

**GCSE (9-1)**

**Examiners' report**

# **COMPUTER SCIENCE**

**J277**

For first teaching in 2020

**J277/01 Summer 2023 series**

# Contents

Introduction.....	3
Paper 1 series overview .....	4
Question 1 (a) .....	5
Question 1 (b) .....	5
Question 1 (c) .....	6
Question 1 (d) .....	6
Question 1 (e) .....	7
Question 1 (f) .....	7
Question 2 (a) (i).....	8
Question 2 (a) (ii) .....	8
Question 2 (b) (i) .....	9
Question 2 (b) (ii) .....	9
Question 2 (b) (iii) .....	10
Question 3 (a) .....	11
Question 3 (b) (i) .....	12
Question 3 (b) (ii) .....	13
Question 3 (b) (iii) .....	14
Question 3 (b) (iv) .....	14
Question 3 (c) (i) .....	15
Question 3 (c) (ii) .....	15
Question 4 (a) .....	16
Question 4 (b) .....	16
Question 5 (a) (i) .....	17
Question 5 (a) (ii) .....	17
Question 5 (a) (iii) .....	18
Question 5 (b) .....	18
Question 5 (c) (i) .....	19
Question 5 (c) (ii) .....	20
Question 5 (d) (i) .....	21
Question 5 (d) (ii) .....	22
Question 6* .....	23
Question 7 .....	24

## Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

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# Paper 1 series overview

Unit 1 focuses on theoretical concepts of Computer Systems including:

- systems architecture
- memory and storage
- computer networks, connections and protocol
- network security
- systems software
- ethical, legal, cultural and environmental concerns.

This is the second year that the new J277 specification has been assessed.

A large number of candidates took this examination and there was a range of responses. Some candidates demonstrated secure understanding of the concepts of computer science and expressed this concisely in their responses. Candidates often found recall questions more straight forward than the applied questions, where candidates had to consider the context and respond by using their knowledge in that context.

To do well in this examination candidates needed to recall knowledge about computers, hardware, network and storage, as well as consider how these relate to given scenarios. The quality of extended response question required candidates to consider the positive and negative sides of AI being used in CCTV to track individuals in a shopping centre and evaluate the use of this technology.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
<ul style="list-style-type: none"> <li>• provided expansions on their answers to explain why their answer met the criteria</li> <li>• checked their mathematical answers to binary questions, for example by checking that their binary addition gave the correct response</li> <li>• considered both the positive and negative sides of the use of AI in CCTV, giving a balanced response that covered perspectives from different groups of people the technology would impact.</li> </ul>	<ul style="list-style-type: none"> <li>• gave single word responses, for example 'faster' or 'cheaper' without identifying what was faster, what it was faster at, what was cheaper</li> <li>• answered the quality of extended response question from one side, for example entirely negatively, or did not consider the use of AI and focused purely on CCTV in general</li> <li>• gave choices but did not justify them in context, for example why lossless compression was most appropriate in that context, instead describing how lossless compression is performed.</li> </ul>

### Question 1 (a)

1 Computers represent data in binary form.

(a) Tick (✓) **one** box to identify the statement about binary that is true.

- Binary digits can only be the values 0, 1 and 2
- The left-most bit of a binary integer has the smallest value
- Binary is used because computers are made of switches that can only be on or off
- The smallest whole number that can be stored in 8 bits is the number 1

[1]

This question required candidates to identify the true statement. Many responses identified that the third statement was true. Statement 1 was incorrect because binary digits cannot include the value 2. Statement 2 was incorrect because the left-most bit is the largest value. Statement 4 was most commonly given as an incorrect choice, the smallest whole number that can be stored in 8 bits is the number 0, not the number 1.

### Question 1 (b)

(b) Complete the table by writing the missing denary, 8-bit binary or hexadecimal values.

Denary	8-bit binary	Hexadecimal
	00000111	7
49		31
	01100110	66
244	11110100	

[4]

This question required candidates to translate denary, binary and hexadecimal numbers into each of the other forms.

Many responses accurately converted the 8-bit binary to denary. The binary conversion was often correctly converted. However, some candidates did not include the required 0s at the start to make the answer an 8-bit binary number as required.

The conversion of the third binary number to denary was more challenging. A range of responses were often seen including 114, and conversion to hexadecimal.

