Chhetri Academy

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GCSE COMPUTER SCIENCE

2.2

Edexcel 1CP2 | Specification point 2.2.4

The limitations of binary representation of data when constrained by the number of available bits

Untiered

Answers and examiner comments

2	2020-2025	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.

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
1(a)(i)	**The only correct answer is A** *B is not correct because a kibibyte contains 8192 bits* *C is not correct because a mebibyte contains 8192 x 8192 bits* *D is not correct because a nibble contains 4 bits*	The correct answer is gibibyte	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	Award **one** mark for any of the following: • 2^7 (1) • 128 (1) • 2 × 2 × 2 × 2 × 2 × 2 × 2 (1)	Allow equivalent	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(a)(iii)	Award **one** mark for: • 71 (1)		**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	Award **one** mark for any of the following up to a maximum of **two** marks: • Base 16 number (1) • Needs 16 different symbols to represent the range of values (1) • Hexadecimal uses the digits 0-9 (to represent values between denary 0 and 9) (1) • Hexadecimal uses the letters A-F (to represent values between denary 10 and 15) (1) • Each hexadecimal symbol requires 1 nibble/4 bits to represent it (1) • Because there are **more** (hexadecimal) **digits/symbols** than there are (denary) digits, it uses letters (1)	Do not award responses comparing hexadecimal to binary/denary Do not award responses indicating 'number' instead of 'digit', without clarification (0-9, A-F) Responses must be related to characteristics and not benefits or drawbacks of hexadecimal notation.	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	Award up to **two** marks for a linked explanation such as: • Hexadecimal numbers are easy to understand/remember (1) because they contain fewer digits (than binary) (1) • Hexadecimal numbers are easier to read/write (1) because they are not just 1s and 0s (1) • Hexadecimal numbers are shorter/easier for programmers to read/write (1) because memory addresses are binary patterns (1) • Hexadecimal numbers are less prone to error when entering values (1) because there are fewer symbols to type (1) • Memory addresses are long binary patterns (1) so hexadecimal numbers are shorter/easier to read/write (1)	For both marks, the expansion must follow/associate with the statement. Do not accept 'easier' on its own without expansion as to what is easier.	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	Award up to **two** marks for a linked explanation such as: • Some frequencies/data can be removed permanently (1) because they are out of human hearing range (1) • Because the sounds/data outside the range of human hearing (1) can be completely removed (1) • Improves streaming (1) because it decreases the download time (1) • To achieve a higher compression ratio than lossless (1) because the sound will be understandable with some content removed (1) • More files can be saved (on a finite resource) (1) because it reduces the amount of storage space each file uses (1)	For both marks, the expansion must follow/associate with the statement. Do not award responses indicating quality of playback	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)(ii)	Award **one** mark for each of the following: • 315 and 923 in the numerator (1) • 7 in the numerator (1) • 8 in the denominator (1)	Award equivalent expressions	**(3)**

Question Number	Answer	Additional Guidance	Mark
1(d)(i)	**The only correct answer is C** *A is not correct because a shift has not been applied (0001 1100)* *B is not correct because 1101 1000 is the result of a left binary shift of 1* *D is not correct because 1011 0000 is the result of a left binary shift of 2*	The correct answer is: 0001 1011	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(d)(ii)	Award **one** mark for each nibble: 0001(1) 1001(1)	Nibbles must be in the right order Each nibble must be 4 bits	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(d)(iii)	Award **one** mark for each nibble: 1111(1) 0011(1)	Nibbles must be in the right order Each nibble must be 4 bits	**(2)**

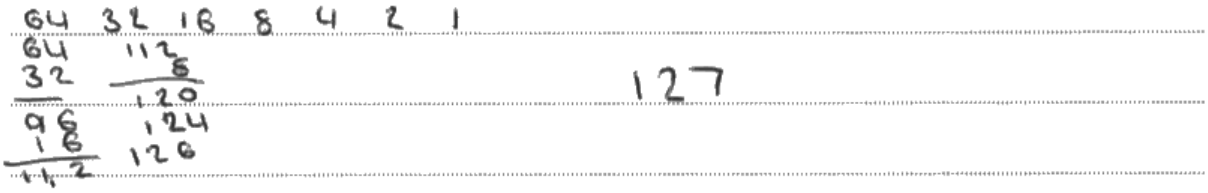
Question 1(a)ii

Most candidates responded correctly giving either 128 or 2^7.

Some candidates gave 127 which is the largest number that can be represented with 7 bits, but is not the total number of unique representations.

(ii) State the number of unique values that can be represented with 7 bits.

(1)



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Examiner Comments

This response scored 0 marks for an incorrect value. It was off-by-one exemplifying a typical candidate misconception giving the largest number that can be represented rather than the number of unique values.

