AQA

A-level
COMPUTER SCIENCE
7517/2

Paper 2

Mark scheme

June 2022

Version: 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 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.

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

Paper 2

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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 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 mark that would otherwise have been awarded has not be awarded because another part of the candidate's response indicates that they did not understand the point they had made. For example, they might have made a contradictory point.

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 questions, the marks available are as follows:

Question 07.4 (max 7 marks)
AO2 (analyse) – 5 marks
AO3 (programming) – 2 marks

Question 08.3 (max 3 marks)
AO1 (knowledge) – 1 mark
AO1 (understanding) – 2 marks

Question			Marks
01	1	**All marks AO1 (knowledge)** Put the bits into groups of four/nibbles (starting at the right); Convert each group of bits/nibble into a hexadecimal digit; **A.** group/section/chunk of bits, even if number of bits not stated or incorrect for this mark **A.** "value" or "number" for "digit" **A.** convert each group of bits into decimal for 0 to 9, and letter A-F for 10 to 15 **Do not award marks if the conversion has been done but has not been described, although it is acceptable for the conversion to be performed as part of the description.**	**2**

Question			Marks
01	2	**Mark is for AO1 (understanding)** More compact when displayed // can be displayed using fewer digits; Easier (for people) to understand / remember; **A.** read, write Lower likelihood of an error when typing in data; Saves (the programmer) time writing / typing in data; **NE.** takes up less space **R.** if stated that hexadecimal uses less memory / storage **Max 1**	**1**

Question			Marks
02	1	**All marks AO1 (knowledge)** Multiple bits transmitted simultaneously / at same time; **NE.** data, values etc for bits Each (simultaneously transmitted) bit is sent down a different wire / cable / path / line; **A.** multiple wires / cables / paths / lines used for transmission	**2**

Question			Marks
02	2	**Mark is AO1 (understanding)** The hardware / wiring required for serial data transmission is cheaper; **NE.** cheaper without reference to hardware or wiring Serial transmission does not suffer from crosstalk // (two) bits cannot interfere with each other because they are not sent simultaneously; Serial transmission does not suffer from data skewing // bits transmitted are guaranteed to arrive in the order they were sent; **NE.** more reliable, lower probability of interference / corruption Serial transmission can be used over longer distances; **Max 1**	**1**

Question			Marks
02	3	**Mark is AO1 (understanding)** **B** Latency is the rate at which signals on a wire or line can change; **R.** if more than one lozenge shaded	**1**

Question			Marks
02	4	**Mark is AO1 (knowledge)** Start the receiver clock ticking; **A.** to wake up the receiver Synchronise the clock in the receiver to the transmitter clock // bring the clock in the receiver into phase with the clock in the transmitter; **A.** to synchronise the receiver and transmitter clocks **A.** synchronise the clocks in the devices **NE.** synchronise the (two) clocks **R.** indicates start of transmission **Max 1**	**1**

Question			Marks
02	5	**Mark is AO1 (knowledge)** Provides time for the receiver to process / transfer the received data; **NE.** indicates that the received data can be processed Allows the (next) start bit to be recognised; **R.** indicates end of transmission **R.** indicates clocks no longer need to be synchronised **Max 1**	**1**

Question			Marks
03	1	**Mark is AO2 (apply)** $\mathbf{A}$ | $\mathbf{B}$ | $\mathbf{A + B}$ | $\overline{\mathbf{A}}$ | $\overline{\mathbf{B}}$ | $\overline{\mathbf{A}} \cdot \overline{\mathbf{B}}$ | $\overline{\overline{\mathbf{A}} \cdot \overline{\mathbf{B}}}$ 0 | 0 | 0 | 1 | 1 | 1 | 0 0 | 1 | 1 | 1 | 0 | 0 | 1 1 | 0 | 1 | 0 | 1 | 0 | 1 1 | 1 | 1 | 0 | 0 | 0 | 1 **1 mark:** Table correctly completed	**1**

Question			Marks
03	2	**Mark is AO1 (understanding)** De Morgan's (Law);	**1**

Question			Marks
03	3	**All marks AO2 (apply)** Simplification of the two sub-expressions $\overline{\overline{A} + B \cdot C + B \cdot \overline{C}}$ and $C \cdot (A + \overline{A} \cdot (B + 1))$ should be marked independently. Stop awarding marks for a sub-expression as soon as a mistake has been made in that sub-expression, but continue to award marks for simplifying the other sub-expression. **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: $A \cdot \overline{B} + C$ **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 putting terms into brackets • successfully expanding brackets • successfully using the distributive law. **Note:** A simpler expression is one that is logically equivalent to the original expression but uses fewer logical operators. **Max 3 overall if any working is incorrect**	**4**

Example Solution (1)

