A-level
COMPUTER SCIENCE
7517/2

Paper 2

Mark scheme

June 2024

Version: 1.0 Final

246A7517/2/MS

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 Examiner.

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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

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 creditworthy.

  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 creditworthy) 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 alternative response
/ - means an alternative word or sub-phrase
A. - means 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.
TO. - a student has made a valid point, but has then demonstrated that they do not understand the point that they have made by including further incorrect or contradictory statements so the mark should not be awarded.

Examiners are required to assign each of the candidates' responses to the most appropriate level according to **its overall quality**, 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 question, the marks available are as follows:

Question 07.3 (max 2 marks)
AO1 (knowledge) – 1 mark
AO1 (understanding) – 1 mark

Qu	Pt	Marking guidance	Total marks
01		**All marks AO1 (understanding)** **Monitoring** Firewall could block packets from sources / computers known to be high-risk // could block packets not part of a current communication (stateful inspection); **A.** firewall could filter/monitor data entering network **A.** firewall could block packets containing malicious data Proxy server could receive/check downloaded files; Spam filters can block emails from suspicious sources // spam filters can block emails that contain suspicious content // block pop-ups to prevent users clicking on potentially harmful links // have a system that enables the reporting of spam emails // block download of attachments from outside organisation / untrusted sources // block download of attachments based on file type / executables; Web filters can check websites against a list of websites known for having content that might contain/spread a virus; Digital certificates can be used to verify the source of a downloaded file; Digital signature / checksum can be used to verify that a file has not been changed // that a file came from a known source; **Protection** Enable automatic update of applications / OS to patch code vulnerabilities; **A.** keep software up to date **R.** automatic update of anti-virus software Use a virtual machine to execute programs // use a sandbox when executing programs (**A.** opening files); Set access rights to minimise risk of viruses being able to access / modify sensitive / important data / files; Disable execution of macros in documents (from outside sources); Restrict execution of software from unverified sources // restrict execution of unauthorised software; Encrypt files so that data cannot be extracted from them; Backup data and keep offline / away from computer so it can be recovered; **NE.** "backup" without explaining that this could be used to recover data or expanding on how backups should be made Disable the use of external drives / removable media; **A**. disable USB ports Use a computer with the Harvard architecture to prevent data being executed as code; Use a MAC address allow list so that only known devices can join a network; (Enforce) strong passwords / biometric access would make it harder for a hacker to access a computer <u>to install a virus</u>; **Code Quality** Ensure code does not allow buffer overflow / overrun // ensure code prevents programs writing to memory locations not allocated to them; Test software for security issues / vulnerabilities; Carry out a code review so the code is independently checked by another programmer / other programmers;	**4**

		Use code analysis software to identify flaws / measure code quality; Only use / load up Internet services / libraries from the Internet if required // use the latest version of libraries // use libraries that are known to have been thoroughly tested // use libraries from trusted sources; **Note:** Question requires a description. Naming methods eg “backup”, “firewall” without describing how they would be used is not enough to award a mark. **Max 4**	

Qu	Pt	Marking guidance	Total marks
02	1	**All marks AO2 (apply)** Award **2 marks** for correct answer: 36 (megabytes). **A.** 4000 x 3000 x $\log_2(16777216) \div 8 \div 1000 \div 1000$ or equivalent eg 1.5 x $\log_2(16777216)$ If answer is incorrect then award **1 method mark** for doing at least **three** of: • multiplying by 4000 • multiplying by 3000 • multiplying by 24 or 3 • dividing by 1000 • dividing by 1000 a second time • dividing by 8 (do not credit if also multiplied by 3).	**2**

Qu	Pt	Marking guidance	Total marks
02	2	**Mark is AO2 (apply)** 7111; **A.** follow-through of 256 x 1000 ÷ incorrect answer to question part **02.1** if rounded down to nearest whole number	**1**

Qu	Pt	Marking guidance	Total marks
02	3	**All marks AO1 (understanding)** (The voltages) are continuously variable (and reflect the structure of the original light data) // (the voltages) can take any value; **NE.** real world quantity (The pixel data) is discrete // the colour of each pixel will be stored in a fixed number of bits // there are gaps/jumps between (colour) values; **A.** there are a finite set of values **NE.** the pixel data is not continuous **NE.** the pixel data is binary	**2**

Qu	Pt	Marking guidance	Total marks
02	4	**Mark is AO2 (apply)** Memory before RLE: 20 Memory after RLE: 26 **Must have both values correct to be awarded the mark.**	**1**

Qu	Pt	Marking guidance	Total marks
02	5	**Mark is AO2 (analyse)** Compression has not been effective because the amount of memory needed has increased // because the runs are not very long // because there are few runs (of length greater than one) // because the colours vary a lot; **Max 1**	**1**

Qu	Pt	Marking guidance	Total marks
03	1	**Mark is AO1 (understanding)** Address (bus);	**1**

Qu	Pt	Marking guidance	Total marks
03	2	**Mark is AO1 (knowledge)** Receiving and transmitting components share a common clock // are (continuously) synchronised by a common clock; **A.** receiver and transmitter **A.** "communicating components" without reference to receiver and transmitter Timing information transmitted within / alongside the data; Receiver and transmitter components clocks are (continuously) synchronised; **A.** receiver and transmitter **A.** "communicating components" without reference to receiver and transmitter **NE.** receiver and transmitter are synchronised **TO.** stated that synchronisation is only when data is transmitted **Max 1**	**1**

