO1 (understanding)** **6**

Level	Description	Mark Range
3	A detailed, coherent, description that covers both the reading mechanism and how data is represented, demonstrating a very good level of understanding.	5-6
2	An adequate description, including at least three points from the list below. The description may cover one or both of the reading mechanism and how data is represented. The description is logically organised so that it makes sense when read as a whole and therefore demonstrates a reasonable understanding of the principles of operation of an optical disk drive.	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). The structure of the response, or lack of it, means that only a very limited understanding of the principles of operation is demonstrated.	1-2

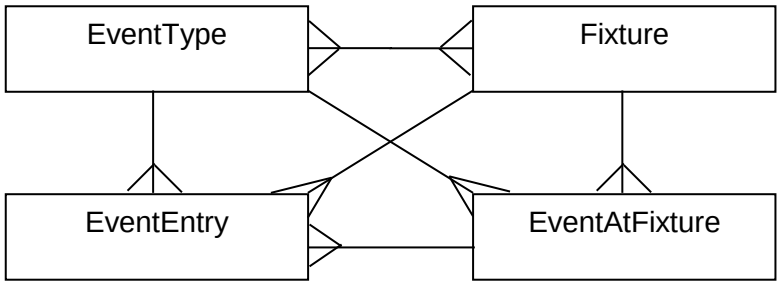
Indicative Content

Reading mechanism

- (Low power beam of) laser / light is shone at disk
  NE. implication because it is reflected
- Light is focussed on spot on track
- (Some) light is reflected back from disk
- Amount of light reflected back is measured // light sensor detects reflection
- Disc spins at constant linear velocity // zoned constant linear velocity // variable (angular) velocity
  A. variable speed
  R. constant speed

How data is represented

- Data is stored on one/spiral track
  A. data is read in a spiral
- Continuation of land/pit reflects light whereas transition between land and pit scatters light
  A. land reflects light whereas pits scatter light/do not reflect light or vice-versa
  A. "bump" for "land"
- Transition between land and pit indicates a 1 and continuation of land/pit represents 0
  A. land represents 1, pit 0 or vice-versa
  A. reflection represents 1, no reflection 0 or vice-versa
  A. "bump" for "land" or other wording which clearly reflects nature of pits and lands

06	**2**	**Mark is AO1 (understanding)** Flash drives can have a higher (storage) capacity; **R.** references that could be to physical size eg "Flash drives are bigger" Flash drives have faster access/read/write times; No drive is required to use a flash drive // flash drive and medium are integrated; Flash drives can be reused; Flash drives are more compact; Flash drives not damaged by scratches; **NE.** more robust without a reason why **R.** points about cost unless they are supported by a reason, such as no separate drive being required **NE.** more portable unless this is supported with a valid reason that would not also apply to a CD	**1**
07	**1**	**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 **A.** a many:many relationship drawn between EventType and Fixture as this is modelled by a linking relation (EventAtFixture)  	**2**
07	**2**	**All marks AO2 (analyse)** There is no data type for the primary key/`AthleteID` // The primary key/`AthleteID` needs a data type; The data type is specified before the fieldname // fieldname should precede the data type // `PRIMARY KEY` is specified before the fieldname; **A.** an example of a specific field and data type which are the wrong way around There is a semi-colon missing at the end; **Max 2**	**2**

07	**3**	**All marks AO1 (understanding)** *Minimise data duplication // no unnecessary repeated data; **A.** reduce for minimise **R.** eliminate *Eliminate data redundancy; **A.** reduce/minimise for eliminate Eliminate data inconsistency // improve consistency // avoid inconsistency problems; Eliminate update anomalies; **A.** example in context **A.** updates only need to be made in one place Eliminate insertion anomalies; **A.** example in context Eliminate deletion anomalies; **A.** example in context **NE.** easier to update/insert/delete without concrete example or good explanation **NE.** fewer errors when updating/inserting/deleting without concrete example or good explanation **NE.** saving space/memory **NE.** easier/faster to query **Note: Only award one of the two marks with *. ie a response cannot get two marks for discussion of only duplication and redundancy**	**2**