$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C} \cdot \left(\mathrm{A} + \overline{\mathrm{A}} \cdot (\mathrm{B} + 1)\right)$	
$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C} \cdot (\mathrm{A} + \overline{\mathrm{A}} \cdot 1)$	By $X + 1 = 1$
$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C} \cdot (\mathrm{A} + \overline{\mathrm{A}})$	By $X \cdot 1 = X$
$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C} \cdot 1$	By $X + \bar{X} = 1$
$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C}$	By $X \cdot 1 = X$
$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot (\mathrm{C} + \overline{\mathrm{C}})} + \mathrm{C}$	Put into brackets
$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot 1} + \mathrm{C}$	By $X + \bar{X} = 1$
$\overline{\overline{\mathrm{A}} + \mathrm{B}} + \mathrm{C}$	By $X \cdot 1 = X$
$\mathrm{A} \cdot \overline{\mathrm{B}} + \mathrm{C}$	Application of De Morgan

Example Solution (2)

$\overline{\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C} \cdot (\mathrm{A} + \overline{\mathrm{A}} \cdot (\mathrm{B} + 1))}$	
$\overline{(\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}) \cdot \overline{\mathrm{C} \cdot \left(\mathrm{A} + \overline{\mathrm{A}} \cdot (\mathrm{B} + 1)\right)}}$	Application of De Morgan
$\overline{(\overline{\mathrm{A}} + \mathrm{B} \cdot (\mathrm{C} + \overline{\mathrm{C}})) \cdot \overline{\mathrm{C} \cdot \left(\mathrm{A} + \overline{\mathrm{A}} \cdot (\mathrm{B} + 1)\right)}}$	Put into brackets
$\overline{(\overline{\mathrm{A}} + \mathrm{B} \cdot (1)) \cdot \overline{\mathrm{C} \cdot \left(\mathrm{A} + \overline{\mathrm{A}} \cdot (\mathrm{B} + 1)\right)}}$	By $X + \bar{X} = 1$
$\overline{(\overline{\mathrm{A}} + \mathrm{B}) \cdot \overline{\mathrm{C} \cdot \left(\mathrm{A} + \overline{\mathrm{A}} \cdot (\mathrm{B} + 1)\right)}}$	By $X \cdot 1 = X$
$\overline{(\overline{\mathrm{A}} + \mathrm{B}) \cdot \overline{\mathrm{C} \cdot (\mathrm{A} + \overline{\mathrm{A}} \cdot 1)}}$	By $X + 1 = 1$
$\overline{(\overline{\mathrm{A}} + \mathrm{B}) \cdot \overline{\mathrm{C} \cdot (\mathrm{A} + \overline{\mathrm{A}})}}$	By $X \cdot 1 = X$
$\overline{(\overline{\mathrm{A}} + \mathrm{B}) \cdot \overline{\mathrm{C} \cdot (1)}}$	By $X + \bar{X} = 1$
$\overline{(\overline{\mathrm{A}} + \mathrm{B}) \cdot \overline{\mathrm{C}}}$	By $X \cdot 1 = X$
$\overline{\overline{\mathrm{A}} + \mathrm{B}} + \mathrm{C}$	Application of De Morgan
$\mathrm{A} \cdot \overline{\mathrm{B}} + \mathrm{C}$	Application of De Morgan

Example Solution (3)

$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C} \cdot (\mathrm{A} + \overline{\mathrm{A}} \cdot (\mathrm{B} + 1))$	
$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C} \cdot (\mathrm{A} + \overline{\mathrm{A}} \cdot 1)$	By $X + 1 = 1$
$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C} \cdot (\mathrm{A} + \overline{\mathrm{A}})$	By $X \cdot 1 = X$
$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C} \cdot 1$	By $X + \overline{X} = 1$
$\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C} + \mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C}$	By $X \cdot 1 = X$
$(\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C}}) \cdot \overline{\mathrm{B} \cdot \overline{\mathrm{C}}} + \mathrm{C}$	Application of De Morgan
$(\overline{\overline{\mathrm{A}} + \mathrm{B} \cdot \mathrm{C}}) \cdot (\overline{\mathrm{B}} + \mathrm{C}) + \mathrm{C}$	Application of De Morgan
$(\mathrm{A} \cdot \overline{\mathrm{B} \cdot \mathrm{C}}) \cdot (\overline{\mathrm{B}} + \mathrm{C}) + \mathrm{C}$	Application of De Morgan
$\mathrm{A} \cdot (\overline{\mathrm{B}} + \overline{\mathrm{C}}) \cdot (\overline{\mathrm{B}} + \mathrm{C}) + \mathrm{C}$	Application of De Morgan
$\mathrm{A} \cdot \overline{\mathrm{B}} \cdot \overline{\mathrm{B}} + \mathrm{A} \cdot \overline{\mathrm{C}} \cdot \overline{\mathrm{B}} + \mathrm{A} \cdot \overline{\mathrm{B}} \cdot \mathrm{C} + \mathrm{A} \cdot \overline{\mathrm{C}} \cdot \mathrm{C} + \mathrm{C}$	Expand Brackets
$\mathrm{A} \cdot \overline{\mathrm{B}} + \mathrm{A} \cdot \overline{\mathrm{C}} \cdot \overline{\mathrm{B}} + \mathrm{C}$	By $C +$ any term with $C = C$ / distributive law
$\mathrm{A} \cdot \overline{\mathrm{B}} + \mathrm{C}$	By distributive law

