Chhetri Academy

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GCSE COMPUTER SCIENCE

2.3

Edexcel 1CP2 | Specification point 2.3.2

The need for data compression and methods of compressing data (lossless, lossy)

Untiered

Answers and examiner comments

3	2018-2023	Untiered
question groups	available papers	tier

Using this booklet

1. Answer numbers match the companion question booklet.
2. Follow the original question number on marking tables.
3. Examiner comments are included where available.

Name _____ **Date** _____

Some entries use full source marking material in an appendix. Any unavailable mark schemes are identified beside the relevant answer.

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	Any two from different categories: • Share peripherals/devices (e.g. printers, scanners) (1) • Communicate (e.g. email, instant messaging, play games) (1) • Share data (e.g. files/music/videos/backups on servers) (1) • Deploy/update applications (1)		**2**

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	Any three from: • May not have space for cables to be installed (1) • Employees and visitors can move around the building without disconnecting (1) • Adding new users just means giving out the SSID and password (1)		**3**

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	Most people do not notice (1) And one from: …because: • People have a limited hearing range (1) OR • Sounds (frequencies/amplitudes) can be masked by other sounds (1) OR • People's brains will 'fill in the blanks'	Max 1 mark without first statement.	**2**

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	May increase the file size / the file may not be compressed very much/at all (1) if characters are distributed randomly/not repeated/no runs of similar characters are found (1).		**2**

Question Number	Answer	Additional Guidance	Mark
3(c)	Total number of bits to transfer: 1 mark for 81 x 1024^2 1 mark for x 8 Speed in bits per second: 1 mark for 54 x 1000^2 Time = number of bits / bits per second: $\frac{81 \times 1024 \times 1024 \times 8}{54 \times 1000 \times 1000}$ 1 mark = number of bits in numerator 1 mark = number of bits per second in denominator	• No units required • Any equivalent expression to be awarded	**5**

7(a)	An explanation to include **two** from: Binary can represent two states (1) because computer circuits use transistors, which can either be on or off (1)		**2**

Question Number	Answer	Additional Guidance	Mark
7(b)	1 1 1 1 1 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 0 1 1 1 Award **one** mark for first two rows being correct Award **both** marks if last row is correct		**2**

Question Number	Answer	Additional Guidance	Mark
7(c)	An explanation such as: A two's complement of an 8-bit number can only represent positive integers up to 127 (1) because the rest of the bit combinations (with the most significant bit as '1') represent negative integers (1)		**2**

Question Number	Answer	Additional Guidance	Mark
7(d)	Indicative content: (Digital) audio quality is represented using binary. A number of bits (referred to as bit-depth) are used to 'describe' each sample. A lossy algorithm will reduce the bit-depth. However, it will improve the experience of users who want to stream/download the published files. It will not use frequency/amplitude masking (as is the case with lossless compression algorithms). Lossless algorithms are more complex so will take longer to run. The quality of the audio file is reduced when using a lossy algorithm and may not be as acceptable to a listener as one that has been compressed using a lossless algorithm. Depending on the level of compression, listeners may not be able to distinguish between the original and compressed file. Lossless algorithms will allow the musician to work on files at a later date at their original quality/sample rate/resolution. Files that have been compressed using a lossless algorithm will take longer to upload and require more storage/cost (and reverse).		**6**

Level	Mark	Descriptor
	0	No rewardable content
Level 1	1-2	A comparison may be attempted but with limited application of knowledge and understanding of key concepts/principles of computer science to the theoretical context. The comparison will contain basic information with some attempt made to link knowledge and understanding to the given context.
Level 2	3-4	A comparison will be given with adequate application of knowledge and understanding of key concepts/principles of computer science to the theoretical context. Lines of reasoning are occasionally supported through a linkage. The comparison shows some linkages and lines of reasoning with some structure.
Level 3	5-6	A comparison will be given with comprehensive application of knowledge and understanding of key concepts/principles of computer science to the theoretical context. Line(s) of reasoning are supported throughout by sustained application of relevant evidence. The comparison shows well-developed and sustained lines of reasoning which are clear, coherent and logically structured.

