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AQA

AS
COMPUTER SCIENCE
7516/2

Paper 2

Mark scheme

June 2020

Version: 1.1 Final

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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

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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.

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To Examiners:

- **When to award '0' (zero) or '–' (hyphen) 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 an 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. - means "Don't penalise twice". 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.

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

eg

In the following questions the marks available are as follows:

Question 06.5 (max 8 marks)
AO1 (knowledge) – 4 marks
AO1 (understanding) – 4 marks

Question 08.2 (max 4 marks)
AO1 (understanding) – 2 marks
AO2 (analyse) – 2 marks

Where a candidate's answer only reflects one element of the AO, the maximum mark they can receive will be restricted accordingly.

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Qu		Marks	
01	1	**Mark is for AO2 (apply)** 3159;	1
01	2	**Mark is for AO2 (apply)** 2^{16} / 65 536;	1
01	3	**Mark is for AO2 (analyse)** C;	1
01	4	**2 marks are for AO1 (knowledge)** Consists of a digit calculated (using an algorithm); from the other digits/letters (in the input sequence); **A.** Answer by example.	2

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02	1	**2 marks are for AO2 (apply)**
		
		Mark as follows:
		
		1 mark for any relevant working out such as multiplying one number on a bit-wise basis by the other **or** summing the results of (incorrect) bitwise multiplications:
		`10110100`
		`  101101`
		
		1 mark for final answer:
		`11100001`
		
		Alternative Method
		`10100000`
		`  101000`
		`   10100`
		`     101`
		
		MAX 2
		MAX 1 if no working is shown
			2

02	2	**2 marks are for AO2 (apply)** `110;01011;`	2

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03	1	**3 marks are for AO1 (understanding)** (Analogue signal) sampled at fixed/regular time intervals; **R.** Amplitude/Voltage of signal/wave (at each sample point) measured; Measurement coded into a fixed number of bits // coded in binary;	3
03	2	**2 marks for AO2 (apply)** 48 000 (Hz) // 34.56 * 1000 * 1000 * 8 / 16 / 360;; **A.** 48 kHz;; **NE.** 48 If final answer is incorrect then award 1 mark for working for one of: • calculating recording size in bits: 34.56 * 1000 * 1000 * 8 • showing recording size in bits: 276 480 000 • dividing **(A.** incorrect) recording size in bits by 16 and 360 **Note**: Award 2 marks if correct answer given regardless of working. **Max 1** if final answer is incorrect.	2
03	3	**2 marks for AO1 (knowledge)** You must sample at a rate that is at least double; the highest frequency (component) in the original sound;	2

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04		**2 marks are for AO2 (analyse)** The student has used the number of colours (4) instead of the colour depth/number of bits per pixel (2); The correct minimum file size is 40 bytes;	2