07	4	**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 (`Athlete, EventEntry, Fixture`) and the fields that need to be extracted (`Surname, Forename, DateOfBirth`), 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 conditions - `Athlete.AthleteID = EventEntry.AthleteID` and `EventEntry.FixtureID = Fixture.FixtureID`)
		
		1 mark for identifying the correct condition to use within the model for the `FixtureDate` field (`FixtureDate = "17/09/2018"`) 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 fully correct SQL in two of the four clauses (SELECT, FROM, WHERE, ORDER BY)
		
		OR
		
		2 marks for fully correct SQL in all four clauses (SELECT, FROM, WHERE, ORDER BY)
		
		Note: For an SQL clause to be counted as "fully correct", the syntax of the clause must be correct and the relevant AO2 decisions must also have been taken for the clause. eg the `SELECT` clause must have the correct fields in it only
		
		Example Solutions
		
		Example 1
		
		`SELECT Surname, Forename, DateOfBirth`
		`FROM Athlete, EventEntry, Fixture`
		`WHERE FixtureDate = "17/09/2018"`
		`  AND Athlete.AthleteID = EventEntry.AthleteID`
		`  AND EventEntry.FixtureID = Fixture.FixtureID`
		`ORDER BY Surname`
			5

Example 2

```
SELECT Surname, Forename, DateOfBirth
FROM Athlete INNER JOIN EventEntry ON Athlete.AthleteID =
  EventEntry.AthleteID INNER JOIN Fixture ON
  EventEntry.FixtureID = Fixture.FixtureID
WHERE FixtureDate = "17/09/2018"
ORDER BY Surname
```

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

Allow the inclusion of the unnecessary table `EventAtFixture` for AO2 and AO3 marks but only if it is linked to the other tables with a correct condition ie `EventAtFixture.FixtureID = Fixture.FixtureID` or alternatively `EventAtFixture.FixtureID = EventEntry.FixtureID` or both

Allow omission of delimiters around date for AO2 marks only.

AO3 marks:

A. table names before fieldnames separated by a full stop.
A. use of `Alias`/`AS` command eg `FROM Athlete AS A` then use of `A` as the table name but note that command `Alias` is not required eg `FROM Athlete A`.
A. `INNER JOIN` written as one word ie `INNERJOIN`.
A. `ORDER BY` written as one word ie `ORDERBY`.
A. `ASC` at end of `ORDER BY` clause but **R.** `ASCENDING`
A. insertion of spaces into fieldnames.
A. use of `" #` or `'` as delimiters around date – **Note:** delimiters are required for AO3 correct code but not for AO2 mark for date condition
A. date parts given in any order so long as they are separated by `/`
A. `18` instead of `2018` in year
I. 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.

08		**All marks AO1 (understanding)**
		
		One mark per challenge that is explained.
		
		Information can be combined/processed/transferred in ways that were not previously possible; **A.** an example of this **NE.** there is a lot more data
		
		Technology evolves quickly (so difficult for law to keep up with changes) // new types of crime become possible // some crimes are easier // future problems may not be understood;
		
		Global nature of Internet means crimes may be committed in one country from outside its direct jurisdiction // laws are often national/local whilst the Internet is global // digital crime can be committed from a great distance // different countries have different laws;
		
		Some crimes may be committed by states rather than individuals;
		
		Different countries/cultures may have different attitudes to principles important to computer science (such as copyright, intellectual property, privacy); **Note:** this point relates to attitudes not legislation
		
		Methods such as encryption make it harder to monitor criminal activity // electronic evidence may be harder to gather than physical evidence // can be harder to identify culprits online (eg by use of proxies, VPN) // peer-to-peer systems make it harder to identify criminal; **NE.** hard to catch criminals
		
		Individuals may have access to large amounts of sensitive information that may be of public interest // conflicts between freedom of speech/information and privacy/state secrets;
		
		Technology companies (can use their wealth) to lobby for their own interests // concern over influence of companies on legislators;
		
		Resources required to enforce legislation may not be available;
		
		NE. Copyright, Data Protection, Misuse, Hacking
		
		Refer responses containing other relevant points to team leaders.
		