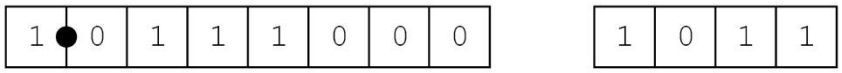
Qu	Pt	Marking guidance	Total marks
03	3	**All marks are AO1 (understanding)** **1 mark** for identifying a difference between communicating with peripherals and between components inside the computer: • data has to travel further to a peripheral // data travels a shorter distance between internal components • position of internal components is fixed // peripherals may be moved • more data is transmitted between internal components than to peripherals // data is transmitted more frequently between internal components than to peripherals // data must be transmitted at a higher rate between internal components than to peripherals. **1 mark** for giving a reason why internal buses are parallel: • more data / multiple bits can be transmitted simultaneously / at the same time. **A.** faster transmission **1 mark** for giving a reason why serial is used for connecting peripherals: • data skew cannot occur • crosstalk cannot occur • data transmission speed (on one wire) can be higher • cabling is cheaper • cabling allows more flexibility over positioning • cables can be longer. **Award marks for differences stated in reverse, eg serial communication has slower transmission is equivalent to parallel faster transmission, parallel cabling more expensive is equivalent to serial cabling cheaper.**	**3**

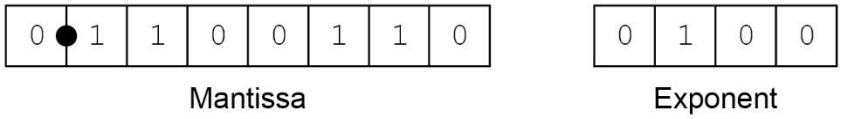
Qu	Pt	Marking guidance	Total marks
03	4	**All marks are AO1 (understanding)** Allows processor to control / communicate with a peripheral using an (I/O) port; Allows peripheral to appear as a set of registers / memory locations (to the processor); Translates signals / data received from a peripheral into a form that can be processed by the computer // translate signals / data sent by the processor into a form that can be used by a peripheral // converts voltages used by processor and I/O device (if they operate using different voltages); Buffer data being received from a peripheral (so the processor does not have to wait for it); Allows new peripherals to be added without having to redesign the processor / computer hardware; Allows peripheral designers to create new peripherals to one common interface standard // allows peripheral designer to reduce / minimise the number of ports/connections that a peripheral needs to support; To carry out some of the I/O related processing // to reduce the workload on the CPU in relation to I/O processing; To check that data received from peripherals is not corrupted // performs error detection/correct on data received from peripherals; Implements the protocols used by I/O devices for communication; Generates an interrupt when data is ready to be transferred from an I/O device // when an I/O device needs the immediate attention of the CPU; **Max 2**	**2**

Qu	Pt	Marking guidance	Total marks
03	5	**All marks AO2 (analyse)** Award **2 marks** for correct answer: 128 // 2^7 (gibibytes). If answer is incorrect then award **1 method mark** for at least **two** of: • including 2^{36} in the calculation • multiplying by 16 • dividing by 8 • dividing by 1024 // 2^{10} • dividing by 1024 // 2^{10} a second time. Or award **1 method mark** for **one** of: • including 2^{37} in the calculation • multiplying by 2 (an alternative to multiplying by 16 then dividing by 8) • dividing by 1048576 // 2^{20} • dividing by 1073741824 // 2^{30}	**2**

Qu	Pt	Marking guidance	Total marks
03	6	**Mark is AO1 (knowledge)** Indicate that a memory write is occurring // cause data on the data bus to be written into the memory / RAM; Transfer clock signal // synchronise operation of processor and memory / RAM; Indicate the number of bits being transferred; Receive transfer acknowledgement // receive acknowledgement that data received (by memory/ RAM); Send signal to request use of (system) bus // issue bus request; Receive signal granting use of (system) bus // receive bus grant; **Max 1**	**1**

Qu	Pt	Marking guidance	Total marks
04	1	**All marks AO1 (understanding)** **A** A processor can usually carry out calculations on fixed point numbers more quickly than calculations on floating point numbers. ⬬ **B** Fixed point numbers represent data using a mantissa and an exponent. ⬭ **C** In a given number of bits, a fixed point system can represent positive numbers that are closer to zero than a floating point system can. ⬭ **D** In a given number of bits, a fixed point system can represent some numbers more precisely than a floating point system. ⬬ **E** In a given number of bits, a floating point system can represent a bigger range of numbers than a fixed point system. ⬬ **2 marks**: All five rows shaded / not shaded correctly **OR** **1 mark**: Three or four rows shaded / not shaded correctly	**2**

Qu	Pt	Marking guidance	Total marks
04	2	**All marks AO2 (apply)**  Award **2 marks** for correct answer: –0.017578125 // –9/512 **A.** rounded to at least 4 dp (eg –0.0176) If answer is incorrect then award **1 method mark** for either: • showing correct value of both mantissa and exponent in decimal (Mantissa = –0.5625 // –9/16 Exponent = –5) • showing binary point shifted 5 places to left in binary number • indicating that final answer has been calculated using answer = mantissa x $2^{exponent}$ and using either the correct mantissa, the correct exponent, or both in this calculation.	**2**