Question Number	Answer	Additional Guidance	Mark
5(a)	Award up to two marks for a linked description, such as: • (Removed) data (1) cannot be restored / means that the original file/information cannot be fully recreated/represented (1) • When data is removed (1) humans may perceive/interpret the image/sound/text/information differently (1)	For both marks, the expansion must associate with the statement. Award both marks for reference to loss of data and an example of the effect of that. Do not accept reference to 'quality' as an effect.	(2)

Question Number	Answer	Additional Guidance	Mark
5(b)	Award up to two marks for a linked explanation, such as: • One bit can only have two values (1), so can only represent black and white (1) • The three colours in this image cannot be represented (1) because one bit can only have two values (1) • It is not possible to represent each pixel with three colours / as greyscale / as anything other than black and white (1) because one bit can only represent two unique values (1)	For both marks, the expansion must associate with the statement.	(2)

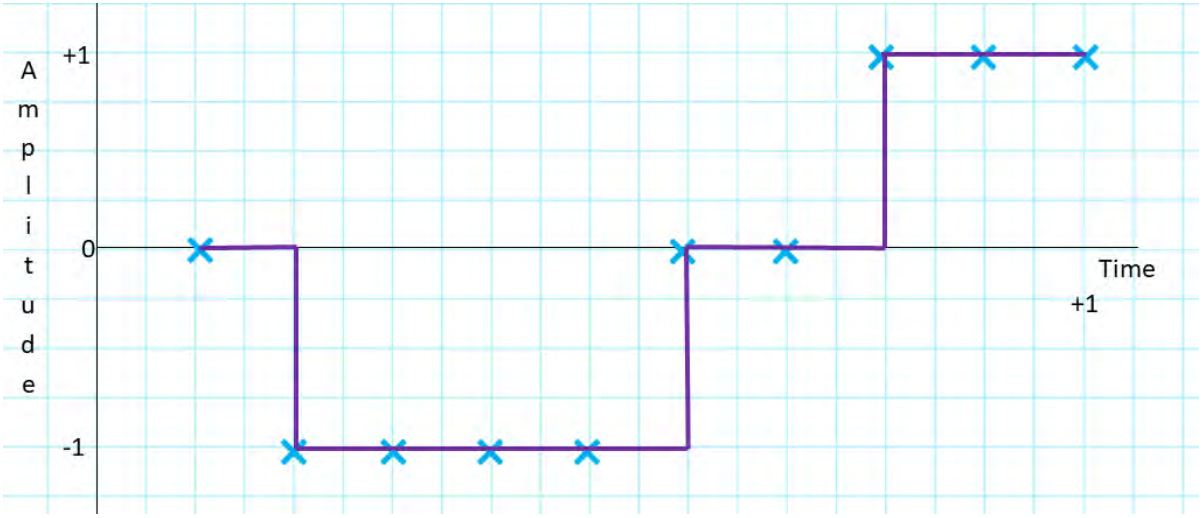
Question Number	Answer	Additional Guidance	Mark
5(c)	Award up to two marks for a linked description, such as: • An arithmetic shift fills from the left with a copy of the most-significant bit (MSB) (1), whereas a logical shift fills from the left with a 0 (1) • An arithmetic shift keeps the most-significant bit (MSB) the same (1) whereas a logical shift always fills the MSB bit with a 0 (1)	Both statements must be provided for two marks, as an arithmetic shift will fill with 0s, if the MSB is 0. Read carefully responses that indicate what the fill character is. Allow 'sign bit' for MSB	(2)

Question Number	Answer	Additional Guidance	Mark
5(d)(i)	Award one mark for: • 66 (1)		(1)

Question Number	Answer	Additional Guidance	Mark
5(d)(ii)	Award one mark for each correct digit in the correct order: • 5B		(2)

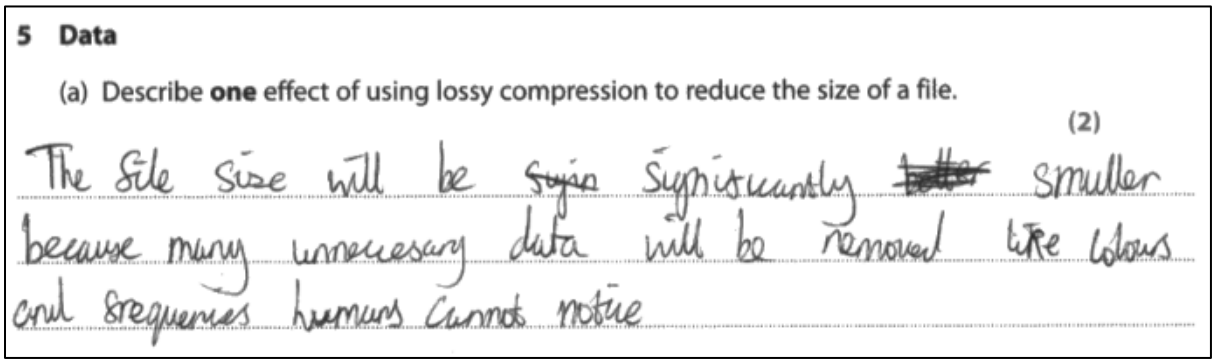
Question Number	Answer	Additional Guidance	Mark
5(e)(i)	Award one mark for any of the following: • 64 (1) • 2^6 (1) • 2^6 (1) • 2**6 (1) • 2 x 2 x 2 x 2 x 2 x 2 (1)	Allow any expression that evaluates to 64	(1)