The final conversion to hexadecimal was often given inaccurately, for example E4 or F2 being given instead.

### Question 1 (c)

(c) Tick (✓) **one** box to identify the largest file size.

2 000 000 bytes

2300 KB

200 MB

0.1 GB

[1]

There were a range of responses given by candidates. Many candidates identified 200MB as the correct response. 2300 KB was commonly given as an incorrect response.

### Question 1 (d)

(d) Tick (✓) **two** boxes to identify the two file sizes that are equal to each other.

4 500 000 bytes

450 KB

4.5 MB

0.45 GB

[1]

This question required candidates to work out which of the two file sizes were the same. Candidates had to tick two boxes. Many candidates identified the two correct answers. Correct responses often had working at the side of the answer.

There was a range of incorrect answers given where different combinations were selected.

### Question 1 (e)

(e) Complete the binary addition by adding these two 8-bit binary numbers.

Show all your working.

$$\begin{array}{r}
 0\ 1\ 1\ 1\ 0\ 0\ 0\ 1 \\
 +\ 1\ 0\ 0\ 1\ 1\ 1\ 1\ 0 \\
 \hline
 \hline
 \end{array}$$

[2]

Candidates were required to complete the addition in binary.

Some responses converted each binary number to denary, added these, and then converted them back to binary. This allowed them to access the final answer mark, but **not** the mark for showing their working. The mark for showing working out required candidates to show how the data was carried.

Some responses correctly identified the inclusion of an overflow. The overflow was not required for the mark this time but is good practice.

Incorrect answers must be clearly crossed out. The new answer must be written clearly and separately. Some candidates overwrite a 1 with a 0, or vice-versa, making it impossible to identify the intended answer.

### Question 1 (f)

(f) Identify the binary shift that has been applied to the 8-bit binary number 10110000 to get the result 10000000.

.....  
 ..... [2]

This question was often answered well. For full marks, candidates needed to accurately identify that it was a left 3-place shift. Some responses only gave the direction, i.e. left, and did not note the number of marks (2) that can identify the level of response required.

### Question 2 (a) (i)

- 2 A student is performing a range of actions on the internet using their computer.
- (a) A range of protocols are used for the transmission of data by the student's computer, and the web servers they are accessing.
- (i) Complete the table by identifying the most appropriate protocol for each of the tasks the student is performing.

Task	Protocol
Requesting to view a news webpage from a web server	
Entering a username and password to access their bank account	
Downloading a text document from a web server	
Checking for new emails in their inbox	

[4]

Many candidates demonstrated an understanding of common protocols. The most common correct responses were giving HTTP and HTTPS as protocols for the first two tasks.

Responses to the last two tasks were more commonly inaccurate. A range of protocols were given including SMTP for email.

### Question 2 (a) (ii)

- (ii) Some protocols have layers.

Give **two** reasons why protocols have layers.

- 1 .....
- .....
- 2 .....
- .....

[2]

Candidates were often able to show an understanding of layers but could not say why layers are used. The most common responses referred to the need for independence between layers, and that it provides the ability to change one layer without having to change/impact on any other layers.



### Question 2 (b) (i)

(b) The student's computer is part of their home Local Area Network (LAN). The LAN currently only has wired connections.

(i) One characteristic of a LAN is that they are set up over a small geographical area.

Give **one** other characteristic of a LAN.

.....  
..... [1]

Candidates often gave a benefit of a LAN instead of a characteristic. This was often in comparison to a WAN. Examples included that it is cheaper, or that you can share devices and transfer data. Some responses identified the use of owner-owned hardware, or that third-part hardware was not required.

### Question 2 (b) (ii)

(ii) Describe the benefits of the student changing their home LAN to include wireless connections.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
..... [4]

Candidates were often able to explain the benefits of including wireless connections. Common answers included the ability to be mobile and move around the home and allowing a wider range of devices to connect to the network.

Some candidates extended their answers by explaining or justifying the wider range of devices. For example by stating mobile phones do not have wired ports.

Some responses answered the question as though it was excluding wired connections all together and that the wires were being replaced; this did not answer the question asked which was the benefits of it including wireless – as well as wired.

### Question 2 (b) (iii)

(iii) State **two** drawbacks of changing their home LAN to include wireless connections.

- 1 .....
- .....
- 2 .....
- .....