Qu	Pt	Marking guidance	Total marks
04	3	**All marks AO2 (apply)** Award **3 marks** for correct answer:  If answer is incorrect then award **up to 2 method marks**, one for each point from this list: • correct (unsigned) fixed point representation of 12.765625 in binary: 1100.110001; **A.** leading 0s and trailing 0s • correct 7-bit rounded fixed point representation of 12.765625 in binary: 1100.110; **A.** a single leading 0 • correct mantissa value: 0.1100110 • correct value of the exponent in decimal (4) or binary (100) // showing the binary point being shifted 4 places left **A.** if only shown in final answer exponent box	**3**

Qu	Pt	Marking guidance	Total marks
04	4	**Mark is AO2 (apply)** 3 (bits);	**1**

Qu	Pt	Marking guidance	Total marks
04	5	**All marks AO2 (apply)** Award **2 marks** for correct answer: –2147483648 ***//*** -2^{31} // -1×2^{31} If answer is incorrect then award **1 method mark** for **one** of: • giving the most negative value of mantissa 1.000000000 and exponent 011111 • giving the most negative value as a binary integer: 1000 0000 0000 0000 0000 0000 0000 0000	**2**

<table>
<tr><th>Qu</th><th>Pt</th><th>Marking guidance</th><th>Total marks</th></tr>
<tr><td>05</td><td>1</td><td>

All marks AO1 (understanding)

<table>
<tr><th>Level</th><th>Description</th><th>Mark Range</th></tr>
<tr><td>4</td><td>A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically-structured response. The response covers both areas indicated in the guidance below and, in each area, there is sufficient detail to show that the student has a good level of understanding.</td><td>10–12</td></tr>
<tr><td>3</td><td>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 one area indicated in the guidance below and some understanding of the other area or a reasonable understanding of both areas.</td><td>7–9</td></tr>
<tr><td>2</td><td>A limited attempt has been made to follow a line of reasoning and the response has a mostly logical structure. A reasonable level of understanding has been shown of one area or some understanding of both areas.</td><td>4–6</td></tr>
<tr><td>1</td><td>A few relevant points have been made but there is no evidence that a line of reasoning has been followed.</td><td>1–3</td></tr>
</table>

<u>Guidance – Indicative Content</u>

Area 1: How data is stored on and read from a magnetic hard disk drive

<table>
<tr><th>Key Points</th><th>Additional Points</th></tr>
<tr><td>Disk is coated in a magnetisable material // iron / cobalt-based material

Magnetising a spot in one direction could represent 0 and the other direction could represent 1 A. any plausible way of representing two values

Disk divided into rings called tracks

Tracks divided into sectors / blocks

Read/write head moves in / out (radially) (to correct track)

Wait until correct sector / block passes under read/write head

Disk spins at high speed

Read/write head senses magnetic field and converts to 0s and 1s</td><td>Whole block read together

Data stored in buffer while being read

Can be many disks inside drive known as platters

Disk and drive are a sealed unit

Data near outside edge of disk stored less densely // disk has constant angular velocity

Files stored in hierarchical structure / directories

Free / used space indicated in file allocation table

Mirroring / striping / RAID may be used for automatic backup // to protect against drive failure</td></tr>
</table>

</td><td>12</td></tr>
</table>

A good understanding could be demonstrated by covering many of the points in the 'Key Points' column of the table, conveying the fundamental method by which magnetic hard disks work, but may omit some detail. Referencing points in the 'Additional Points' column could compensate for any omissions in the 'Key Points' column, but is not required.

Area 2: How the TCP/IP stack is used in the file server

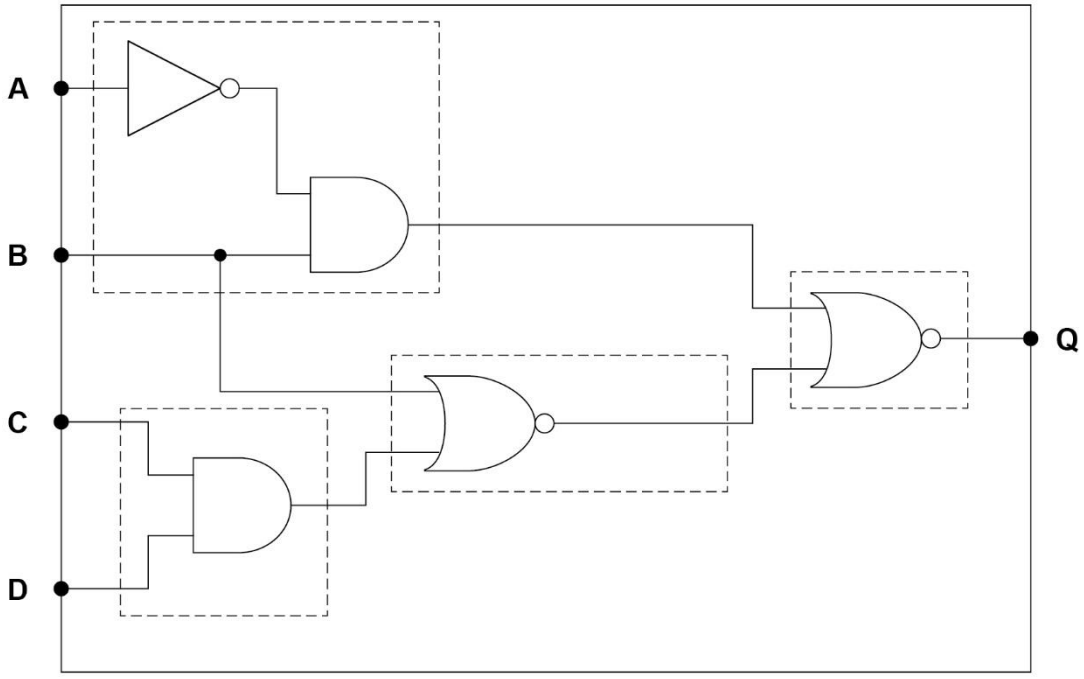
- Four layers of stack are Application, Transport, Network/Internet and Link/Physical.
- File will be passed down/through each layer in turn.