		Max 3
			3

09	**1**	**All marks AO1 (understanding)** **15/23:** Rational, Real; **108:** Natural, Integer, Rational, Real; **R.** answers in which additional lozenges are shaded	**2**

09	**2**	**1 mark AO1 (knowledge) and 1 mark AO1 (understanding)** **What is – 1 mark (AO1(knowledge)):** Shows order / position / rank / place; **Use in array – 1 mark (AO1(understanding)):** The ordinal numbers would represent the position / index / location of the values in the array;	**2**
10		**All marks AO2 (apply)** Award up to four marks for the working shown, but **Max 3** if the response does not show that $(A + B) \cdot (B + C \cdot (D + \overline{D})) = A \cdot C + B$ **1 mark** for each application of an identity or theorem that produces an expression that is logically equivalent to the original expression but uses fewer logical operators. **1 mark** for a successful application of the distribution law – only one mark, regardless of how many times this has been applied Continue marking until an incorrect step is encountered. If a student misses out some steps but does not make an error then continue marking. **Example Solution 1** $(A + B) \cdot (B + C \cdot (D + \overline{D}))$ $= (A + B) \cdot (B + C \cdot 1)$ By identity $X + \overline{X} = 1$ $= (A + B) \cdot (B + C)$ By identity $X \cdot 1 = X$ $= A \cdot B + A \cdot C + B \cdot B + B \cdot C$ Using distribution law $= A \cdot B + A \cdot C + B + B \cdot C$ By identity $X \cdot X = X$ $= A \cdot B + A \cdot C + B$ By redundancy theorem $X + X \cdot Y = X$ $= A \cdot C + B$ By redundancy theorem $X + X \cdot Y = X$ **Example Solution 2** $(A + B) \cdot (B + C \cdot (D + \overline{D}))$ $= (A + B) \cdot (B + C \cdot 1)$ By identity $X + \overline{X} = 1$ $= (A + B) \cdot (B + C)$ By identity $X \cdot 1 = X$ $= A \cdot C + B$ Using distribution law (<u>this jump is worth 2 marks</u>)	**4**
11	**1**	**Mark is AO2 (Analyse)** 4 bits // nibble / half a byte; **NE.** 4, 0.5	**1**
11	**2**	**Mark is AO2 (Apply)** 1000 // 1 x 10^3 // 10^3 (Hz / samples per second) // 1kHz; **A.** 10 ÷ 0.01	**1**

<table>
<tr><td>11</td><td>3</td><td>All marks AO1 (Understanding)

Significance: It will not be possible to reproduce the original signal (completely) accurately // the recording is not (completely) accurate;
NE. “error” without explaining that this affects the quality of the recording/reproduction
NE. lower

How reduced: Increase the sample resolution // increase the number of bits used to record each sample;
TO. references to changing the sample rate (even if changing sample resolution also mentioned)</td><td>2</td></tr>
<tr><td>11</td><td>4</td><td>Mark is AO2 (Apply)

2400 (Hz) // 2.4kHz;
A. 1200 x 2</td><td>1</td></tr>
<tr><td>12</td><td>1</td><td>All marks AO2 (analyse)

One mark for correct purposes given for one or two registers OR two marks for correct purposes given for all three registers.

<table>
<tr><th>Register</th><th>Purpose</th></tr>
<tr><td>R1</td><td>The plaintext letter // the letter before it has been encrypted // the original letter // the <code>characterCode</code></td></tr>
<tr><td>R2</td><td>The key // the number of positions to shift letters by // the value to add to the letter // the <code>keyValue</code></td></tr>
<tr><td>R3</td><td>The ciphertext letter // the encrypted letter // the <code>encryptedCode</code></td></tr>
</table>

A. “letter” for “character” and vice-versa</td><td>2</td></tr>
<tr><td>12</td><td>2</td><td>Mark is AO3 (programming)

<code>MOV R3, R1;</code>
I. missing comma
A. another command which would achieve the same affect eg <code>ORR R3, R1, #0</code></td><td>1</td></tr>
</table>