Question Number	Answer	Additional Guidance	Mark
5(e)(ii)	Award one mark for any of the following up to a maximum of two marks: • Sight of 100 x 600 (1) • x 32 in numerator **and** 8 in the denominator (1) • + 1024 applied to whole expression (1) Award three marks for all three elements presented as a correct expression such as: • $\frac{100 \times 600 \times 32}{8} + 1024$ • ((100 x 600 x 32) / 8) + 1024	Consider order of operations (BIDMAS) Award mental reductions, such as (100 x 600 x 4) + 1024	(3)

Question Number	Answer	Additional Guidance	Mark
5(f)	Award one mark for any of the following up to a maximum of six marks: • x-axis labelled correctly as time/seconds (1) • y-axis labelled correctly as amplitude/value/sample (1) • value labels on x-axis as 0 and 1 (1) • value labels y-axis as -1 and 1 (1) • all 10 values plotted to correct points (1) • points joined to form a square wave, even if not all points are there or some are plotted inaccurately (1) 	Allow first sample at time 0 Award inverse (vertical flip) if y-axis labels also flipped, i.e. must recognise 11111 as -1. Ignore any other values on x and y axes Accept binary representation for value labels on y axis.	(6)

Question 5a

Many students showed a good understanding of lossy compression, particularly with regards to permanent data loss. Some went as far as comparing with lossless. The use of examples that could describe how data loss affects file quality was not always well explained.



5 Data

(a) Describe **one** effect of using lossy compression to reduce the size of a file.

(2)

The file size will be ~~sign~~ significantly ~~better~~ smaller because many unnecesary data will be removed like colours and frequencies humans cannot notice

This response scored 2 marks.

(a) Describe **one** effect of using lossy compression to reduce the size of a file.

(2)

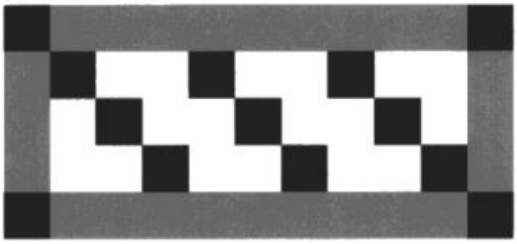
An effect of using lossy compression is that it will make file transmission faster leading to being able to send more files faster and efficiently.

This response scored 0 marks.

Question 5b

Some responses showed good understanding of how an image is constructed and how the number of colours impacted the number of bits required for the colour depth of the image, while a lot of responses thought the question was about resolution and thought that the image was not clear because 1-bit resolution was too low.

(b) Here is an original image.



There is one bit available to represent each pixel.

Explain **one** reason why the image cannot be accurately represented using one bit for each pixel.

(2)

only 2^1 (2) colours can be represented with a color depth of 1 so it will be in black and white, whereas this original image portrays black, grey and white (3 colors) which would need at least 2 bits to represent as 1 only shows black and white

This response scored 2 marks. 1 mark for 'colours can be represented' and 1 mark for 'so it will be in black and white'.

Question 5c

Lots of confusion around this question with some students knowing what a logical shift was, but many struggled with arithmetic shifts. Many students did not reference the most significant bit in their responses.

A **logical** shift right is performed on a pattern.

An **arithmetic** shift right is performed on the same original pattern.

Describe the reason the results will be different.

(2)

Logic shifts right replace blank spaces the MSB with a 0, whereas Arithmetic shifts copy the MSB to use for the ne MSB

(c) Shifts are performed on binary patterns.

A **logical** shift right is performed on a pattern.

An **arithmetic** shift right is performed on the same original pattern.

Describe the reason the results will be different.

(2)

because logical shift will replace the value on the farmost left with 0 and arithmetic will replace it with the value it lost.