Layer	Key Points	Additional Points
Application	File server software will operate in the Application Layer File transfer may use FTP protocol	Alternative protocols are SMB, NFS
Transport	Establishes end-to-end connection between file server and computer Receives file / data on a port from the application layer // adds source and destination port numbers to segment Splits file / data into segments Adds checksum to segment // adds error detection information to segment // deals with transmission errors // retransmits lost / corrupted segments **A.** packet for segment	Performs flow control Performs congestion control Adds sequence number to segment May use TCP or UDP protocol
Network / Internet	Adds source and destination IP addresses to datagram **R.** routes data across network **A.** packet for datagram	Encapsulates each TCP/IP segment into an IP datagram Add time to live Uses subnet mask to determine if destination is on same subnet
Link / Physical	Physical interface to network communications medium // writes (encoding of) data to communications medium (**A.** cable for medium) Uses device drivers // uses network interface card Adds hardware / MAC address of destination / router / gateway / source	

Points cannot be credited unless they are linked to the appropriate layer.

		A good understanding could be demonstrated by covering many of the points in the 'Key Points' column of the table, including naming all four layers and making a range of accurate points about at least three of them. Referencing points in the 'Additional Points' column could compensate for any omissions in the 'Key Points' column, but is not required.	

Qu	Pt	Marking guidance	Total marks
05	**2**	**All marks AO1 (understanding)** **Advantage (1 mark):** • lower power consumption • faster access times // faster transfer rate // lower latency **NE.** faster • smaller (physically) • generate less heat // require less cooling • lower failure rate // less susceptible to damage from impact // not affected by magnetic fields **A.** more reliable **R.** quieter **R.** portable **Disadvantage (1 mark):** • higher cost (per megabyte) • higher error rate (over time) // more blocks become unusable over time in an SSD **R.** lower capacity	**2**

Qu	Pt	Marking guidance	Total marks
06	1	**All marks AO2 (apply)**  **1 mark:** Circuit input A connected to a NOT gate. The output of the NOT gate and B connected as the inputs to an AND gate. **1 mark:** Circuit inputs C and D connected as the inputs to an AND gate. **A.** C and B connected to an OR gate, the output of which is connected to an AND gate with D as the other input (misunderstanding of precedence) **1 mark:** Circuit input B and output of an AND gate (not the same AND gate as first mark point is awarded for) connected as the inputs to a NOR gate. **1 mark:** NOR gate connected to circuit output Q. **A.** correct use of OR and NOT gates instead of NOR gate **Max 3** if circuit logic not fully correct.	4

Qu	Pt	Marking guidance	Total marks
06	2	**Mark is AO1 (understanding)** Output Q will change to (reflect current value of) D; **A.** if D=1, Q will be set to 1 <u>and</u> if D=0, Q will be set to 0 **A.** if Q and D are the same then Q will not change <u>and</u> if Q and D are different then Q will change **NE.** Q will update	1