12	**3**	**All marks AO3 (programming)**
		
		`R3` compared to `90` or `91`as first command;
		`26` subtracted from `R3` and result stored back into `R3` after comparison (whether comparison is correct or not);
		Fully working code;
		DPT omission of `#` for immediate addressing values
		DPT use of register number other than R3
		I. missing commas
		
		Example Solution 1
		
		`CMP R3, #91`
		`BLT finished`
		`SUB R3, R3, #26`
		`B finished`
		
		Example Solution 2
		
		`CMP R3, #90`
		`BGT moveBack`
		`B finished`
		`moveBack:`
		`SUB R3, R3, #26`
		`B finished`
		
		Example Solution 1
		
		`CMP R3, #90`
		`BLT finished`
		`BEQ finished`
		`SUB R3, R3, #26`
		`B finished`
			3

13 **1** **All Marks AO1 (Understanding)** **2**

Award one mark for each pair of measure and how this is effective.
Do not award marks for both rows 1 and 2.

	Measure	**How Makes Effective**
1	Use WPA (WiFi Protected Access)/WPA2 (**A.** WEP) (which is strong) **NE.** use of password	To encrypt transmission // so that if intercepted transmissions cannot be understood/read by someone who does not have the key / by an unauthorised person
2	Encrypt transmissions	So that if intercepted cannot be understood/read by someone who does not have the key / by an unauthorised person
3	Disable broadcast of SSID (Service Set Identifier)	So that the network is harder to discover // so that you must know the SSID to connect
4	Use a MAC address white list **A.** "Hardware" for "MAC" **NE.** whitelist without reference to MAC addresses	So that only devices with a known address // address on the list can connect

Max 2

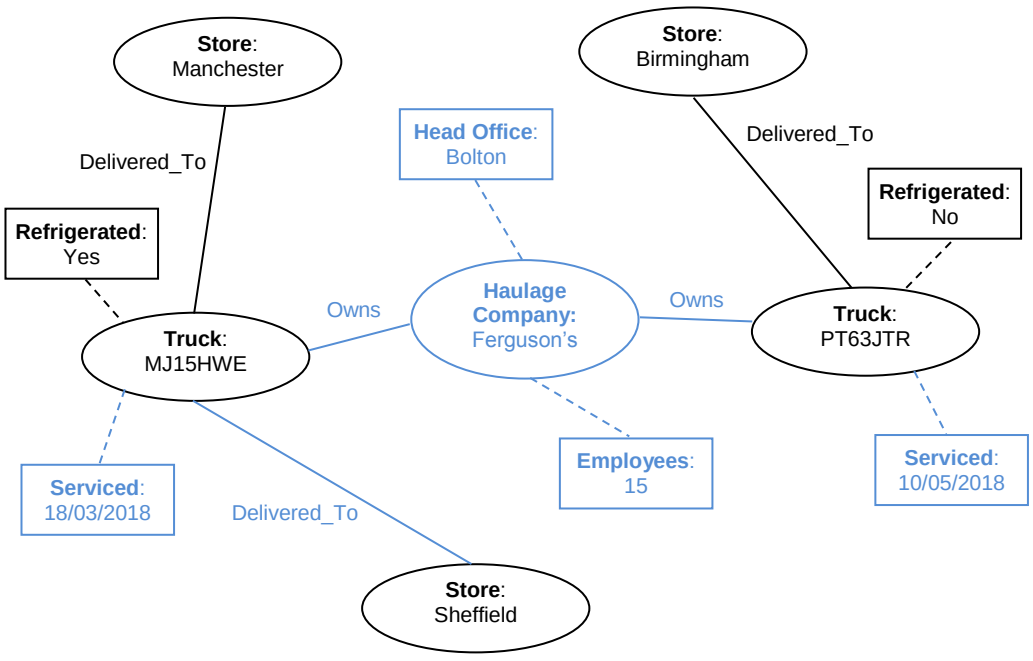
13	2	**2 marks for AO1 (knowledge) and 4 marks for AO1 (understanding)**	6