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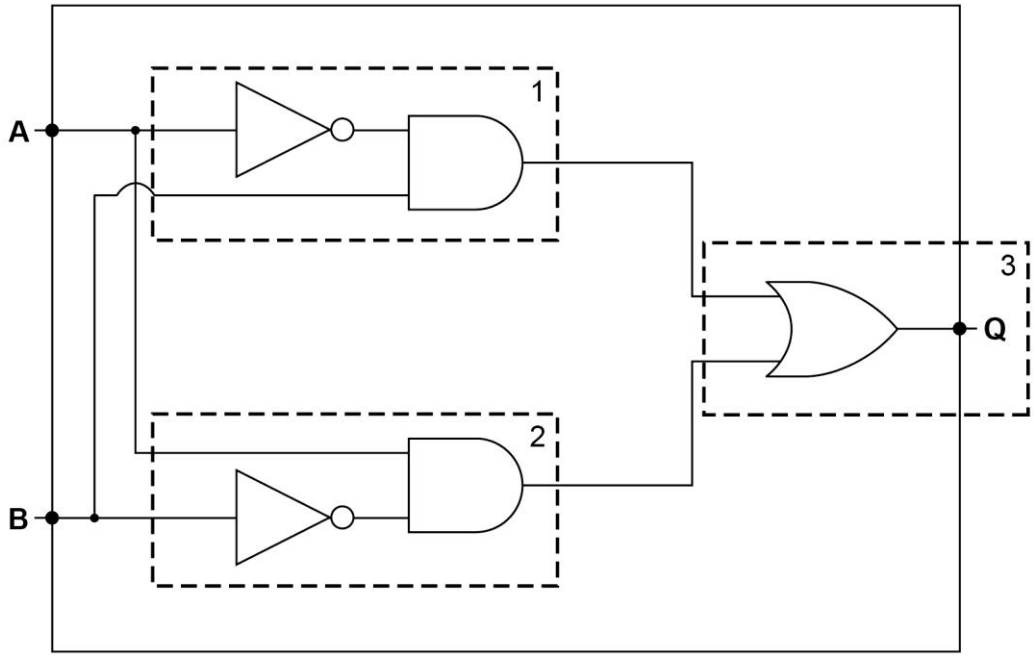
05	1	**Mark is for AO1 (knowledge)** **A** | **B** | **A NAND B** 0 | 0 | 1 0 | 1 | 1 1 | 0 | 1 1 | 1 | 0	1
05	2	**3 marks are for AO2 (apply)** **1 mark** for getting Part 1 **or** Part 2 correct on any of the three diagrams. **1 mark** for getting **corresponding** Part 1 **or** Part 2 correct on the same diagram. **1 mark** for getting **corresponding** Part 3 correct on the same diagram. **MAX 2** if not fully correct Mark response against diagram that will give the highest mark. Mark point 3 can only be awarded if at least one other mark point has been awarded. di Alternative Diagram 1  	3