Qu	Pt	Marking guidance	Total marks
06	3	**All marks AO2 (apply)** **Marking guidance for examiners** • Award marks for working out until an incorrect step has been made. • Ignore missing steps from the example solutions, as long as the jumps between steps are logically correct. • If, in any one step, a candidate is simplifying different parts of an expression simultaneously, award all relevant marks for this multiple stage but don't award any further marks for working in any parts simplified incorrectly. For example, if the expression P.P.(P+Q) + P.P.1 was changed to P.(P+Q)+P.0, the candidate would get one mark for simplifying the first part to P.(P+Q) and could get further marks for correctly simplifying this part of the expression further but should not be awarded marks for simplifying the incorrectly changed part P.0 (ie to 0). **1 mark** for final answer: $\mathrm{A} \oplus \mathrm{B}$ **A.** XOR instead of $\oplus$ **A.** $\overline{\mathrm{A}} \cdot \mathrm{B} + \mathrm{A} \cdot \overline{\mathrm{B}}$ **Max 3** for working. Award up to **three marks** for applying each one of the three techniques (**one mark** per application): • a successful application of De Morgan's Law (and any associated cancellation of NOTs) that produces a simpler expression • applying an identity other than cancelling NOTs that produces a simpler expression • successfully expanding brackets // factorising. **Max 2** for working if there is no successful application of De Morgan **Max 3** overall if any errors in working **Note:** A simpler expression is one that is logically equivalent to the original expression but uses fewer logical operators. **Example Solution (1)** $\overline{\mathrm{A}} \cdot (\mathrm{B} \cdot \mathrm{C} \cdot \mathrm{D} + \mathrm{B} \cdot \mathrm{C} \cdot \overline{\mathrm{D}} + \mathrm{B}) + \overline{\overline{\mathrm{A}} + \mathrm{B}}$ $\overline{\mathrm{A}} \cdot (\mathrm{B} \cdot \mathrm{C} \cdot (\mathrm{D} + \overline{\mathrm{D}}) + \mathrm{B}) + \overline{\overline{\mathrm{A}} + \mathrm{B}}$ Factorising $\overline{\mathrm{A}} \cdot (\mathrm{B} \cdot \mathrm{C} \cdot 1 + \mathrm{B}) + \overline{\overline{\mathrm{A}} + \mathrm{B}}$ By $X + \overline{X} = 1$ $\overline{\mathrm{A}} \cdot (\mathrm{B} \cdot \mathrm{C} + \mathrm{B}) + \overline{\overline{\mathrm{A}} + \mathrm{B}}$ By $X \cdot 1 = X$ $\overline{\mathrm{A}} \cdot \mathrm{B} + \overline{\overline{\mathrm{A}} + \mathrm{B}}$ By $X + X \cdot Y = X$ $\overline{\mathrm{A}} \cdot \mathrm{B} + \mathrm{A} \cdot \overline{\mathrm{B}}$ Application of De Morgan $\mathrm{A} \oplus \mathrm{B}$ Simplification to XOR	4

Example Solution (2)

$\overline{A} \cdot (B \cdot C \cdot D + B \cdot C \cdot \overline{D} + B) + \overline{\overline{A} + B}$	
$\overline{A} \cdot B \cdot C \cdot D + \overline{A} \cdot B \cdot C \cdot \overline{D} + \overline{A} \cdot B + \overline{\overline{A} + B}$	Expand brackets
$\overline{A} \cdot B \cdot C \cdot D + \overline{A} \cdot B \cdot C \cdot \overline{D} + \overline{A} \cdot B + A \cdot \overline{B}$	Application of De Morgan
$\overline{A} \cdot B \cdot C \cdot (D + \overline{D}) + \overline{A} \cdot B + A \cdot \overline{B}$	Factorising
$\overline{A} \cdot B \cdot C \cdot 1 + \overline{A} \cdot B + A \cdot \overline{B}$	By $X + \bar{X} = 1$
$\overline{A} \cdot B \cdot C + \overline{A} \cdot B + A \cdot \overline{B}$	By $X \cdot 1 = X$
$\overline{A} \cdot B + A \cdot \overline{B}$	By $X + X \cdot Y = X$
$A \oplus B$	Simplification to XOR

Example Solution (3)

$\overline{A} \cdot (B \cdot C \cdot D + B \cdot C \cdot \overline{D} + B) + \overline{\overline{A} + B}$	
$\overline{A} \cdot (B \cdot C \cdot D + B) + \overline{\overline{A} + B}$	By $X + X \cdot Y = X$ (where $X = B$ and $Y = C \cdot \overline{D}$)
$\overline{A} \cdot B + \overline{\overline{A} + B}$	By $X + X \cdot Y = X$ (where $X = B$ and $Y = C \cdot D$)
$\overline{A} \cdot B + A \cdot \overline{B}$	Application of De Morgan
$A \oplus B$	Simplification to XOR

Example Solution (4)

$\overline{A} \cdot (B \cdot C \cdot D + B \cdot C \cdot \overline{D} + B) + \overline{\overline{A} + B}$	
$\overline{A} \cdot B + \overline{\overline{A} + B}$	By $X + X \cdot Y = X$ – Award 2 marks as rule applied twice (where $X = B$ and $Y = C \cdot \overline{D}$ then $Y = C \cdot D$)
$\overline{A} \cdot B + A \cdot \overline{B}$	Application of De Morgan
$A \oplus B$	Simplification to XOR

Example Solution (5)

$\overline{A} \cdot (B \cdot C \cdot D + B \cdot C \cdot \overline{D} + B) + \overline{\overline{A} + B}$	
$\overline{A} \cdot (B \cdot (C \cdot D + C \cdot \overline{D} + 1)) + \overline{\overline{A} + B}$	Factorising
$\overline{A} \cdot (B \cdot 1) + \overline{\overline{A} + B}$	By $X + 1 = 1$
$\overline{A} \cdot B + \overline{\overline{A} + B}$	By $X \cdot 1 = X$
$\overline{A} \cdot B + A \cdot \overline{B}$	Application of De Morgan
$A \oplus B$	Simplification to XOR

Qu	Pt	Marking guidance	Total marks
07	1	**Mark is AO2 (analyse)** **1 mark**: Both protocol and domain name correct. **Protocol:** HTTP // Hypertext Transfer Protocol **R.** HTTPS **Domain name:** `loveapug.org.uk` **NE.** `www.loveapug.org.uk` **I**. minor misspellings in domain name, case	**1**