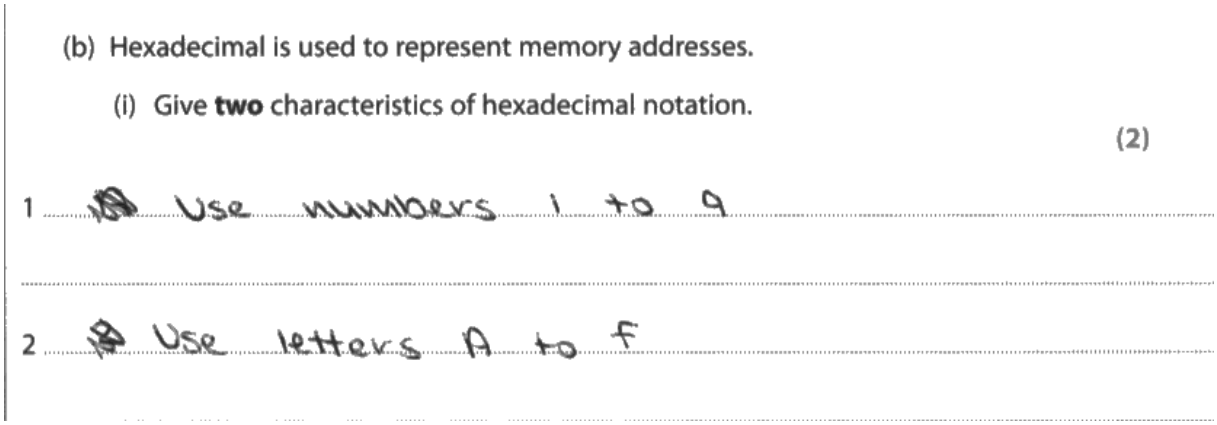
Question 1(a)iii

Most candidates gave the correct ASCII code for G which was 71.

Question 1(b)i

Candidates sometimes confused the benefits of using hexadecimal with its characteristics, giving the benefits of using hexadecimal rather than focusing on its intrinsic characteristics. The characteristics are the features of the notation. Where candidates gave characteristics, they were sometimes too vague. For example, specifying 'letters' rather than 'letters A to F are used'.

Some candidates also stated that hexadecimal digits went from 1 to 9 instead of specifying from 0 to 9.


(b) Hexadecimal is used to represent memory addresses.

(i) Give **two** characteristics of hexadecimal notation.

(2)

1 Use numbers 1 to 9

2 Use letters A to F

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This response scored 1 mark for stating that hexadecimal uses letters A to F. To gain the second mark the candidate would have needed to state that numbers/digits 0 to 9 are used as well, and not just 1 to 9.

Question 1(b)ii

Many candidates were able to identify a reason why programmers use hexadecimal notation such as that it is easier to read or write, but fewer were able to give the required linked explanation to give the reason for their assertion. A number of candidates wrote that hexadecimal took less storage space than binary which is incorrect - the amount of bits required to store the value is identical.

(ii) Explain **one** reason why programmers use hexadecimal to specify memory addresses.

(2)

one reason why programmers use Hexadecimal is because it is easier for ~~them~~ other programmers to understand.

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This response scored 1 mark for identifying that hexadecimal is easier to understand/use, but there was no expansion to give a reason to explain why this was the case for the second mark.

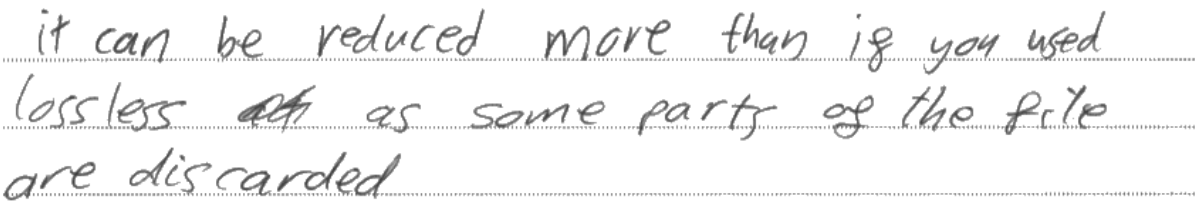
Question 1(c)i

Some candidates confused lossless compression with lossy compression. Many candidates were able to state that lossy compression would give higher compression ratios by removing data that would be outside the range of human hearing. Other popular reasons related to decreased file sizes for improved streaming by reducing download times.

(c) Audio and image files store data in binary.

(i) Explain **one** reason why lossy compression is used to reduce the size of an audio file.