Level	Description	Mark Range
3	A detailed, coherent, description that includes the use of RTS/CTS and that conveys good understanding of how the access method works. Whilst there may be some omissions from the description it contains no misunderstandings.	5-6
2	An adequate description, including at least three points from the list below. 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. The description may or may not include the use of RTS/CTS.	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, demonstrated only a very limited understanding, if any, of the access method used.	1-2

Indicative Content

- computer with data to send monitors/listens for (data signal)
- if (data) signal present/another transmission in progress then continue to wait
- when no (data) signal present computer sends a Request to Send / RTS **A.** if no valid points made about RTS/CTS in response then accept that when no data signal is present computer starts to transmit data, but with no marks awarded for RTS/CTS then response is limited to max Level 2
- two computers could start transmitting simultaneously if they both detect there is no data signal
- receiver/WAP responds (to RTS) with a Clear to Send / CTS signal **A.** router
- RTS/CTS signal blocks any other transmissions from nodes in range
- if/when CTS received then start to transmit **A.** by implication as **BOD** if the student states that the computer will begin to transmit after the receiver sends the CTS
- if CTS not received continue to wait (until transmission ends)
- receiver sends acknowledgement / ack after (all) data received
- after transmitting (the transmitter) waits to receive acknowledgement packet (to confirm data received and not corrupted)
- if no acknowledgement/ack received (within reasonable time period) then:
  - wait a time period
  - then listen again / retransmit.
- the acknowledgement/ack also notifies other computers that they can transmit again
- waiting periods are (often) random **A.** an example waiting period that is random
- collisions cannot be detected by transmitter

14	**1**	**All marks AO1 (knowledge)** There is a lot / high volume of data (to process) // data will not fit on one server; **NE.** "volume" on its own. The data is generated/received/must be processed at high velocity/very quickly; **NE.** "velocity" on its own. **NE.** high velocity of data **NE.** speed data sent at **A.** changed, modified or similar instead of "processed"	**2**

14	2	**All marks AO2 (apply)** **1 mark** for representing "Truck MJ15HWE has made a delivery to the Sheffield store" with a solid line joining the truck and the store labelled "Delivered_To". **A.** alternative labels which clearly have the same meaning eg "Delivery" **A.** use of directed arrow **1 mark** for representing "Truck PT63JTR was last serviced on 10/05/2018 and truck MJ15HWE was last serviced on 18/03/2018" by drawing rectangular boxes containing the data, connected to the trucks with dashed lines. **1 mark** for representing "Both of the trucks are owned by a haulage company called "Ferguson's" which has 15 employees and has a head office in Bolton" by adding an oval for the haulage company with rectangles connected to it by dashed lines indicating the Head Office and Number of Employees, and joining the oval to the trucks using solid lines with appropriate labels such as "owns". **A.** alternative labels which clearly have the same meaning eg "Belongs To" **A.** oval only references "Company" not "Haulage" (and possibly but not necessarily additional property added to indicate the type of the company is haulage). **A.** instead of Head Office Bolton being drawn as a rectangle and joined with a dotted line it can be drawn as an oval and joined with a solid line. **A.** use of directed arrows An example fully correct diagram is shown below:  **Max 2 if diagram contains any errors or incorrect additions**	3
15	1	**Mark is AO1 (understanding)** 2; **R.** If more than one lozenge shaded	1

<table>
<tr>
<td>15</td>
<td>2</td>
<td>All marks AO2 (apply)

One mark per correct row in the Result column:

<table>
<tr><th>Function Call</th><th>Result</th></tr>
<tr><td><code>fw [4,3]</code></td><td><code>12;</code></td></tr>
<tr><td><code>fx sales</code></td><td><code>[20, 50, 32];</code>
A. alternative styles of bracket
R. no brackets
R. each element in a separate list</td></tr>
<tr><td><code>fz sales</code></td><td><code>102;</code></td></tr>
</table>
</td>
<td>3</td>
</tr>
<tr>
<td>15</td>
<td>3</td>
<td>Mark is AO2 (analyse)

Total/one day’s sales value/income/revenue (for all products);
A. total/one day’s profit as BOD
NE. sales, total sales</td>
<td>1</td>
</tr>
</table>