Qu	Pt	Marking guidance	Total marks
07	2	**All marks AO1 (knowledge)** **1 mark**: Hierarchical organisation **A.** names of two parts of domain stated eg top/first-level domain and second-level domain **NE.** split into parts **TO.** hierarchical used in incorrect context eg hierarchical organisation of DNS servers **1 mark**: Expansion / example of hierarchical organisation: • example of top-level domain that is identified as being a top-level domain eg com, org, uk, fr • example of second-level domain that is identified as being a second-level domain eg ac, co **A.** ac.uk, co.uk or similar • domains can have subdomains created for them • example of subdomain for a domain, eg pastpapers.aqa.org.uk for aqa.org.uk **Note:** Do not award second mark if part of a URL that is not part of the domain name is referenced eg the protocol or the name of the file on the server.	**2**

Qu	Pt	Marking guidance	Total marks
07	3	**1 mark AO1 (knowledge) and 1 mark AO1 (understanding)** **Service (1 mark – knowledge)**: Registering domains to people / organisations / companies // storing domain names and who owns them; **Why needed (Max 1 mark – understanding)**: To enter domain name (to IP address mappings) into the DNS system; To ensure that domain names are unique; To ensure domain names not used by more than one person / organisation / company; **A.** "website" for person / organisation / company **NE.** domain names could not be used // all addressing would need to be done using IP addresses	**2**

Qu	Pt	Marking guidance	Total marks
07	4	**All marks AO1 (understanding)** Computers (outside the LAN) will use the (public) IP address of the router / 186.7.2.31 (to access the web server); **NE.** no reference to IP address (The router will perform) port forwarding; Router maintains a port mapping table // router uses rules for converting port numbers and IP addresses; **A**. NAT table for "port mapping table" Router must identify traffic arriving on the HTTP port // the port used for web services // port 80/8080 (from outside the network) // HTTP traffic (from outside the network); **A.** HTTPS / port 443 (Relevant traffic) must be forwarded (by the router) to the IP address of the Web Server // IP address 192.168.0.2; **NE.** the non-routable IP address without reference to web server **Max 3**	**3**

Qu	Pt	Marking guidance	Total marks
07	5	**Mark is AO1 (understanding)** The IP address of the web server might be changed (by the DHCP server); If the IP address of the web server changes the router will not be able to forward data to it // port forwarding will no longer work; **A.** DHCP server / router would need to be configured to allocate a fixed / static IP address to the web server **A.** just "IP" for "IP address" as **BOD** **NE.** "settings" for "IP address" **Max 1**	**1**

Qu	Pt	Marking guidance	Total marks
07	6	**All marks AO1 (understanding)** **When request sent** (When the router receives the FTP request from the computer), it will replace the IP address of the computer / the source IP address / 192.168.0.4 (**A.** the private IP address) with the (public) IP address of the router / 186.7.2.31 / (**A.** the public IP address); **NE.** references to <u>a</u> public IP address The router replaces the (source) port number with a port number it generates; The router <u>adds</u> the mapping (port number to IP address and port number / socket) it has created to its NAT translation table (**A.** list, dictionary or similar); **NE.** router adds mappings without reference to some sort of structure that they might be stored in **I.** incorrectly stated contents of table **When reply received** When a reply is received from the FTP server, it is recognised by its destination port number // the (destination) port number is looked up in the NAT translation table; (If the port number is present in the NAT translation table) the reply is forwarded to the computer that made the original request / computer with IP address 192.168.0.4 // the student's computer (and the destination port number is replaced with the one stored in the NAT translation table / the original source port number) // (If the port number is present in the NAT translation table) the router replaces its IP address / the (public) IP address of the router / 186.7.2.31 / (**A.** the public IP address) with the IP address of the student's computer / 192.168.0.4 (**R.** the private IP address); **A.** private and non-routable as equivalents and public and routable as equivalents **Accept the use of the term "NAT" instead of "router" but Max 2 for overall response** **Max 4**	**4**

Qu	Pt	Marking guidance	Total marks
07	7	**Mark is AO1 (understanding)** There are enough (IPv6) addresses for every device (in the world) to have a unique/public/routable (IP) address; **NE.** there are more IPv6 addresses	**1**

Qu	Pt	Marking guidance	Total marks
07	8	**Mark is AO1 (knowledge)** **D**; (The protocol establishes a full-duplex communication channel) **R.** if more than one lozenge shaded	**1**

Qu	Pt	Marking guidance	Total marks
08	1	**Mark is AO2 (analyse)** **B**; (Each product is only supplied by one supplier) **R.** if more than one lozenge shaded	**1**

Qu	Pt	Marking guidance	Total marks
08	2	**All marks are AO3 (programming)** **1 mark:** `INSERT INTO Sale` // `INSERT INTO Sale (SaleID, CustomerID, SaleDate)` If field list given in `INSERT INTO` command then allow fields in any order, but must include all three fields. **1 mark:** `VALUES (4072, 48, "29/09/2024")` If field list given in `INSERT INTO` command then values must match order in that command. If field list not given then values must be in order shown, otherwise this mark cannot be awarded. **A.** use of `#` or `'` as date delimiters instead of `"` **A.** other date formats **R.** no delimiters around date **R.** use of delimiters around SaleID or CustomerID **Max 1** if `VALUES` command before `INSERT INTO` command. **Max 1** if command would not work.	**2**

Qu	Pt	Marking guidance	Total marks

08	3	**All marks are AO3 (programming)**
		
		Mark against Alternative 1 unless the response includes the command `FROM` and the `SaleLine` table, in which case mark against Alternative 2.
		