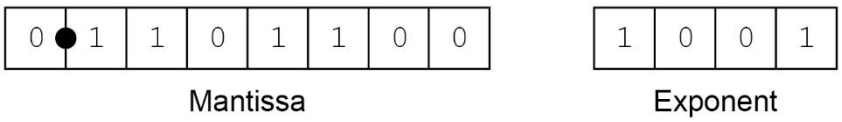
Question			Marks
04	1	**Mark is AO1 (knowledge)** Software used in the management of a computer system // layer(s) of software that abstract the user from how the computer works // software that provides a platform for other software to use; **A.** software used to run the computer **A.** software that provides a virtual machine **NE.** software that maintains a computer	**1**

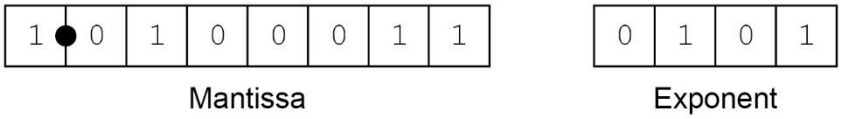
Question			Marks
04	2	**Mark is AO1 (knowledge)** **B** Bitmap image editors; **R.** if more than one lozenge shaded	**1**

Question			Marks
04	3	**All marks AO1 (knowledge)** To hide the complexities of the hardware from the user; **NE**. virtual machine without description **R.** user interface To handle interrupts // to call appropriate interrupt handler (**A.** ISR) when an interrupt occurs; To allocate processors/cores to processes // schedule processes // decide which process to carry out when // manage the execution of multiple processes; **NE.** processor management To allocate memory/RAM to processes // to determine what areas of memory are used for what purpose // moving data into and out of RAM / to a paging file for virtual memory // ensuring processes can only write to memory that they have been allocated; **NE.** memory management To allocate I/O devices to processes // manages communication between processes and I/O devices // automatic installation of drivers for new I/O devices; **A.** examples of devices (but no more than one mark) **NE.** manages I/O devices To allocate space on a storage device to files // organising files into directories // determines where on a device to save a file // recognising storage devices when they are connected; **A.** defragmentation of disks **NE.** saving a file Installation of new software // automatic / managing updating of software; **A.** "programs" or "tasks" for "processes" Manage power consumption / use of battery; **A.** examples of this eg controlling clock speed, brightness of screen **Note:** Students must describe – phrases such as "processor management", "allocating memory" etc are not enough. **Max 2**	**2**

Question			Marks
05	1	**All marks AO2 (apply)** Award **2 marks** for correct answer: –19 5/16 // –309/16 // –19.3125 If answer is incorrect then award **1 method mark** for working including one of: • –19 • –5/16 // –.3125 • –32 • Addition of 8 and 4 // 12 • Addition of 1/2, 1/8 and 1/16 // 11/16 // 0.6875 • 44.6875 // 44 11/16	**2**

Question			Marks
05	2	**All marks AO1 (understanding)** Maximises precision / accuracy for given number of bits; **Note:** Must have concept of given number of bits or an example of this eg word length. Unique representation of each number // simpler to test for equality of numbers;	**2**

Question			Marks
05	3	**All marks AO2 (apply)**  Award **2 marks** for correct answer: 27 / 4096 // 0.0066 (4dp) **A.** answers expressed to a higher precision (0.0065917969 to 10dp) **A.** mathematically equivalent values, with at least as many significant figures eg 6.6×10^{-3} If answer is incorrect then award **1 method mark** for either: • showing correct value of both mantissa and exponent in decimal (Mantissa = 0.84375 // 27/32 Exponent = –7) • showing binary point shifted 7 places to left in binary number • indicating that final answer calculated using answer = mantissa x $2^{exponent}$ and using the correct mantissa or exponent in this calculation.	**2**

Question			Marks
05	4	**All marks AO2 (apply)** Award **3 marks** for correct answer:  If answer is incorrect then award up to **2 method marks** for these steps (one per step): • Correct (unsigned) fixed point representation of 23.25 in binary: 10111.01 **A.** leading 0s and trailing 0s • Correct (signed) fixed point representation of –23.25 in binary: 101000.11 **A.** leading 1s and trailing 0s **NE.** this value only shown in final answer mantissa box • Showing the correct value of the exponent in decimal (5) or binary (101) // showing the binary point being shifted 5 places left; **A.** if only shown in final answer exponent box	**3**