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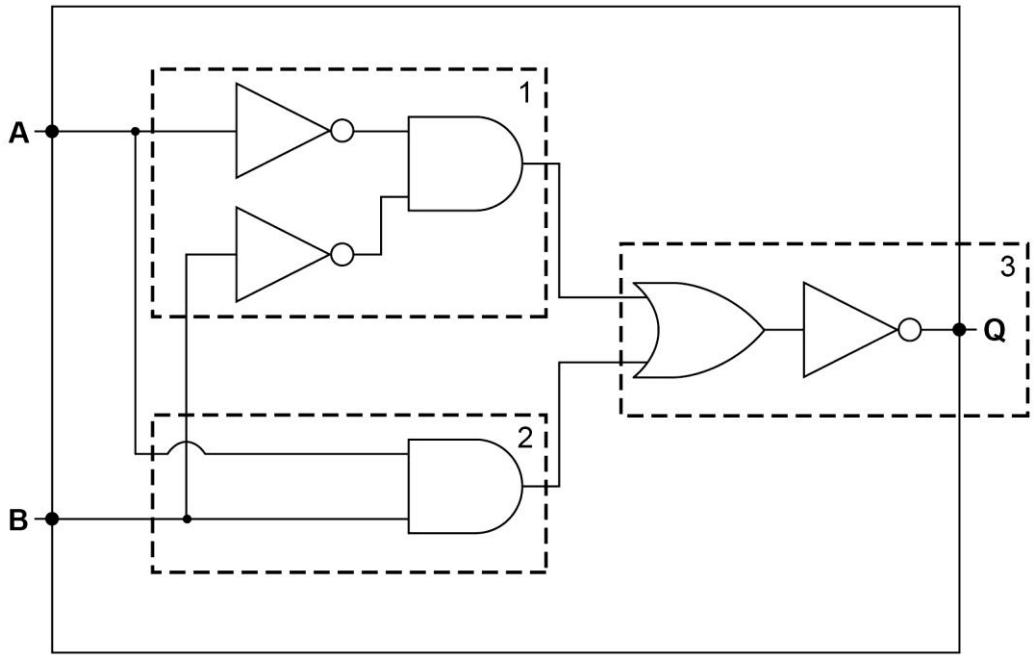
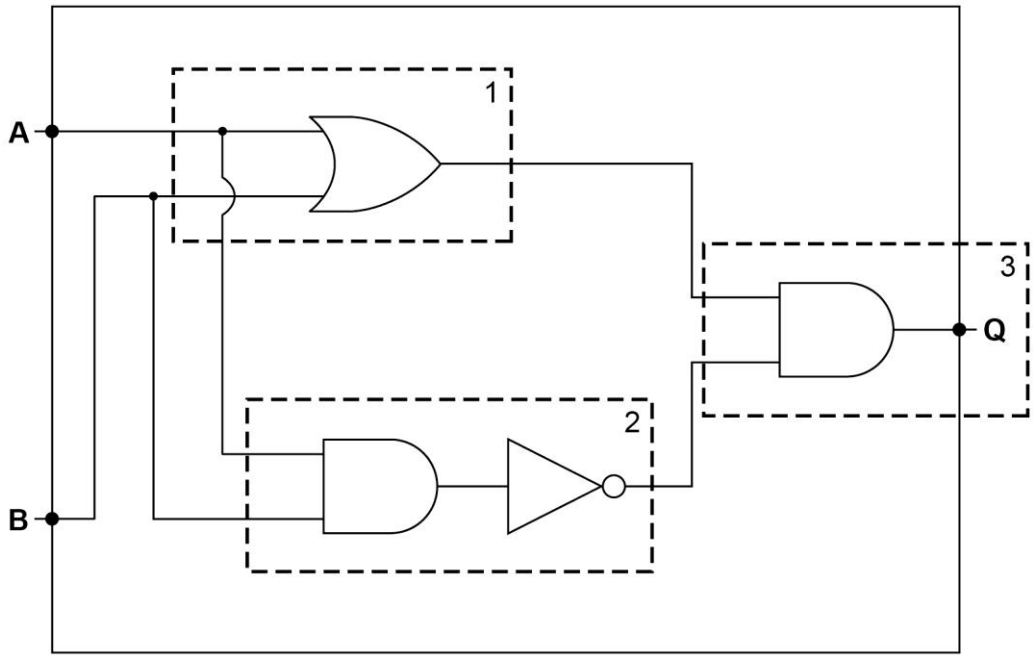
Alternative Diagram 2



Alternative Diagram 3



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05	3	**4 marks are for AO2 (apply)** **Marking guidance for examiners** • Award marks for working out until an incorrect step has been made. If a student misses out some steps but does not make an error then continue marking. • 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. 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) **Mark as follows** **1 mark** for final answer $A \cdot \overline{C}$ **Max 3 marks for working:** • **1 mark** for <u>each</u> application of an identity or theorem other than cancelling NOTs that produces a simpler expression. • **1 mark** for a <u>single</u> successful application of the distributive law that produces a simpler expression. **Note:** a simpler expression is one that is logically equivalent to the original expression but uses fewer logical operators. **Max 3** if answer is correct but any incorrect working or significant steps of working is missing. **Example working (1)** $\overline{\overline{A + 0} + C \cdot A}$ [B. NOT B = 0] $(A + 0) \cdot \overline{C \cdot A}$ [Application of De Morgan's Law] $(A + 0) \cdot (\overline{C} + \overline{A})$ [Application of De Morgan's Law] $A \cdot (\overline{C} + \overline{A})$ [A + 0 = A] $A \cdot \overline{C} + A \cdot \overline{A}$ [Expand brackets] $A \cdot \overline{C} + 0$ [$A \cdot \overline{A} = 0$] $A \cdot \overline{C}$ [$A + 0 = A$] **Example working (2)** $(A + B \cdot \overline{B}) \cdot \overline{C \cdot A}$ [Application of De Morgan's Law] $(A + 0) \cdot \overline{C \cdot A}$ [B. NOT B = 0] $A \cdot \overline{C \cdot A}$ [A + 0 = A] $A \cdot (\overline{C} + \overline{A})$ [Application of De Morgan's Law] $A \cdot \overline{C} + A \cdot \overline{A}$ [Expand brackets] $A \cdot \overline{C} + 0$ [$A \cdot \overline{A} = 0$] $A \cdot \overline{C}$ [$A + 0 = A$]	4