(2)



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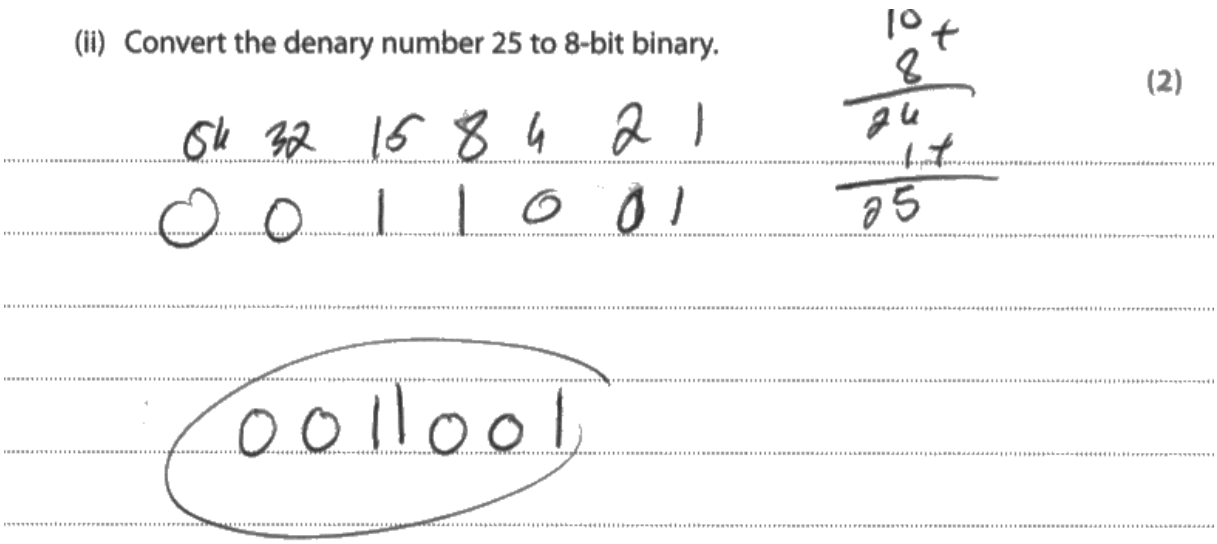
This response scored 2 marks without specifically relating to the context of lossy compression for audio. It did identify that lossy compression would achieve a higher compression ratio because some of the original data was discarded.

Question 1(c)ii

Most candidates scored at least one mark for multiplying the width (315) by the height (923) and many went on to give fully correct responses. Common errors included confusing the colour depth of 7 with 2^7 for the number of colours available and dividing by 1000 in an attempt to convert to KB rather than dividing by 8 to convert the total number of bits into bytes. A number of candidates also left one or more of the boxes empty rather than attempting to create a solution.

Question 1(d)ii

Candidates showed improved mathematical skills with the majority of candidates being able to convert an unsigned denary integer into binary. Some candidates converted the denary number 25 to the binary pattern 11001 rather than the 8-bit binary pattern 0001 1001, so scored one mark because they gave one correct nibble rather than two correct nibbles.



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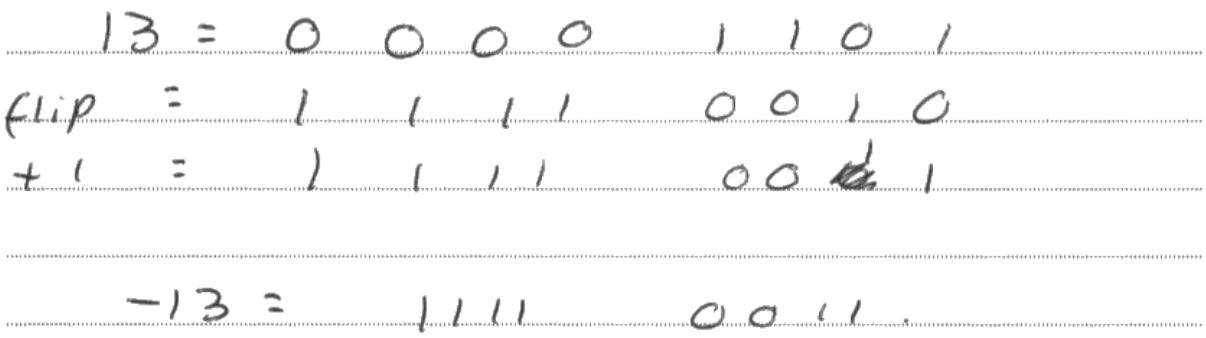
This response scored 1 mark. The response was not a full 8-bit binary number, but the right hand nibble could be identified to score a mark.

Question 1(d)iii

Fewer candidates were able to convert a negative denary integer into an 8-bit binary number using two's complement compared to a positive number conversion in d(ii). Where candidates attempted the conversion and produced incorrect responses, it was often because they tried to do the conversion by writing the positive value for -13 which was 0000 1101 and then flipping the bits to give 1111 0010, but then forgetting to add one. Many candidates also wrote out a number line starting with -128 for the most significant bit and then successfully completed the conversion using that technique.

(iii) Convert the denary number –13 to 8-bit binary using two's complement.

(2)



ResultsPlus Examiner Comments

This response scored 2 marks for a correct answer. It exemplified the method of flipping the bits and adding one to convert between positive and negative representations of numbers using two's complement.