		Alternative 1
		
		1 mark: `UPDATE Product`
		
		1 mark: `SET QuantityInStock = QuantityInStock - 3`
		
		1 mark: `WHERE ProductID = 1`
		
		Alternative 2 (works in some SQL implementations)
		
		Part mark A: `UPDATE Product`
		
		1 mark: `SET QuantityInStock = QuantityInStock – 3` //
		`SET QuantityInStock=QuantityInStock–QuantitySold`
		
		Part mark B: `FROM Product INNER JOIN SaleLine ON`
		`Product.ProductID = SaleLine.ProductID`
		
		1 mark: `WHERE SaleLine.SaleID = 4072`
		
		Note that both part marks (A and B) must be achieved to award one mark.
		
		A. table name before fieldname
		I. case, spaces in fieldnames
		NE. use of variable names instead of 3
		DPT. fieldname before table name
		R. use of delimiters around 1, 3 or 4072
		
		Max 2 if commands not given in the correct order or would not work
			3

Qu	Pt	Marking guidance	Total marks
08	4	**All marks are AO1 (understanding)** Timestamps are generated for each transaction // timestamps indicate the order that transactions occurred in; **A.** timestamps generated for edits / queries / requests as BOD **NE.** transactions are put in a queue without reference to timestamps **NE.** transactions are processed in order by time when they were made **R.** timestamps generated for sales Database records time(stamp) of last read / last write transaction for each record / data item; **A.** just one of read/write **A.** "edit" for "write", "access" for "read" **R.** file Database server applies rules to determine if processing a transaction <u>will result in loss of data integrity / inconsistency</u> (and if so aborts the transaction); **A.** Examples of rules for third mark point: • if a transaction tries to **write** to a record / data item, then the transaction should be aborted if the read/write timestamp on the record / data item is greater than the time at which the transaction started • if a transaction tries to **read** a record / data item, then the transaction should be aborted if the write timestamp on the record / data item is greater than the time at which the transaction started.	**3**

Qu	Pt	Marking guidance	Total marks
08	5	**All marks are AO1 (understanding)** Redundant/duplicated data may waste storage space; **NE.** data redundancy, data duplication If data is stored more than once then it could be inconsistent // two copies of the 'same' data item might store different values; **NE.** data inconsistency If data is stored more than once then each copy of the data would need to be updated if it changed; **NE.** eliminate update anomalies It might not be possible to store data about one type of entity without creating a record for another type of entity // if a record for one type of entity does not exist then it might not be possible to store data about another type of entity; **NE.** eliminate insertion anomalies **A.** example in context When a record for one type of entity is deleted it might delete the data about another type of entity // it might not be possible to delete a record for one type of entity without deleting the data about another type of entity; **NE.** eliminate deletion anomalies **A.** example in context May be difficult to select/edit data if it is not atomic // if there are repeating groups; **NE.** harder to update / insert / delete without concrete example or good explanation **NE.** more errors when updating / inserting / deleting without concrete example or good explanation **NE.** uses more space / memory **NE.** harder / slower to query	**2**

<table>
<tr><th>Qu</th><th>Pt</th><th>Marking guidance</th><th>Total marks</th></tr>
<tr><td>09</td><td></td><td>

All marks are AO2 (analyse)

<table>
<tr><th>Level</th><th>Description</th><th>Mark Range</th></tr>
<tr><td>3</td><td>A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically-structured response. The response demonstrates a very good understanding of the issues that might arise with a range of points having been made and developed.</td><td>5–6</td></tr>
<tr><td>2</td><td>A limited attempt has been made to follow a line of reasoning and the response has a mostly logical structure. Responses will either go beyond just accuracy and responsibility or, if they focus only on these two issues, points made will be developed.</td><td>3–4</td></tr>
<tr><td>1</td><td>A few relevant points have been made but there is no evidence that a line of reasoning has been followed. The points made do not provide evidence of a good understanding of the issues. Responses may focus solely on areas such as the risk of inaccurate diagnosis and who would be held responsible for this.</td><td>1–2</td></tr>
</table>

<u>Guidance – Indicative Content</u>

Risk of inaccurate diagnosis.

Will patients trust a computer system to diagnose them?

Who is responsible for the accuracy of a diagnosis // if a diagnosis is incorrect?

Does responsibility lie with the people who programmed / designed it or the people operating it? // AI systems themselves cannot be held responsible.

Should patients be informed if their diagnosis will be made by a computer system?

Should patients have the option to ask for the diagnosis to be done by a person instead? // Will patients accept diagnosis or want it to be confirmed by human (thus removing some benefits of system)? // Should diagnoses be double-checked by a human?

A human doctor may feel a moral responsibility that an AI system would not.

Data may be of a confidential / private / personal nature // Data Protection Act / GDPR may apply (**A.** one example of provisions of these laws eg keeping data securely, patients having right to view data).

Appropriate security would be required for the system as it would store personal data.

Is it legal for an AI system to diagnose (without human assistance)?

AI system will need training with data – how will this be obtained?

Consent would be needed from patients to use their data for training.

Choice of training data may affect reliability / effectiveness of system // algorithmic bias may develop (eg if one group of people not represented / underrepresented).

Should system explain reasoning (if possible) to increase confidence in diagnosis?