[2]

Candidates often demonstrated a good understanding of the drawbacks of wireless connections. Common responses included lower bandwidth and possible interference from other devices and/or objects.

In this response some candidates stated that wireless connections could be slower – but did not give enough information to explain what was slower.

#### Exemplar 1

- 1 Not as fast as wired ~~wired~~ connections.
- 2 ~~It~~ It is ~~set~~ over a small geographical area meaning that

[2]

The response in Exemplar 1 has identified that wireless is “not as fast as wired connections”. However, the candidate has not specified what it is not as fast at doing. To gain the mark, the candidate could refer to the transmission speed, the speed that errors are corrected, the speed that it loads, etc.

### Question 3 (a)

3 Binary numbers can represent different forms of data.

(a) One form of data is characters.

Complete the description of how computers represent characters in binary using the given list of terms. Not all terms will be used.

2	4	8	9	16	32	256	
71	72	74	76	78	80	81	
all	different	identical	one	repeated	similar	some	unique

A character set stores ..... of the characters that the computer can represent. Each character is given a ..... binary code. Lower-case and upper-case letters in a character set are given ..... binary codes. One example of a character set is ASCII. This character set uses ..... bits for each character. If the code value for the character 'F' is 70 then the code value for the character 'L' is .....

[5]

This question required candidates to use the given terms to complete the description of character sets.

Many responses accurately identified that a character set stores all the characters. Some candidates identified each character as being given an identical code or a repeated code. This is incorrect.

The code for L was often given accurately.

The number of bits for each character had a range of responses given, commonly 256 bits for each character. The specification for J277 states that in the exam ASCII will be described as having 8-bits to avoid confusion between ASCII and extended-ASCII, which are not differentiated in the specification.

### Question 3 (b) (i)

(b) Binary numbers can also represent images.

The table shows the colours that are used in an image and the binary value for each colour.

Colour	Binary value
Red	0000
Green	0010
Blue	1000
Purple	0110

The metadata states that the image is 3 pixels wide by 4 pixels high.

The data in the file starts in the top left of the image and goes from left-to-right, top-to-bottom.

(i) State what is meant by **metadata** in an image file.

.....

..... [1]

This question required a definition of the term metadata and many responses correctly defined it as the data about the image, or the data about the file.

Some candidates used information, for example the information about the file, which was not precise enough - but they often carried on with an example that supported their statement and demonstrated their understanding.

#### Misconception



A common misconception was that metadata identifies the colour of each pixel in the image.

### Question 3 (b) (ii)

(ii) The binary data stored for the image is given:

000000000110100000101000011001100110000000101000

A grid is given for the image. Each square is one pixel.

Write the name of the colour in each square that the pixel will show for this image.


[2]

This question required candidates to consider the binary number and the binary value for each colour, divide the binary number into groups of 4 bits and match them to the appropriate colour. This was completed accurately by many candidates who were able to match the codes and colours.

The instructions stated that the image starts in the top left, but some candidates started in the bottom right instead.

Some responses did not use the colours provided in the question and created their own colour scheme for the image, commonly just using black and white.

### Question 3 (b) (iii)

- (iii) A colour depth of 4 is used. This means 4 bits are used to store the colour for each pixel.

State the maximum number of different colours that can be represented in 4-bits.

..... [1]

Candidates were required to calculate the number of different colours that can be represented in 4-bits. This was done by working out how many binary numbers can be created using 4-bits. A common error was giving four colours, or in some cases only one or two colours.

### Question 3 (b) (iv)

- (iv) The colour depth is increased to 2 bytes.

State **two** effects that this change can have on the image.

1 .....

.....

2 .....

.....

[2]

This question was often answered well. Candidates commonly identified that the file size will increase with an increase in colour depth. Some responses also identified that this increase would allow the image to use more colours.

### Misconception



A common misconception is that colour depth increases the resolution of the image. This would need to be an increase in the resolution (the number of pixels) as opposed to the number of bits per pixel.

### Question 3 (c) (i)

(c) A student has a text document and an image file that need to be compressed separately.

The student needs to reduce the file size of both of these files as much as possible.

(i) Identify the most suitable type of compression for the **text** document. Justify your choice.

Type of compression .....

Justification .....

.....

.....

.....

[3]

Lossless compression was often correctly identified as the type of compression used for text.

Some candidates justified this in context either by explaining why lossless is required for text files, or by explaining why lossy was not appropriate.

