Chhetri Academy

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GCSE COMPUTER SCIENCE

2.2

Edexcel 1CP2 | Specification point 2.2.3

How analogue sound is represented in binary (amplitude, sample rate, bit depth, sample interval)

Untiered

Answers and examiner comments

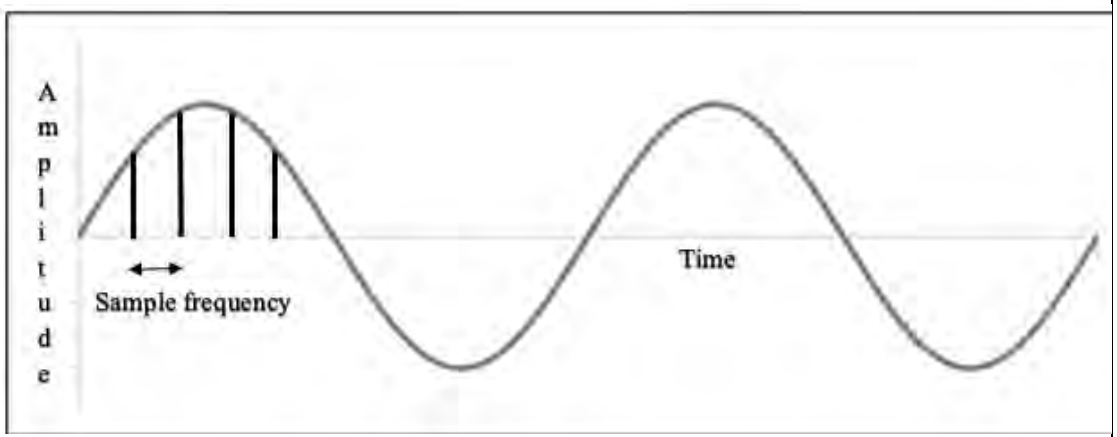
3	2019-2023	Untiered
question groups	available papers	tier

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
4(a) (i)	X axis correctly labelled (1) Y axis correctly labelled (1) Sample frequency indicated (1) Do not award marks if wavelength is labelled, rather than sample frequency. Accept for sample frequency if two points given that are shorter than the wavelength.  		**3**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	The amplitude / original sound can be represented more accurately. Accept: • Better (sound) quality • Higher fidelity • Clearer (sound)		**1**

Question Number	Answer	Additional Guidance	Mark
4(b)	B – RAM **The only correct answer is B** ***A*** *is not correct because the ALU does not hold a program* ***C*** *is not correct because a hard drive does not hold a currently executing program* ***D*** *is not correct because the control unit does not hold a program*		**1**

Question Number	Answer	Additional Guidance	Mark

4(c)	Total number of bits to transfer: **1 mark for** 20×1024^2 **1 mark for** $\times 8$ Speed in bits per second: **1 mark for** 2×1000000 Numerator/Denominator: **1 mark for** $$\frac{bits\ to\ transfer}{bits\ per\ second}$$ e.g: $$\frac{\mathbf{20 \times 1024 \times 1024 \times 8}}{\mathbf{2 \times 1000000}}$$	Any equivalent expression to be awarded	**4**

Question Number	Answer	Additional Guidance	Mark
4(d)	A description such as: • Input from sensor (1) • The input level is compared against pre-set values (1) • Output to LED/speaker (1)		**3**

Question Number	Answer	Additional Guidance	Mark
4(e)	A. Copper cable B. Fibre optic		**2**

Question Number	Answer	Additional Guidance	Mark
4(a)	• 32 • 2^5		**1**

Question Number	Answer	Additional Guidance	Mark
4(b)	AD		**1**

Question Number	Answer	Additional Guidance	Mark
4(c)	**Binary:** One mark for 1110 0011 **Denary:** One mark for 227	Allow follow through.	**2**

Question Number	Answer	Additional Guidance	Mark
4(d)	One mark for each nibble in the correct location: 0100 0101 Or **one** from: • H – E (1) • 72 – 3 (1) • 69 (1)	Binary must be expressed using 8 bits for both marks.	**2**

Question Number	Answer	Additional Guidance	Mark
4(e)	A comparison to include **two** from: Effect on sample resolution (1) e.g. More levels of amplitude can be represented (with 24 bits) Effect on accuracy of representation (1) e.g. The sound is more like the original (with 24 bits) Effect on transmission speed/storage/memory (1) e.g. Takes longer to transmit / creates larger file sizes / uses more memory (with 24 bits)		**2**

Question Number	Answer	Additional Guidance	Mark
4(f) (i)	One mark for each nibble: 0 0 1 1 1 0 1 0 1 0 1 1 0 0 1 1 1 1 1 0 1 1 0 1		**2**

Question Number	Answer	Additional Guidance	Mark
4(f) (ii)	It will produce an overflow error (1) because there are not enough available bits (1)		**2**

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)