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06	1	**Mark is for AO1 (knowledge)** A memory/storage location inside/on a processor; **A.** CPU instead of processor **NE.** memory/storage location	1
06	2	**2 marks are for AO1 (knowledge)** Instructions are stored in (main) memory; Instructions are fetched, (decoded) and executed (serially) by the processor; Programs can be moved in and out of main memory; **MAX 2**	2
06	3	**2 marks are for AO1 (understanding)** When data/instructions are needed/fetched they have to be transferred from memory to the processor (using the data bus); (after execution) result/data may need to be transferred back to memory (using the data bus); **A.** responses referring to I/O controllers instead of memory	2
06	4	**2 marks are for AO1 (understanding)** **In the Harvard architecture:** Instructions and data have separate buses; Instructions and data are stored in separate memories // Instructions and data have separate memory/address spaces; **NE.** Places, locations, registers, areas of memory Instruction word size can be different to data word size // Instruction bus width can be different to data bus width; Instructions and data can be fetched simultaneously; **A.** points made in reverse that state how the von Neumann architecture works **MAX 2**	2

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<table>
<tr>
<td>06</td>
<td>5</td>
<td>
4 marks for AO1 (knowledge) and 4 marks for AO1 (understanding)
<table>
<tr><th>Description</th><th>Explanation</th></tr>
<tr><td>Contents of the Program Counter / PC transferred to the Memory Address Register / MAR</td><td>so that the PC can be updated // to enable the memory address to be transferred along the address bus/to the memory</td></tr>
<tr><td>Contents of MAR placed onto address bus</td><td>so the correct location in the main memory will be accessed</td></tr>
<tr><td>Contents of addressed memory location/value received on data bus loaded into the Memory Buffer Register / MBR</td><td>not all fetches will be for instructions so cannot be loaded directly into Current Instruction Register / CIR // the value will only be present transiently on the bus so must be stored in a register // the MBR is used to cope with the speed difference between the processor and the main memory</td></tr>
<tr><td>(Contents of) PC is incremented</td><td>so that the next instruction in the sequence can be fetched</td></tr>
<tr><td>The contents of the MBR is copied to the CIR</td><td>so that if data is fetched/written during the execute phase it does not overwrite the instruction // because the control unit uses the instruction from the CIR</td></tr>
</table>
A. Memory Data Register/MDR for Memory Buffer Register/MBR

Max 4 for descriptions
Max 4 for explanations
Max 8
</td>
<td>8</td>
</tr>
</table>

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<table>
<tr>
<td>07</td>
<td>1</td>
<td>
4 marks for AO3 (programming)

Example 1:
<pre>
            LDR R0, 100
            LDR R1, 101
            ADD R2, R0, R1
            CMP R2, #26
            BLT store
            SUB R2, R2, #26
store: STR R2, 102
</pre>
Example 2:
<pre>
            LDR R0, 100
            LDR R1, 101
            ADD R2, R0, R1
            CMP R2, #25
            BGT adjust
            STR R2, 102
            HALT
adjust: SUB R2, R2, #26
            STR R2, 102
</pre>
Example 3:
<pre>
            LDR R0, 100
            LDR R1, 101
            ADD R2, R0, R1
            CMP R2, #25
            BGT adjust
            B end
adjust: SUB R2, R2, #26
end: STR R2, 102
</pre>
A. Use of alternative registers
A. Any label name in place of store / adjust