### Question 3 (c) (ii)

(ii) Identify the most suitable type of compression for the **image** file. Justify your choice.

Type of compression .....

Justification .....

.....

.....

.....

[3]

Many candidates correctly identified that lossy is the most appropriate. Lossless could be used but is not as appropriate in this scenario. Candidates who stated lossy compression were often able to describe how the loss of data would not be noticed, and some responses also identified that the file size could be decreased more.

Candidates that gave lossless were able to gain marks for the justification. However, often candidates could not justify it appropriately, for example by describing how it would be compressed instead of why this was appropriate.

**Question 4 (a)**


4 (a) Tick (✓) **one or more** boxes on each row to identify all of the methods that can help to prevent each threat.

Threat	Anti-malware	Penetration testing	Encryption	Firewall
Spyware				
Brute-force attack				
Data interception				
SQL injection				

[4]

This question required candidates to consider which methods would be appropriate to prevent each threat. For each threat there was one method that was most appropriate. Some threats had other suitable responses. Some candidates did not take note of these instructions and only ticked one box for each row, commonly missing another appropriate method.

**Misconception**



A common misconception was that a firewall and penetration testing could stop data interception. Both of these methods would prevent access to a computer system, but if data is being transferred between computers (for example on the internet) then there will be no firewall to stop the interception.

**Question 4 (b)**

(b) Name **and** describe **one** threat to a computer system that is not given in **question 4(a)**.

Threat .....

Description .....

.....

.....

.....

[3]

Many responses accurately identified another threat. The most common responses were denial of service or virus. Some responses gave a keylogger which was a repeat of spyware because it is a specific type of spyware.

DDOS was often described appropriately, although some responses described it as being an attack on an individual's device instead of a server. Virus was also often described appropriately with the possible effects of deleting or corrupting files.

Some responses described how to prevent the threat instead of describing the threat itself.



### Question 5 (a) (i)

5 An artist has a computer that they use to create images.

Their computer has both hardware and software.

(a) The hardware includes primary and secondary storage.

(i) Explain why a computer needs both primary **and** secondary storage.

.....

.....

.....

..... [2]

Some candidates found this question challenging and often gave examples of each type of storage instead of answering why both are required. Some candidates were able to accurately describe the purpose of primary storage as storing currently running data and software.

**Misconception**

A common misconception was that secondary storage is used when primary storage is full, or that it is only used as a backup.

### Question 5 (a) (ii)

(ii) Give **one** example of a secondary storage device that the artist's computer will have **and** an example of the data that will be stored on it.

Secondary storage device .....

Example data .....

.....

[2]

Candidates were required to identify a secondary storage device. Some responses identified a type of storage media (for example magnetic) instead of identifying a device (for example hard drive). Some responses gave RAM or ROM as a secondary storage device. These responses were incorrect.

The example data varied but many responses were able to identify the storage of files, the images or software.

### Question 5 (a) (iii)

(iii) The computer has Virtual Memory (VM).

The table has four statements about VM. Not all of the statements are correct.

Tick (✓) the **True** column for the statements that are correct.

Re-write any statement that is incorrect in the **False** column by changing the statement to make it true.

Statement	True (✓)	False – rewrite the statement to make it true
A section of primary storage is partitioned to act as virtual memory		
Data from ROM is transferred into VM		
VM is needed when RAM is full, or nearly full		
Data from VM is transferred back to secondary storage when needed		

[4]

In this question candidates needed to consider each statement, identify whether it was true or false and if it was false re-write the statement about virtual memory to make it true.

Candidates commonly identified the third statement as being true.

The first statement was often correctly altered to identify that secondary storage was used. The second statement was sometimes changed correctly to RAM, but at other times was changed to secondary storage.

The final statement was often changed to primary storage, which was not enough because primary storage would include ROM and cache, therefore not being precise enough to describe how VM works.

### Question 5 (b)

(b) The computer has an operating system and utility software.

State the need for utility software in a computer.

.....  
 ..... [1]

Some candidates gave an example of utility software and described the purpose of that software instead of utility software in general. For example, a candidate gave defragmentation, or file management as the need.

Question 5 (c) (i)

(c) The artist uploads images to be displayed on a website. This is a client-server relationship.

(i) Identify the computer that is acting as the client in this scenario **and** justify your choice.

