2.6 Data Representation: Images, Sound and Compression: Test Pack

OCR J277 · Calculators not allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Digital images are made up of a grid of picture elements.

(a) Define the term 'pixel'. **(1)**

(b) A photograph has a resolution of 1200 x 800. State what the two numbers in this resolution represent. **(1)**

(c) Calculate the total number of pixels in the photograph described in part (b). **(2)**

(Total for Question 1 is 4 marks)

2 Digital photographs usually store extra information alongside the pixel data, called metadata.

(a) State what is meant by the term 'metadata'. **(1)**

(b) Give two examples of metadata that might be stored with a digital photograph. **(2)**

(c) State one reason why storing metadata increases the overall file size of a photograph. **(1)**

(Total for Question 2 is 4 marks)

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3 Files can be compressed using lossy or lossless compression.

(a) Define 'lossy compression'. **(1)**

(b) Define 'lossless compression'. **(1)**

(c) Give one example of a file format that commonly uses lossy compression. **(1)**

(d) State one situation where lossless compression would be more suitable than lossy compression, and justify your answer. **(2)**

(Total for Question 3 is 5 marks)

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4 Table 1 shows the file size of the same photograph saved in three different ways.

Table 1

Version	File size (KB)
Original (uncompressed)	4800
Lossless compressed	3200
Lossy compressed	800

(a) Calculate the compression ratio of the lossless compressed version compared to the original, giving your answer in the form n:1. **(2)**

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(b) Calculate the percentage reduction in file size achieved by the lossy compressed version compared to the original. **(3)**

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(Total for Question 4 is 5 marks)

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5 A hospital stores digital X-ray images for diagnosis, and also stores short video clips of ultrasound scans for training purposes.
Evaluate whether lossy or lossless compression would be more appropriate for each of these two types of file, justifying your answer with reference to the consequences of data loss and the practical constraints of storage and transmission.

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(Total for Question 5 is 6 marks)

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Mark scheme · 2.6 Data Representation: Images, Sound and Compression: Test Pack

Question 1

(a) the smallest single element (a dot of one colour) that a digital image is made up of (oe) **B1**

(a) Answer: A pixel is the smallest single element (a dot of colour) that makes up a digital image.

(b) the number of pixels across the width and the number of pixels down the height of the image (oe) **B1**

(b) Answer: The number of pixels wide (1200) and the number of pixels high (800).

(c) correct method: 1200 x 800 (oe) **M1**

(c) 960000 cao **A1**

(c) Answer: 960 000 pixels

Question 2

(a) data that describes/gives information about other data (oe) **B1**

(a) Answer: Data that describes other data.

(b) one valid example, e.g. date and time taken (oe) **B1**

(b) a different valid example, e.g. camera/device model, GPS location, resolution/dimensions, colour depth, orientation, exposure settings (oe) **B1**

(b) Answer: Any two of: date and time taken; camera/device model; GPS location; image resolution; colour depth; exposure settings.

(c) extra data/bits are stored in the file alongside the pixel data, so more bits/bytes are needed in total (oe) **B1**

(c) Answer: Because extra data is stored alongside the pixel data, more bits/bytes must be stored in total.

Question 3

(a) compression that permanently removes some data/detail from the file, so it cannot be exactly restored to the original (oe) **B1**

(a) Answer: Compression that permanently removes some data, so the original file cannot be exactly recreated.

(b) compression that reduces file size without permanently losing any data, so the original file can be exactly reconstructed (oe) **B1**

(b) Answer: Compression that reduces file size without losing any data, so the original file can be exactly recreated.

(c) valid lossy format, e.g. JPEG or MP3 **B1**

(c) Answer: JPEG (or MP3).

(d) identifies a suitable situation, e.g. compressing a text/program file, a spreadsheet, or a medical/legal document (oe) **B1**

(d) justifies: because losing any data/detail could change the meaning of the file or make it unusable/inaccurate (oe, ft) **B1**

(d) Answer: Example: a legal document. Losing even small details through lossy compression could change its meaning or make it invalid, so lossless compression must be used.

Question 4

(a) correct method: 4800 / 3200 (oe) **M1**

(a) 1.5:1 cao **A1**

(a) Answer: 1.5:1

(b) finds the reduction in size: 4800 - 800 = 4000 (oe) **M1**

(b) correct method: (4000 / 4800) x 100 (oe, ft) **M1**

(b) awrt 83.3% cao ft **A1**

(b) Answer: 83.3% (to 3 s.f.)

Question 5

Level 1 A vague or one-sided statement, e.g. that lossless is always best because no data is lost, with little or no reference to the two specific file types or to practical constraints. **1-2**

Level 2 Some valid points made about both the X-ray images and the ultrasound clips, with limited justification or explanation of the consequences of data loss; the discussion may be one-sided or lack a balanced conclusion. **3-4**

Level 3 A balanced, well-justified evaluation covering both file types, referencing the medical consequences of losing diagnostic detail and the practical impact of large lossless file sizes on storage/transmission, reaching a supported conclusion. **5-6**

Indicative content:

- X-ray images are used to diagnose patients, so losing fine detail (e.g. a hairline fracture) through lossy compression could lead to a missed or incorrect diagnosis, risking patient harm.
- Lossless compression is therefore more appropriate for diagnostic X-rays, even though the resulting files will be larger and require more storage.
- Ultrasound training videos are used to teach general technique rather than diagnose a specific patient, so some loss of quality from lossy compression may be acceptable.
- Video files are typically much larger than still images, so using lossy compression on the ultrasound clips saves considerably more storage space and makes the files quicker to transmit between hospitals or training sites.
- Hospitals must store and transmit very large volumes of medical data, so storage costs and available network bandwidth are real practical constraints that must be balanced against the risk of losing important information.
- A supported conclusion balancing patient safety and diagnostic accuracy against storage/transmission efficiency, e.g. lossless compression for diagnostic X-rays but lossy compression acceptable for non-diagnostic training footage.

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