2.6 Data Representation: Images, Sound and Compression: 30-minute Pack

OCR J277 · Calculators not allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A bitmap image is 320 pixels wide and 240 pixels high. Each pixel is stored using a colour depth of 8 bits.

(a) State the number of different colours that a colour depth of 8 bits can represent. **(1)**

(b) Show that the uncompressed image requires 614400 bits of storage. **(2)**

(c) Calculate the size of the uncompressed image in kilobytes (KB). Use 1 byte = 8 bits and 1 KB = 1000 bytes. **(2)**

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(Total for Question 1 is 5 marks)

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2 Sound is recorded by sampling an analogue sound wave at regular intervals.

(a) Define the term 'sample rate'. **(1)**

(b) Define the term 'bit depth' in the context of sound recording. **(1)**

(c) State the effect on the recorded sound of increasing the sample rate used. **(1)**

(d) State one drawback of increasing the sample rate. **(1)**

(Total for Question 2 is 4 marks)

3 A mono sound clip is recorded with a sample rate of 8000 Hz and a bit depth of 8 bits. The clip lasts 3 seconds.

(a) Calculate the total number of samples taken during the recording. **(2)**

(b) Calculate the file size of the recording in bits. **(2)**

(c) Calculate the file size of the recording in kilobytes (KB). Use 1 byte = 8 bits and 1 KB = 1000 bytes. **(2)**

(Total for Question 3 is 6 marks)

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4 A sound engineer is deciding on recording settings for a podcast that will be streamed to mobile phones.

(a) Explain the effect of recording in stereo instead of mono on the file size of the podcast. **(2)**

(b) Explain why the sound engineer might choose a lower bit depth for the podcast than a professional music studio would use for a music recording. **(2)**

(Total for Question 4 is 4 marks)

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5 A single row of a black and white bitmap image is 12 pixels wide, shown below (W = white pixel, B = black pixel):
W W W W W B B B W W W W



(a) State what run-length encoding (RLE) is used for. **(1)**

(b) Use run-length encoding to encode the row of pixels above. Give your answer in the form (run length)(colour). **(2)**

(c) State one type of image for which RLE would achieve a high compression ratio, and one type for which it would not. **(2)**

(Total for Question 5 is 5 marks)

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6 A row of pixels has been run-length encoded as: 6W 2B 6W
The original (uncompressed) row used 1 byte to store the colour of each pixel. The encoded version above uses 2 bytes for each run (1 byte for the run length number and 1 byte for the colour letter).

(a) Decode this run-length encoded data to show the original row of pixels. **(2)**

(b) Calculate the compression ratio of the encoded row compared to the original uncompressed row, giving your answer in the form n:1 (original size : encoded size). **(3)**

(Total for Question 6 is 5 marks)

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Mark scheme · 2.6 Data Representation: Images, Sound and Compression: 30-minute Pack

Question 1

(a) 256 cao **B1**

(a) Answer: 256 colours

(b) calculates the total number of pixels: 320 x 240 = 76800 (oe) **M1**

(b) 76800 x 8 = 614400 shown correctly cso (answer given, working must be shown) **A1**

(b) Answer: 320 x 240 = 76800 pixels; 76800 x 8 = 614400 bits

(c) converts bits to bytes: 614400 / 8 (= 76800) (oe, ft from part b) **M1**

(c) 76.8 (KB) cao ft **A1**

(c) Answer: 76.8 KB

Question 2

(a) the number of samples of the sound wave taken per second, measured in Hertz (Hz) (oe) **B1**

(a) Answer: The number of samples of the sound wave taken per second.

(b) the number of bits used to store/represent each sample (oe) **B1**

(b) Answer: The number of bits used to store each sample.

(c) the recording more closely/accurately matches the original analogue sound wave, giving higher quality sound (oe) **B1**

(c) Answer: The recording more closely matches the original sound wave, giving higher quality.

(d) the file size increases, as more samples must be stored (oe) **B1**

(d) Answer: The file size increases because more samples must be stored.

Question 3

(a) correct method: 8000 x 3 (oe) **M1**

(a) 24000 (samples) cao **A1**

(a) Answer: 24000 samples

(b) multiplies number of samples by bit depth: (their samples) x 8 (oe, ft from part a) **M1**

(b) 192000 (bits) cao ft **A1**

(b) Answer: 192000 bits

(c) converts bits to bytes: (their bits) / 8 (= 24000) (oe, ft from part b) **M1**

(c) 24 (KB) cao ft **A1**

(c) Answer: 24 KB

Question 4

(a) stereo requires two channels of audio data to be stored instead of one (oe) **B1**

(a) so the file size (approximately) doubles compared to the equivalent mono recording (oe, ft) **B1**

(a) Answer: Stereo stores two channels of audio instead of one, so the file size roughly doubles compared to mono.

(b) a lower bit depth produces a smaller file size, so it downloads/streams faster and uses less of the listener's mobile data allowance (oe) **B1**

(b) spoken word/podcast audio does not need the same level of quality as music, so the small loss in quality is unlikely to be noticeable on a phone speaker (oe) **B1**

(b) Answer: A lower bit depth gives a smaller file that streams faster and uses less mobile data; speech does not need studio-quality sound, so the small quality loss is not very noticeable.

Question 5

(a) to compress data by storing a value and how many times it repeats (its run length), instead of storing the value once for every repeat (oe) **B1**

(a) Answer: It compresses data by storing a repeated value once along with a count of how many times it repeats.

(b) identifies the three correct runs, in order: 5 white, 3 black, 4 white (oe) **M1**

(b) 5W 3B 4W cao (accept equivalent consistent notation, e.g. (5,W)(3,B)(4,W)) **A1**

(b) Answer: 5W 3B 4W

(c) images with large areas of a single/repeated colour, e.g. simple line drawings, icons or logos, compress well (oe) **B1**

(c) photographs, or images with lots of colour variation/noise between adjacent pixels, compress poorly, as there are few or no long runs (oe) **B1**

(c) Answer: RLE works well on simple images with large blocks of one colour (e.g. a logo), but poorly on photographs, which have little colour repetition between adjacent pixels.

Question 6

(a) correctly identifies the total number of pixels represented: 6 + 2 + 6 = 14 (oe) **M1**

(a) WWWWWW BB WWWWWW cao (14 symbols in the correct order) **A1**

(a) Answer: WWWWWWBBWWWWWW (14 pixels)

(b) correctly finds the original size: 14 pixels x 1 byte = 14 bytes (ft from part a) **M1**

(b) correctly finds the encoded size: 3 runs x 2 bytes = 6 bytes (oe) **M1**

(b) (7/3):1, approximately 2.33:1 cao (accept awrt 2.3:1) **A1**

(b) Answer: (7/3):1, approximately 2.33:1

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