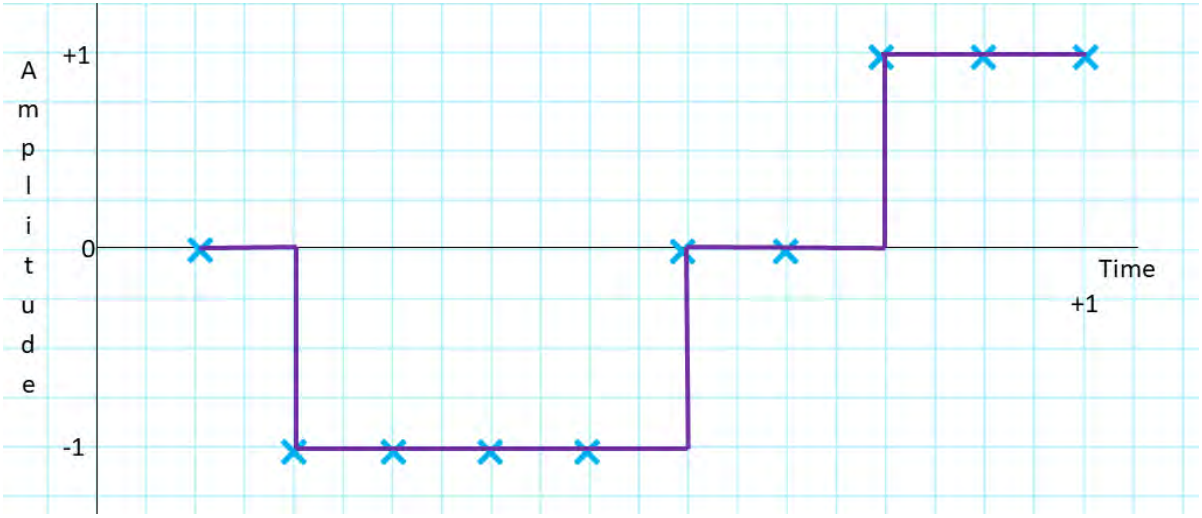
Question Number	Answer	Additional Guidance	Mark
5(c)	Award up to two marks for a linked description, such as: • An arithmetic shift fills from the left with a copy of the most-significant bit (MSB) (1), whereas a logical shift fills from the left with a 0 (1) • An arithmetic shift keeps the most-significant 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)

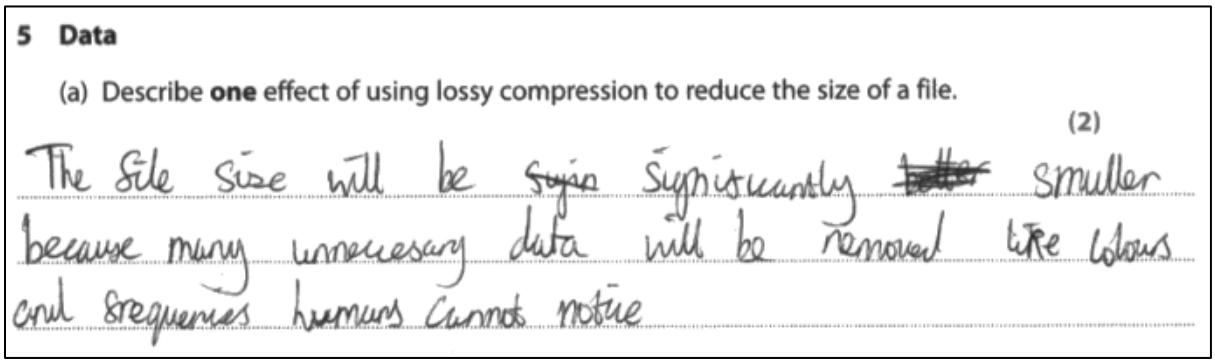
Question Number	Answer	Additional Guidance	Mark
5(e)(i)	Award one mark for any of the following: • 64 (1) • 2^6 (1) • 2^6 (1) • 2**6 (1) • 2 x 2 x 2 x 2 x 2 x 2 (1)	Allow any expression that evaluates to 64	(1)

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)

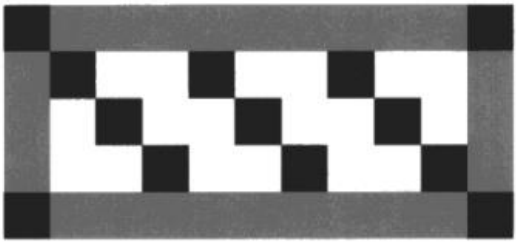
An effect of using lossy compression is that it will make file transmission faster leading to being able to send more files faster and efficiently.

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.

The sound is one second long and is sampled at 10 Hz.

The digital representation has a bit depth of 5 and is stored in two's complement.

Sound data:

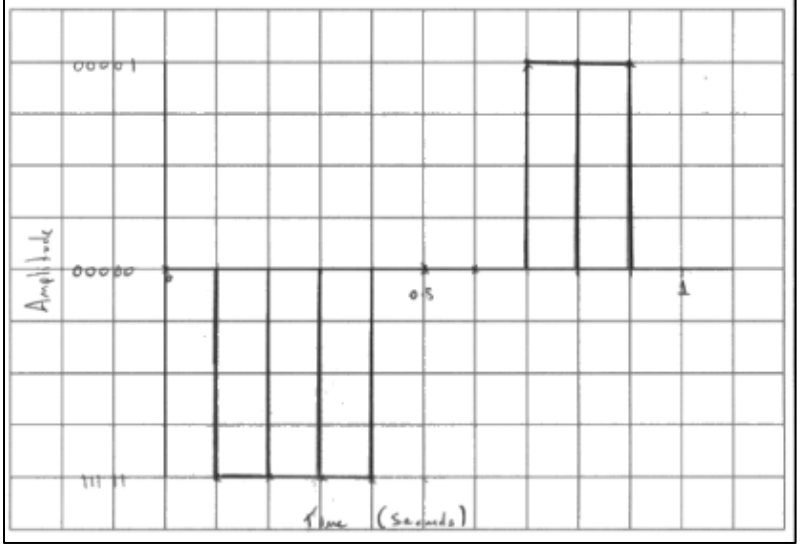
00000 11111 11111 11111 11111
00000 00000 00001 00001 00001

Draw a graph to represent the data sampled.

You must include:

- labels for the x and y axes
- values for the x and y axes
- each sample plotted as an X
- samples joined up to show the digital form.

(6)



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.