These responses scored 2 marks.

Question Q5eii

A number of responses did not set out the expression accurately, or show understanding the arithmetic process required. Generally, at least one mark was awarded for 100 X 600. There were still some misconceptions around converting into bytes. In many instances the +1024 was included in the numerator, rather than being applied to the whole expression.

(ii) A file format uses a 100 × 600 table of 32-bit integers.

The file uses 1 kibibyte of additional data.

Construct an expression to show the number of **bytes** of storage needed to store the file.

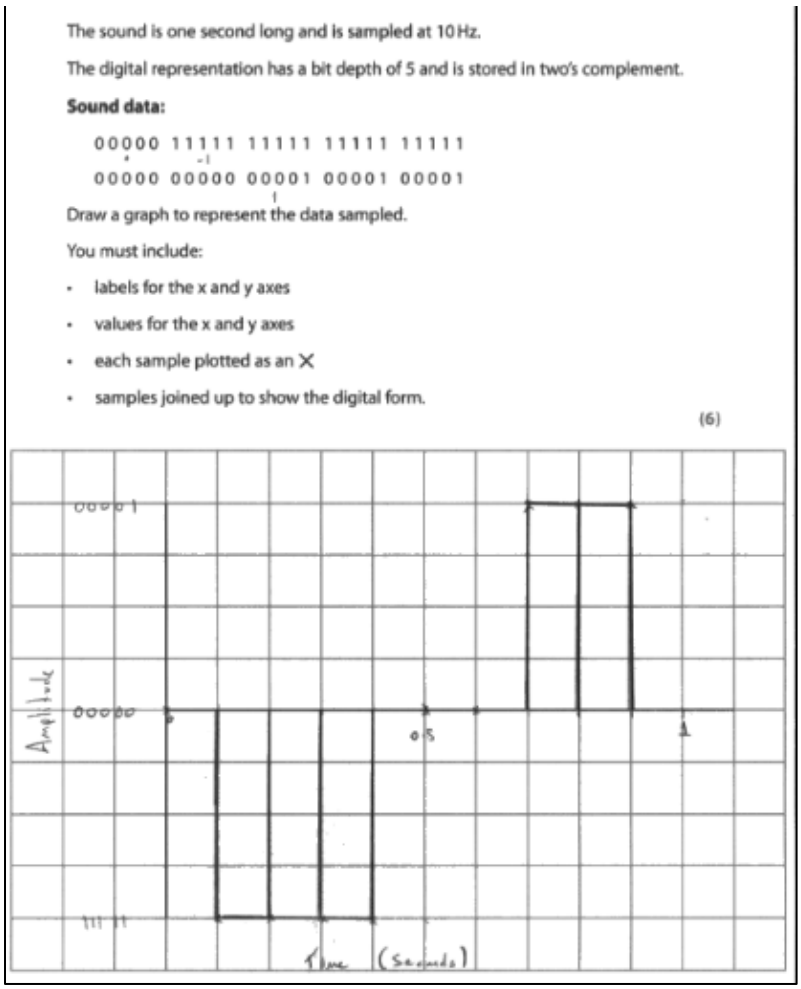
(3)

100 x 600 x 32 + 1024

This response scored 2 marks.

Question 5f

Students did not always label the axes correctly, especially the y axis. It was often the case that not all points were accurately plotted. Very few students produced a square wave and some students stopped plotting at point 9 rather than point 10. Some students mistakenly flipped the two's complement values, leading to incorrect amplitudes in their representation, others gave amplitude values from 0 to 1 to 15, instead of -1 to 0 to 1.



This response scored 6 marks. X-axis labelled correctly, 1 mark. Y-axis labelled correctly, 1 mark. Value of X-axis as 0 and 1, 1 mark. Binary values on y axis, 1 mark. All 10 values plotted to correct points (starting from 0), 1 mark. Points join to form a square wave, 1 mark.

Paper Summary

Based on their performance on this paper, students are offered the following advice:

- Expand and explain answers using examples and reasons, especially where more than a simple statement or list is requested.
- Where a context or scenario is provided, respond with the context of the question in mind.
- Read and interpret the question prompt to focus on the specific requirements and provide more relevant responses that address the critical aspects of the question.
- Develop a clear understanding of data representation, e.g. the number of states that can be represented with 1 bit and focus on understanding the key elements of representing analogue and digital signals.
- Familiarise yourself with the appropriate symbols and conditions to ensure clarity and accuracy in diagrammatic representations of algorithms.