DPT. Use of invalid register name eg Rd
DPT. Use of incorrect addressing mode
DPT. Inclusion of invalid symbols in commands

Programming Marks:
1 Mark for <code>LDR R0, 100</code>, <code>LDR R1, 101</code> and <code>STR R2, 102</code>
1 Mark for <code>ADD R2, R0, R1</code>
1 Mark for <code>SUB R2, R2, #26</code>
1 Mark for either:

• <code>CMP R2, #26</code>, <code>BLT store</code> and <code>store:</code> aligned to a <code>STR</code> instruction or
• <code>CMP R2, #25</code>, <code>BGT adjust</code> and <code>adjust:</code> aligned to a <code>SUB</code> instruction

Max 3 if any errors.
</td>
<td>4</td>
</tr>
<tr>
<td>07</td>
<td>2</td>
<td>
Mark is for AO1 (understanding)

The operand is the datum;
</td>
<td>1</td>
</tr>
</table>

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07	3	**Mark is for AO1 (understanding)** Frequency/statistical/syntactical analysis cannot provide clues to the plaintext // nothing can be learnt about the plaintext from the ciphertext;	1

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08	1	**9 marks are for AO2 (analyse)** **Level of response question**	9

Level	Description	Mark Range
3	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. The response covers a wide range of issues that are consistently explained and/or supported by examples. Answers may cover moral/ethical, legal and cultural arguments or examine a smaller range of arguments in depth.	7–9
2	A line of reasoning has been followed to produce a mostly coherent, relevant, substantiated and logically structured response that covers a range of issues that are sometimes explained and/or supported by examples. Answers will cover a range of arguments in some depth.	4–6
1	There is little evidence that a line of reasoning has been followed. The response covers a small number of issues that are generally not explained nor supported by examples. Answers lack range and depth.	1–3

Examples could include:

Note: Some points may fit under more than one heading. These have been indicated with a #.

Moral/Ethical

- It is unethical to collect data about people without them knowing what the data is to be used for. #
- It is unethical to have residents wear a device if they don't have a full understanding of its capabilities.
- If the device is in testing, it may not be as reliable as the PERS devices.
- The observers may watch the streams for reasons other than monitoring. #
- It may not be ethical to have your actions monitored in more detail than just your essential life signs.
- Could be an invasion of privacy. #
- Who controls the data? Should a resident be able to press a button to stop the recording?
- Need to consider exactly what data should be recorded/stored. #

Legal

- Will the data be stored securely? #
- If the data is being life blogged, who will be able to see it?
- Will the data be stored in compliance with the data protection regulations?
- Who will be responsible if the devices go wrong and someone dies? #
- Will the data be shared with doctors?
- What happens if the observers see something (eg an illegal act) being carried out on the life blogger cameras? #
- How long will data be stored?

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<td>
• Can monitor staff/visitors via camera in case of abuse allegation. #
• Do visitors need to be told about cameras? #
• What happens to data when the resident dies? How long can the data be kept for?
• Can next of kin get access to data?
• Who owns the data – the company/home/residents? #
• In what country will the data be stored?

Cultural
• Some people from some cultures may not like being videoed (particularly without their knowledge).
• Residents may not want staff of the opposite gender viewing images of them in certain situations. #

Examples of points covered in depth
<table>
<tr><th>Issue</th><th>Explanation/Depth</th></tr>
<tr><td>It is unethical to collect data about people without them knowing what the data is to be used for</td><td>As it could be used for something that they do not want/agree with or make them vulnerable in some way</td></tr>
<tr><td>It is unethical to have residents wear devices if they don’t have a full understanding of its capabilities</td><td>People cannot agree to wear something that records so much data if they do not know what it does</td></tr>
<tr><td>If the device is in testing, it may not be as reliable as the PERS device</td><td>System might fail or send incorrect data if there are problems</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>2</td>
<td>
2 marks are for AO1 (understanding) and 2 marks are for AO2 (analyse)