</td><td>6</td></tr>
</table>

		System could be used by GPs, reducing demand for more specialist doctors. **A.** may result in medical staff being made redundant How much evidence of the reliability of a system is needed before humans are no longer involved in the diagnosis? Could relying on computer systems risk missing diagnosis of very rare / new conditions? Could relying on computers de-skill medical staff? Would a doctor feel confident to over-rule a diagnosis by the computer system? If computer system could diagnose conditions that were not spotted by doctors, would this undermine faith in doctors? **A.** AI systems may be able to diagnose some conditions more reliably than humans Could be used to make diagnosis of some conditions possible in poorer countries (where there are fewer doctors). If cost of system is high, benefits of it may not be available to all people // in poorer countries. Are there some conditions that AI could be trusted to diagnose but others that it could not be? Would it be acceptable to use AI if it missed some cases but detected many others? System may detect issues / potential issues which would actually never turn into a condition that needed treating. If more conditions diagnosed, may increase demand for treatments // may put pressure on hospital services. System could go back through old cases and identify potential missed diagnoses. Should patients be asked before old cases re-examined? If data transferred between countries different laws may apply. Should medical data be shared if it can help diagnose other patients?	

Qu	Pt	Marking guidance	Total marks
10	1	**All marks AO2 (apply)**	6

Memory Location 130	R1	R2	R3	R4
83 (01010011)	*1* 83 (01010011)	0		0
		1	1	1 *2*
	3 41 (00101001)	2	1	2
	20 (00010100)	3	0	
	10 (00001010)	4	0	
	5 (00000101)	5	1	3
	2 (00000010)	6	0	
	1 (00000001)	7	1	4
	0 (00000000)	*4*	*5*	
6	83 (01010011)			0
	211 (11010011)			
211 (11010011)				

1 mark: Correct initial values loaded into `R1`, `R2` and `R4` – Area 1.
1 mark: First increment of `R2` and `R4` and first logical AND of `R3` – Area 2.
1 mark: Contents of `R1` shifted right 7 times – Area 3.
1 mark: `R2` counts up from 2 to 7 – Area 4.
1 mark: `R3` shows correct values of ANDing `R1` and 1 and `R4` increments from 2 to 4 – Area 5.
1 mark: `R4` set to 0, MSB of `R1` set to 1 and contents of `R1` copied to memory location 130 – Area 6.

Award marks for the correct values in the indicated areas. The values do not need to be in the exact cells shown for marks to be awarded, but must be in the correct sequence in the column they are in.

Award marks for values written in either decimal or binary. If binary and decimal values are written in one cell and one is correct but the other incorrect then treat the cell as being correct.

Max 5 if any incorrect values in table (ignore cells where one of the binary and decimal is incorrect but the other correct).

Qu	Pt	Marking guidance	Total marks
10	2	**All marks AO2 (analyse)** **If the student recognises that the program is connected to parity:** Sets (**A.** calculates) the parity bit (for the ASCII character); using odd parity; **If the student does not recognise that the program is connected to parity:** Counts the number of 1s (in the ASCII code); **NE.** literal descriptions of how the code is working or responses that don't interpret what the purpose of the program is	**2**

Qu	Pt	Marking guidance	Total marks
10	3	**All marks AO1 (understanding)** Machine code produced by assembler / assembling may use up less memory // contain fewer instructions than machine code produced by compiler / converting HLL code would; **A.** code may take up less memory // code may use fewer instructions **NE.** more compact, smaller Machine code produced by assembler / assembling may execute more quickly than machine code produced by compiler / converting HLL code would; **A.** code may execute more quickly **NE.** assembly language is faster **R.** references to increased speed relating to faster/no translation Assembly language may allow (better) access to hardware / registers / (low-level) operating system routines; **A.** other examples of hardware access **A.** 'will' for 'may' **Max 2**	**2**

Qu	Pt	Marking guidance	Total marks
10	4	**Mark is AO1 (knowledge)** Program is a sequence of instructions that are followed in order; Instructions describe how to carry out a task // each instruction is a step; Instructions can change the state of the program; **Max 1**	**1**

Qu	Pt	Marking guidance	Total marks
11	1	**Mark is AO2 (analyse)** The set of real numbers // the set of all possible real-world quantities; **A.** real numbers **A.** numbers that represent any quantity along an infinite number line **A.** all numbers excluding imaginary/complex numbers **A.** rational and irrational numbers **NE.** $\mathbb{R}$ **TO.** real number stated but then another set described	**1**

Qu	Pt	Marking guidance	Total marks

11	2	**All marks are AO1 (understanding)**
		
		(Data structures/variables are immutable which means that) the state/values stored in data structures/variables cannot be changed (after they are created) // functional programming languages do not have variables;
		
		(Functions / programs are stateless which means that) functions do not have side-effects // the output of a function depends only on its inputs // functions are pure // the output of a function is not influenced by a stored state;
		
		Higher-order functions can compose the results of processing on multiple processors/cores // higher order functions can take a function as an argument and apply it to every element in a list // map-reduce can be used // functions are first-class objects and so can be passed to other functions as an argument;
		
		The order of execution can be determined at run-time // the order of execution can be determined by the translator/compiler/interpreter (**A.** language) // the order of execution is not defined by the program code // programs are not a sequence of instructions that must be followed in a specific order;
		
		Max 2
			2