Question			Marks
05	5	**All marks AO2 (apply)** Award **2 marks** for correct answer: 0.43(%); **A.** 0.0043 **A.** answers expressed to a higher precision (0.4328993199 to 10dp) **A.** mathematically equivalent values, with at least as many significant figures eg $4.3x10^{-3}$ **R.** 0.0043% If answer is incorrect then award **1 method mark** for any one of: • performing calculation -0.22558594 – -0.2265625 // 0.00097656 shown in working **R.** -0.00097656 • division by 0.22558594 or –0.22558594 • giving final answer as –0.43(%) or (–0.0043)	**2**

Question			Marks
06		**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 there is sufficient detail to show that the student has a good level of understanding of at least two of these.	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 one area indicated in the guidance below and a satisfactory understanding of at least one other area.	7–9
2	A limited attempt has been made to follow a line of reasoning and the response has a mostly logical structure. Either a good level of understanding has been demonstrated of one area or some understanding had been demonstrated of at least 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. There is insufficient evidence of a good understanding of any of the three areas.	1–3

Guidance – Indicative Content

Area 1: How RFID works

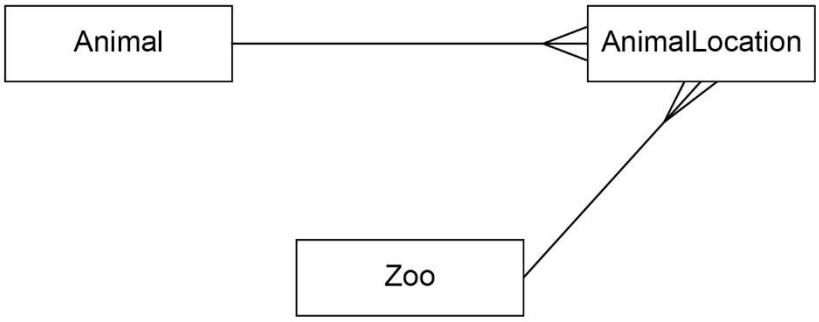
RFID tag contains (transmission) circuitry and antenna
Memory on tag stores (customer) data
RFID reader (at till) transmits / sends signal // emits electric / electro-magnetic field
Signal activates / energises / induces current in RFID tag
RFID tag transmits / sends data by radio (wave)
RFID reader converts radio (wave) / signal back into (binary) data
RFID tag (on a card) is a passive device
RFID transmits over very short range

Area 2: How barcode works

(reflected light method)
A light source / laser is directed at bar code // bar code is illuminated
(Moving) mirror / prism moves light beam across bar code // user moves reader across bar code // user moves the bar code across the reader
Light reflected back
Black / white bands reflect different amounts of light // black reflects less light // white reflects more light
Light sensor / photodiode / CCD (measures amount of reflected light)

		Light reflected converted into an electrical signal **A.** convert reflection to (binary) numbers / characters / ASCII
		
		(CMOS/CCD/camera method)
		Grid of (pixel) sensors // CMOS/CCD sensor
		Each sensor measures light intensity of a point
		Sensor outputs a voltage dependent upon light intensity
		Voltages turned into binary data // voltages passed through Analogue-to-Digital Converter (ADC) // voltages turned into a digitised version of the image / barcode
		Image processing software analyses image
		This identifies black / white bands in barcode (which are turned into numbers)
		
		Note: Students only need to describe one of the two methods for barcodes.
		
		Area 3: Ethical and legal issues
		
		(ethical)
		Customers may believe that data about what they buy/spend is personal // invasion of privacy
		Purchase of some items might be considered sensitive // some data might be considered to be sensitive (accept relevant examples)
		Will people fully understand what will be done with the data, even if they are told it is being collected
		Customers need to decide whether to allow the store to collect data about them (is it worth it for the return that they may get eg incentives / vouchers?) //do people feel forced to consent to benefit from offers
		Can company be sufficiently confident that any other companies they share the data with will process the data legally / fairly/for the purposes that they said they would?
		Risk of the supermarket carrying out actions that might reveal to other members of a shopper's household things that the supermarket has deduced that the householders don't know
		Should ethical consideration be given to the products promoted to people using the data collected about them or is it okay to promote a product to anyone?
		Are there some types of customers who should not be targeted with promotions at all // is it ethical to promote products to vulnerable customers?
		