Client computer .....

Justification .....

.....  
.....  
.....

[3]

Many responses identified the artist's computer as being the one that is acting as a client.

Fewer responses were able to justify this, for example they described a different scenario, such as downloading the images to view the website, instead of the given scenario of the client uploading the files.

Exemplar 2

Client computer ..... Artist's Computer .....

Justification ..... The Artist's Computer is .....

..... requesting a response for .....

..... uploading images by the website .....

.....

[3]

In this response the candidate has identified the correct computer. The justification states that it is requesting a response, but not where this response is from, and then that the images are uploaded to the website when in this scenario they should be referring to the server in the client-server relationship.

### Question 5 (c) (ii)

(ii) Identify the computer that is acting as the server in this scenario **and** justify your choice.

Server computer .....

Justification .....

.....

.....

.....

[3]

Fewer candidates were able to accurately identify the server in this scenario.

Many candidates identified the website as a server when a website is not a computer.

Some candidates who identified the webserver were also able to justify their choice by identifying the actions it was performing in the scenario.

#### Exemplar 3

Server computer website server

Justification the website server receives and processes data and does not send it back

The response in Exemplar 3 has correctly identified the webserver as the computer. They have also identified that this server (the computer) receives the data and processes the data.

### Question 5 (d) (i)

(d) The artist is working with a programmer on the development of a new piece of software.

The software will allow users to edit images on devices such as mobile telephones.

They are considering releasing the software as open source instead of proprietary.

(i) Describe **two** benefits to the artist and programmer of releasing the software as proprietary.

1 .....

.....

.....

.....

.....

2 .....

.....

.....

.....

[4]

This question required candidates to consider the benefits to the developer of releasing the software as proprietary.

A common error was describing the benefits to the users, for example they know the software has not been tampered with and that there is lots of support.

The most common responses included the ability to earn money from selling the software and retaining control due to no-one else being able to access the source code.

### Question 5 (d) (ii)

(ii) Describe **one** benefit to the users of releasing the software as open source.

.....

.....

.....

..... [2]

This question required candidates to consider the benefits to the users of the software being released as open source.

Many candidates were able to accurately identify that the source code comes with the software, and this allows the user to edit it to meet their needs.

### Question 6\*

6\* A shopping centre has a security system that includes CCTV cameras to record activities in the centre. The security system is being upgraded to include the use of facial recognition to identify, track the movements of and record individuals throughout the shopping centre.

Discuss the positive and negative impacts of this upgrade including:

- ethical issues
- privacy issues
- legal issues

.....

.....

.....

.....

.....

..... [8]

The quality of written communication required a balanced discussion of the positive and negative impacts of including facial recognition with CCTV cameras in a shopping centre.

Some responses gave strongly negative arguments with little, if any, consideration for the positive impacts. Some candidates also chose to focus on the introduction of CCTV cameras, where the question states there are already CCTV cameras and the discussion is about the upgrade to facial recognition.

The more successful responses considered the ethical, privacy and legal issues one at a time and identified the positive and negative impacts (where applicable) for each of these three sections. These responses were usually well structured and had a balanced discussion before leading to justified conclusions.

Some successful responses included bullet points and table structures to help the candidates structure their response. These were often thorough and included detailed discussions.

Some of the less successful responses focused on people not wanting to be watched by CCTV cameras, or that people would misuse the CCTV cameras. The CCTV cameras were already in existence and therefore this was irrelevant to the context of the question.

More successful responses considered the storage of the tracked videos and how this could lead to data privacy issues. These responses also discussed how shops could use the stored data to analyse where people go in shops to identify areas where they could put more adverts.

### Question 7

7 A car comes with many embedded systems, for example parking sensors.

Identify **one** other embedded system that could be found in a car and explain why this is an embedded system.

Example embedded system .....

Explanation .....

.....

.....

.....

[3]

This question required candidates to consider embedded systems within a car.

There were a range of possible systems, the most common being GPS or satellite navigation systems. Other common responses included automated lights, automated wipers, and parking sensors.

The most common explanation was that the system has a single (or limited) purpose, but few candidates expanded beyond this. Some candidates repeated that it was built into the car but this was provided in the question.

Some candidates provided examples of embedded systems such as a washing machine, a microwave and a fridge/freezer. This was not appropriate to the context of the question.



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