Mark as follows:
• SSDs have lower power drain; which is important as the life blogger will run on battery;
• SSDs are less likely to be damaged if dropped; which is important as the devices will be worn and carried around;
• SSDs have faster access time; which could allow more data to be stored per second (which may allow finer detail);
• SSDs are silent; which means they will not disturb the users;
• SSDs are lighter/less obtrusive/smaller; which is important for a device worn around the neck;
• SSDs produce less heat; which makes them more comfortable to wear;

Max 2 for advantages
Max 2 for expansions

Max 4 marks
</td>
<td>4</td>
</tr>
</table>

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09	1	**Mark is for AO1 (knowledge)** Takes up less storage space; Faster transmission times; To fit within certain system restrictions (eg e-mail attachment restrictions); **Max 1**	1
09	2	**Mark is for AO1 (understanding)** The file can be reproduced exactly as it was originally; **A.** The quality of an image/sound/video would not be reduced. The original data can be fully recovered if lossless compression has been used // lossless data compression can be reversed; NE. no data is lost NE. no loss of quality The original data cannot be recovered if lossy compression has been used // lossy compression cannot be reversed // the data is degraded by lossy compression; A. redundant / less important data removed NE. data is lost NE. quality is reduced Max 1 **Max 1**	1
09	3	**3 marks are for AO1 (understanding)** (Variable) length strings of symbols/substrings of original data are represented by single tokens; A table/dictionary is formed using the tokens as the keys/index; The strings of symbols are used as the entries; **Alternative answer for LZ77** A sliding window of previous data is maintained; A length-distance pair is formed where each of the next *length* characters; is equal to the characters exactly *distance* behind it; in the uncompressed stream.	3

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10	1	**3 marks are for AO1 (understanding)** A node broadcasts data (to the entire network); All/Any nodes on the network receive/read the data; A node examines the received data to check if it is the intended recipient; Only one node can (successfully) transmit data at a time // Nodes use a shared transmission medium; **Max 3** **If students write a detailed description covering CSMA/CD (not required for the specification) then award marks as follows:** Computer monitors/listens to (data signal on cable/bus); If (data) signal present // if cable/bus busy continue to wait; When no (data) signal present // when cable/bus idle start to transmit; Whilst transmitting, computer monitors cable/bus to check for collision // to check if signal is identical to what it is sending; Collision occurs if two computers (start) sending at same time // if two packets/frames in transit at same time; If collision detected, jamming signal/signal warning of collision sent; To ensure other (transmitting) computers aware of problem // to stop other computers sending data; Computer that detected collision also stops sending data; Then waits a random period before attempting to retransmit/repeating transmission/this process again; Period is random to reduce likelihood of collision recurring (between computers that caused collision); If a collision occurs again then waits a longer random time before attempting to transmit again; Use of exponential back-off algorithm to determine wait time; **Max 3**	3
10	2	**Mark is for AO1 (understanding)** Bit rate can be higher than baud rate if more than one bit is encoded in each signal change;	1
10	3	**2 marks are for AO1 (understanding)** If the number of 1s received/in the byte is even, the data is (assumed to have been) received correctly // has not been corrupted; **A**. the data is correct If the number of 1s received/in the byte is odd, the data has been corrupted / is incorrect; **A.** odd/even part of second point by implication eg if student has written “is even” for the first point and then “otherwise” for the second.	2

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10	4	**4 marks are for AO1 (understanding)** Serial transmission is cheaper; due to needing fewer wires / less complex hardware; Serial transmission does not suffer from crosstalk; as there is only one transmission line; **A.** only one bit is transmitted at a time Serial transmission does not suffer from data skewing; as only one bit is transmitted at a time; Serial transmission can be used over longer distances; due to needing fewer wires / less complex hardware // as there is only one transmission line // as only one bit is transmitted at a time; **Award up to 2 marks for each stated advantage and explanation of how it is achieved.** **MAX 4**	4