		(legal)
		Naming a relevant law – GDPR, Data Protection Act
		Need to inform customers of what will be done with data // consent required to collect data **R.** customer has not consented
		Data must be kept securely
		Need to consider what purposes data should be used for
		Consideration of who should be able to access the data // there are rules about who the data can be shared with
		Possible negative impact if data stolen or leaked // information could be misused
		Limit on time-period that the data can be kept for
		Need to ensure that collected data is accurate
		Ensure data only transferred to countries it is legally allowed to go to // if transferred abroad, different laws may apply
		The supermarket should let the customers see/edit data about them
		Use of RFID might make data vulnerable to theft	

Question			Marks
07	1	**Mark is AO1 (understanding)** **C** The primary key in each relation consists of only one attribute; **R.** if more than one lozenge shaded	**1**

Question			Marks
07	2	**All marks AO2 (analyse)**  **1 mark**: one-to-many relationship between Animal and AnimalLocation **1 mark:** one-to-many relationship between Zoo and AnimalLocation If no marks awarded then award **1 mark** for many-to-many relationship between Animal and Zoo **Max 1** if any incorrect relationships drawn (ignore the inclusion of a many-to-many relationship between Animal and Zoo)	**2**

Question			Marks

07	3	**All marks AO3 (programming)**
		
		`AnimalID INT PRIMARY KEY,`
		//
		`AnimalID INT,`
		`PRIMARY KEY(AnimalID),`
		
		`IndividualName VARCHAR(50),`
		`Species VARCHAR(40),`
		`DateOfBirth DATE,`
		`Sex VARCHAR(6)`
		
		These **are AO3 marks so syntax must be correct** (including commas) to award them
		
		1 mark: `AnimalID`, with sensible data type and identified as primary key
		
		1 mark: two other fields with sensible data types and lengths (if given)
		
		1 mark: two other fields with sensible data types and lengths (if given)
		
		DPT. data type before fieldname (**Note: penalisation is of marks not mistakes**)
		DPT. incorrect punctuation - missing commas, unnecessary semi-colons, brackets etc but ignore bracket or semi-colon added at very end
		A. Any sensible types. Lengths do not need to be specified
		I. Case
		
		Valid alternative SQL types are:
		
		• Alternative types for `AnimalID`: tinyint, smallint, mediumint, integer, number, byte
		• Alternative types for `IndividualName`, `Species` and `Sex`: char, nchar, nvarchar, ntext, longvarchar, varchar2, nvarchar2, text, tinytext, mediumtext, longtext, string
		• Alternative types for `DateOfBirth`: datetime, datetime2, datetimeoffset, smalldatetime **R.** time
			3

Question			Marks

07	4	**5 marks for AO2 (analyse) and 2 marks for AO3 (programming)**
		
		Mark Scheme
		
		AO2 (analyse) – 5 marks:
		
		1 mark for correctly analysing the data model and identifying the tables that data needs to be extracted from (`Animal`, `AnimalLocation`) and the fields that need to be extracted (`IndividualName`, `DateArrived`), and including these and no other tables or fields in the query
		A. inclusion of unnecessary table `Zoo` as long as it is correctly linked to the `AnimalLocation` table by a linking condition
		
		1 mark for correctly identifying the condition to select the correct species of animal: `Species = "Red Panda"` or correctly identifying the condition to select the correct zoo: `ZooName = "Ashdale Park"`
		
		1 mark for correctly identifying the condition to link the two tables: `Animal.AnimalID = AnimalLocation.AnimalID` - see example 3 for how to apply this to nested solutions.
		R. do not award mark if additional linking conditions for tables that the query does not use are included
		
		1 mark for at least one pair of conditions that would identify some animals that were at the zoo during the required period, or **2 marks** for conditions that would identify all animals that were at the zoo during the period. Example conditions (not the only ones) that would do this are:
		
		Example full set of conditions 1 – award 2 marks for all conditions or 1 mark for any pair of conditions that would identify some animals at the zoo
		
		`DateArrived < "01/04/2020" AND DateLeft > "31/05/2020"`
		(animal arrived before and left after time period)
		
		`DateArrived <= "31/05/2020" AND DateLeft = "01/01/0001"`
		(animal arrived before end of time period and has not left)
		
		`DateArrived >= "01/04/2020" AND DateArrived <= "31/05/2020"`
		(animal arrived during the time period)
		
		`DateLeft >= "01/04/2020" AND DateLeft <= "31/05/2020"`
		(animal left during the time period)
		
		Example full set of conditions 2 – award 1 mark for the DateArrived condition and either of the DateLeft conditions or 2 marks for all three conditions
		
		`DateArrived <= "31/05/2020" AND (DateLeft >= "01/04/2020" OR DateLeft = "01/01/0001")`
		(animal arrived before end of time period and left after start of time period or has not left)
			7

Example incomplete conditions – award 1 mark for pair of conditions

```
DateArrived >= "01/04/2020" AND DateLeft <= "31/05/2020"
```
(animal arrived and left during the time period)

Note: Award a **maximum of 2 of the 4 available marks** for the correct conditions if they are not joined by the correct logical operators.

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.

A. mark(s) can be awarded for the correct logical conditions even if the required tables are not identified as being used by the query
A. > instead of >= and < instead of <=
A. ≥, ≤, => and =<

AO3 (programming) – 2 marks:

1 mark for fully correct SQL in two of the three clauses (SELECT, FROM, WHERE)

OR

2 marks for fully correct SQL in all three clauses (SELECT, FROM, WHERE)

Note:
- For the SELECT and FROM SQL clauses to count as correct SQL, they must have the correct field and table names in them.
- For the WHERE clause to count as correct it must include at least one correct condition, but does not have to include them all (ignore missing conditions or irrelevant conditions), however the whole WHERE clause must have correct syntax.

A. table names before fieldnames separated by a full stop
A. use of `Alias`/`AS` command eg `FROM AnimalLocation AS AL` then use of `AL` as the table name and note that command `AS` is not required eg `FROM AnimalLocation AL`
A. `INNER JOIN` written as one word ie `INNERJOIN`
A. insertion of spaces into fieldnames
I. unnecessary brackets so long as they would not stop the query working
A. use of any type of quotation marks, hashes or no delimiters around dates and times
A. > instead of >= and < instead of <=
R. ≥, ≤, => and =<
I. inclusion of an ORDER BY clause
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

Overall Max 6 if solution does not work fully

Example Solutions

Example 1 – All conditions in WHERE clause

```
SELECT IndividualName, DateArrived
FROM Animal, AnimalLocation
WHERE Species = "Red Panda"
  AND ZooName = "Ashdale Park"
  AND Animal.AnimalID = AnimalLocation.AnimalID
  AND
  ( DateArrived < "01/04/2020" AND DateLeft > "31/05/2020"
    OR DateArrived <= "31/05/2020" AND DateLeft = "01/01/0001"
    OR DateArrived >= "01/04/2020" AND DateArrived <=
       "31/05/2020"
    OR DateLeft >= "01/04/2020" AND DateLeft <= "31/05/2020" )
```

Example 2 – Use of INNER JOIN

```
SELECT IndividualName, DateArrived
FROM Animal INNER JOIN AnimalLocation ON
  Animal.AnimalID = AnimalLocation.AnimalID
WHERE Species = "Red Panda"
  AND ZooName = "Ashdale Park"
  AND
  ( DateArrived < "01/04/2020" AND DateLeft > "31/05/2020"
    OR DateArrived <= "31/05/2020" AND DateLeft = "01/01/0001"
    OR DateArrived >= "01/04/2020" AND DateArrived <=
       "31/05/2020"
    OR DateLeft >= "01/04/2020" AND DateLeft <= "31/05/2020" )
```

Example 3 – A Nested Solution

```
SELECT IndividualName, DateArrived
FROM (SELECT AnimalID, IndividualName
      FROM Animal
      WHERE Species = "Red Panda"
     ) AS RP INNER JOIN AnimalLocation
       ON RP.AnimalID = AnimalLocation.AnimalID
WHERE ZooName = "Ashdale Park"
  AND
  ( DateArrived < "01/04/2020" AND DateLeft > "31/05/2020"
    OR DateArrived <= "31/05/2020" AND DateLeft = "01/01/0001"
    OR DateArrived >= "01/04/2020" AND DateArrived <=
       "31/05/2020"
    OR DateLeft >= "01/04/2020" AND DateLeft <= "31/05/2020" )
```

Refer nested solutions to team leaders for marking

Question			Marks
07	5	**All marks AO2 (analyse)** **Advantage (Max 1):** It will be quicker to lookup an animal's current location; The current location of an animal can be identified without having to query/search the AnimalLocation relation // only the Animal/one relation needs to be searched to identify the location of an animal // the current location of an animal can be identified with a less complex query/search; **NE.** <u>easier</u> to lookup an animal's current location **R.** it will be possible to identify an animal's current location **Disadvantage (Max 1):** Additional storage space will be required; This will introduce data redundancy (as the information can already be found from the AnimalLocation relation); Data inconsistency could occur (as the current location in the Animal relation might not match the current location in the AnimalLocation relation); More updates will be required when an animal is moved between zoos; **A.** the database will no longer be normalised	**2**

<table>
<tr><th colspan="2">Question</th><th></th><th>Marks</th></tr>
<tr><td>08</td><td>1</td><td>
All marks AO1 (understanding)

Award 1 mark for each comparison made (row in the table below). The student only needs to state one side of the comparison to be awarded the mark. Stating both sides is not worth two marks.

<table>
<tr><th>Peer-to-Peer</th><th>Client-Server</th></tr>
<tr><td>Each computer has equal status // each computer can act as (both) a client and a server
R. “user” for “computer”</td><td>One or more computer(s) nominated as server(s), other computers are clients</td></tr>
<tr><td>Resources stored on / shared from any computer
A. examples of resources
NE. data can be sent between clients</td><td>Clients access resources from server(s) // resources are stored on the server(s)
A. examples of resources</td></tr>
<tr><td>No centralised management of security // security can be managed individually on each computer (by the user)</td><td>Centralised management of security // must login to access server(s)</td></tr>
<tr><td>The same resource can be made available or shared from multiple computers // no reliance on central server</td><td>Resources cannot be accessed if server(s) turned off // reliance on central server(s) // the server(s) must always be turned on</td></tr>
<tr><td>Hardware and software on computers is general purpose // not optimised for providing services</td><td>Hardware and software on server(s) can be optimised for providing services</td></tr>
</table>

Max 3
</td><td>3</td></tr>
</table>

<table>
<tr><th colspan="2">Question</th><th></th><th>Marks</th></tr>
<tr><td>08</td><td>2</td><td>
All marks AO1 (understanding)

Small number of users / devices;
NE. small network
Likely that the users will trust each other // unlikely that confidential data that requires security will be stored // no requirement for complex security; (A. examples eg access rights, types of user)
Individual users will have ability to choose which files/resources they share and with who;
Will avoid additional cost of buying server;
R. cheaper without further explanation
No additional expertise required to set up / manage <u>server(s)</u> // easier to setup as no <u>server</u> to configure;
R. easier to set up / maintain without further explanation

Max 3
</td><td>3</td></tr>
</table>

Question			Marks
08	3	**1 mark AO1 (knowledge) and 2 marks AO1 (understanding)** **Purpose (1 mark – AO1 knowledge):** Translates/converts/maps Fully Qualified Domain Names / FQDNs into IP addresses; **A.** domain names **R.** Uniform Resource Locators / URLs **How it works (2 marks – AO1 understanding):** • DNS / Domain Name Server(s) stores a database/table of FQDNs and corresponding IP addresses **A.** FQDN looked up in table **A.** domain names **DPT** Uniform Resource Locators / URLs • DNS is a distributed database of mappings • (Individual) mappings are only known by some DNS servers • DNS servers are organised into a hierarchy **A.** hierarchy given by example **R.** description of how domain names themselves are organised • If one DNS server cannot resolve a lookup the query will be passed to another (DNS server) • DNS servers support load distribution by returning one IP address from a list	**3**

Question			Marks
09	1	**Mark is AO1 (understanding)** Direct (addressing);	**1**

Question			Marks
09	2	**All marks AO2 (apply)** **1 mark:** Correct initial values loaded into registers R0, R1 and R3: 23, 5, 0 **1 mark:** R2 has initial value 1 and R3 is updated to 23 **1 mark:** R0 shifted left to give 46 and R1 shifted right to give 2 **1 mark:** R0 changes to 92 then 184, R1 changes to 1 then 0, R2 changes to 0 then 1 **1 mark:** R3 and memory location 122 set to 115 **Max 4** if any incorrect values written into table	**5**

Memory Locations			Registers			
120	121	122	R0	R1	R2	R3
23	5		23	5		0
					1	23
			46	2	0	
			92	1	1	115
			184	0		
		115				

Question			Marks
09	3	**Mark is AO2 (analyse)** (To) multiply (the two numbers in memory locations 120 and 121 together, storing the result in memory location 122); **A.** multiplication	**1**

Question			Marks
09	4	**All marks AO1 (understanding)** So it will execute more quickly; **TO.** if stated that it executes more quickly because translation is not required So it will use less memory (when translated); **NE**. uses less space, more compact A translator for a high-level language might not have been available; Programmer would have complete (**A.** more) control over the final machine code that is output by the translator / executed; **R.** direct access to hardware / registers **Max 2**	**2**

Question			Marks
09	5	**Mark is AO1 (knowledge)** There is a one-to-one mapping // each assembly language instruction translates into one machine code instruction;	**1**

Question			Marks
10	1	**All marks AO2 (apply)** Award **3 marks** if correct final answer is shown: 195 seconds **A.** 3 minutes 15 seconds, 3.25 minutes but **NE.** 3.25 without units given If final answer is not given / incorrect then award **up to 2 marks** for working for points from this list: • Conversion of sample size into bytes or bits: multiplication by 1000 and 1000 (and 8) // multiplication by 1000000 / 8000000 // value 17199000 / 137592000 used in calculation • Calculating number of seconds from size of sample: dividing a number by both 44100 and 16 (or 2) OR multiplying 44100 by 16 (or 2) **Note:** Award this mark even if sample size incorrectly calculated.	**3**

Question			Marks
10	2	**All marks AO1 (understanding)** More compact representation; **NE.** requires less space Easy to modify / edit (at note level) // easy to change values eg octave for entire score // easy to change instruments; Simple method to compose algorithmically; Musical score can be generated directly from a MIDI file; No data lost about musical notes // no data lost through sampling; **A.** "better quality" but only if there is some explanation of this related to the sampling process eg "no error introduced during sampling", "no background noise recorded" **A.** MIDI records the musician's inputs rather than the sound produced The MIDI file can be directly output to control an instrument / a device; **Max 3**	**3**

Question			Marks
11		**All marks AO1 (understanding)** **For a thin-client system…** **Network (Max 1):** Higher bandwidth network connection required; **A.** examples of how high bandwidth might be achieved eg use of fibre optic cables, gigabit switches **Client (Max 2):** • Slower (clock speed) processor needed • Reduced RAM needed • No / small HDD / SSD / secondary storage required in workstations **A.** "storage" for "secondary storage" **A.** other examples of reduced hardware requirements **Server (Max 2):** • Multiple processors needed / processor with many cores / high clock speed • A lot of RAM needed • Many HDD/SSD/ secondary storage drives needed **A.** "storage" for "secondary storage" **A.** other examples of increased hardware requirements **NE.** more powerful / less powerful, higher performance / lower performance, cheaper / more expensive Accept the opposite of points if a student has written from the point of view of a thick client system instead eg for "Slower (clock speed) processor needed in client" accept "a thick client system would need a faster processor in the client".	**3**

Question			Marks
12	1	**Mark is AO2 (analyse)** `fv`; **R.** if more than one lozenge shaded	**1**

Question			Marks
12	2	**Mark is AO2 (analyse)** `fw` and `fx`; **R.** if number of shaded lozenges is not 2	**1**

Question			Marks
12	3	**All marks AO2 (apply)** **One mark** per correct row in the **Result** column:	**4**

Function call	Result
`fu 50`	10.0 **A.** value given as integer
`fv temps`	[10.0, 20.0, 35.0, 30.0] **A.** alternative styles of bracket **A.** values given as integers **R.** no brackets **R.** each element in a separate list
`fw temps`	4
`fz temps`	23.75 **A.** 95/4 **A.** average of the list the student has given on row 2 of the table (list must be more than one item) **A.** 95 divided by the answer given on row 3 of the table **A.** sum of the list the student has given on row 2 of the table (list must be more than one item) divided by the number the student has given on row 3 of the table

Question			Marks
12	4	**Mark is AO2 (analyse)** Calculates the average temperature in <u>centigrade</u> (from a list of temperatures in Fahrenheit); **NE.** calculates average of a list of numbers	**1**

Question			Marks
12	5	**Mark is AO2 (analyse)** Only one conversion is done (from Fahrenheit to centigrade) // fewer conversions (from Fahrenheit to centigrade) are performed // the function `fv` is no longer required; **A.** fewer calculations / steps / functions / function calls are required **NE.** faster execution, more efficient	**1**

Question			Marks
13	1	**Mark is AO1 (knowledge)** **C** The stored program concept; **R.** if more than one lozenge shaded	**1**

Question			Marks
13	2	**All marks AO1 (understanding)** To store data / programs whilst the computer is turned off; **A.** long-term / permanent storage **NE.** secondary storage devices are non-volatile **NE**. store data this is not in use (As) the contents of RAM are lost when the computer is turned off; **R.** "main memory" for "RAM" **A.** main memory (RAM) To transfer data / programs between computers; **NE.** secondary storage devices are portable Allows the storage of data sets / files that could not fit in RAM // computer architecture supports a limited amount of main memory/RAM; **A.** primary store for main memory **NE.** to extend storage capacity, to store more, to store large files, higher capacity **Max 2**	**2**

<table>
<tr><th colspan="2">Question</th><th></th><th>Marks</th></tr>
<tr><td>13</td><td>3</td><td>
All marks AO1 (understanding)
<table>
<tr><th>Level</th><th>Description</th><th>Mark Range</th></tr>
<tr><td>2</td><td>A good understanding of the operation of an SSD has been demonstrated. The response is well structured, covers most of the points in the indicative content and does not contain any errors of understanding.</td><td>3-4</td></tr>
<tr><td>1</td><td>Some relevant points have been made, but the description omits important details or contains some errors so that only a limited understanding is demonstrated.</td><td>1-2</td></tr>
</table>
Indicative content:

• Data is stored electronically // there are no mechanical / moving parts
• Data is stored in floating gate transistors // data is stored in transistors that do not lose their charge/state <u>when power is no longer applied</u> // electrons are trapped between oxide layers
• Presence of trapped electrons / charge or absence indicates 0 / 1
A. 0 or 1 either way around
A. state represents 0 or 1
A. off = 0, on = 1 (or other way around)
A. “bit” for 0 or 1, but not “binary”
R. positive and negative charges
• NAND memory // flash memory // EEPROM memory is used
• Data is organised into pages / blocks
• A whole block (A. page) of data must be written // it is not possible to write individual values
• A block (A. page) must be erased before it can be overwritten
• Controller manages the organisation of the data // controller manages the reading and writing of data
</td><td>4</td></tr>
</table>