Past-paper walk-through

1.3.1 Compression

A-Level Computer Science

Questions in this set

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 6

9618/12 N25 ▪ Q6 ▪ 6 marks

								parity bit ↓
	1	0	1	1	0	1	1	1
	0	1	1	1	0	0	0	0
	0	0	0	1	1	0	1	1
	0	1	1	1	0	1	0	0
parity byte →	1	0	1	0	0	0	0	0

Question 6

Word	Denary value
Computing	55
Science	56
Computers	57
are	58
Brilliant!	59
is	60
Fun!	61
Amazing!	62

Question 6

Binary value	00111000	00111100	00111110
Word			

Question 6

(a) A sound file is compressed by reducing the sampling rate.
State whether this is lossless or lossy compression. Justify your choice.
Justification **[1]**

								parity bit ↓
	1	0	1	1	0	1	1	1
	0	1	1	1	0	0	0	0
	0	0	0	1	1	0	1	1
	0	1	1	1	0	1	0	0
parity byte →	1	0	1	0	0	0	0	0

Question 6

State whether this is lossless or lossy compression.

Word	Denary value
Computing	55
Science	56
Computers	57
are	58
Brilliant!	59
is	60
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Question 6

State whether this is lossless or lossy compression.

Binary value	00111000	00111100	00111110
Word			

Question 6

(b) The following table shows some words and corresponding denary values.

Word	**Denary value**
Computing	55
Science	56
Computers	57
are	58
Brilliant!	59
is	60
Fun!	61
Amazing!	62

Question 6

The following table shows three bytes of data that have been received.
Use the table to find the corresponding words from the binary values received.

Binary value	00111000	00111100	00111110
Word			

[1]

Question 6

(b) The following table shows some words and corresponding denary values.

parity bit ↓

	1	0	1	1	0	1	1	1
	0	1	1	1	0	0	0	0
	0	0	0	1	1	0	1	1
	0	1	1	1	0	1	0	0
parity byte →	1	0	1	0	0	0	0	0

Question 6

(b) The following table shows some words and corresponding denary values.

Word	Denary value
Computing	55
Science	56
Computers	57
are	58
Brilliant!	59
is	60
Fun!	61
Amazing!	62

Question 6

(b) The following table shows some words and corresponding denary values.

Binary value	00111000	00111100	00111110
Word			

Question 6

(c)(i) Complete the byte by writing the missing parity bit:

	parity bit ↓
0	1
0	1
1	1
0	___

[1]

Question 6

(c)(ii) The computer also uses parity block check. The parity block check uses even parity. Computer A transmits four bytes of data to computer B, followed by a parity byte. Computer B receives the following sequence of bytes.

								parity bit ↓
	1	0	1	1	0	1	1	1
	0	1	1	1	0	0	0	0
	0	0	0	1	1	0	1	1
	0	1	1	1	0	1	0	0
parity byte →	1	0	1	0	0	0	0	0

Question 6

Following transmission, one of the four bytes of data has an error in one of the bits. Circle the bit that has been altered during the data transfer. **[1]**

Question 6

(c)(i) Complete the byte by writing the missing parity bit: center (c)(ii) The computer also uses parity...

								parity bit ↓
	1	0	1	1	0	1	1	1
	0	1	1	1	0	0	0	0
	0	0	0	1	1	0	1	1
	0	1	1	1	0	1	0	0
parity byte →	1	0	1	0	0	0	0	0

Question 6

(c)(i) Complete the byte by writing the missing parity bit: center (c)(ii) The computer also uses parity...

Word	Denary value
Computing	55
Science	56
Computers	57
are	58
Brilliant!	59
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Amazing!	62

Question 6

(c)(i) Complete the byte by writing the missing parity bit: center (c)(ii) The computer also uses parity...

Binary value	00111000	00111100	00111110
Word			

Question 6

(d) A bitmap image has a resolution of 1000 pixels wide by 2000 pixels high.
The colour depth is 16 bits.
Calculate an estimate of the file size in megabytes.
Show your working.
File size ___ megabytes **[2]**

Question 6

Calculate an estimate of the file size in megabytes.

								parity bit ↓
	1	0	1	1	0	1	1	1
	0	1	1	1	0	0	0	0
	0	0	0	1	1	0	1	1
	0	1	1	1	0	1	0	0
parity byte →	1	0	1	0	0	0	0	0

Question 6

Calculate an estimate of the file size in megabytes.

Word	Denary value
Computing	55
Science	56
Computers	57
are	58
Brilliant!	59
is	60
Fun!	61
Amazing!	62

Question 6

Calculate an estimate of the file size in megabytes.

Binary value	00111000	00111100	00111110
Word			

Solution 6

(a)

Mark scheme

1 mark for correct answer

- Type of compression: lossy
- Justification: There will be fewer samples per second, so data will be permanently lost
- // There will be fewer samples per second, so the original sound cannot be re-created

Solution 6

(b) Mark scheme

1 mark for correct words in the correct order

- Binary Value
- 0011 1000
- 0011 1100
- 0011 1110
- Word
- Science is
- Amazing!

Solution 6

(c)(i) Worked steps

Know. A parity bit is chosen so that the **total number of 1s in the whole byte**, including the parity bit itself, matches the agreed parity. This system uses **even** parity, so the finished byte must contain an even number of 1s.

Count the 1s you were given. 0 1 0 1 1 1 0 — that is four 1s.

Decide. Four is already even, so the parity bit must add nothing.

Answer. The parity bit is **0**, giving 0 1 0 1 1 1 0 0.

Check. Count the finished byte, not the seven data bits: $0+1+0+1+1+1+0+0 =$ four 1s, even. ✓ Under **odd** parity the same data would need a 1. The only thing that ever changes between the two schemes is which total you are aiming for. Mark scheme

1 mark for correct answer parity bit

■ ↓

Solution 6

- 0
- 1
- 0
- 1
- 1
- 1
- 0
- 0

Solution 6

(c)(ii) Worked steps

Know. A parity **block** check runs the same test twice, in two directions: every byte (row) carries a parity bit, and a final **parity byte** carries a parity bit for each column. That is what lets it locate an error rather than merely detect one.

Work the columns. The parity byte is computed down each column of the four data bytes, under even parity — so for each column, count the 1s in the four bytes above and write the bit that makes that count even.

The parity bit of the parity byte. It is the parity of the parity byte itself, computed exactly as in (c)(i): count the 1s already in that byte and add whatever makes the total even.

Answer. Parity byte 1 0 1 0 0 0 0 with parity bit **0**.

Check. The reason this scheme is worth the extra byte: a single flipped bit breaks the parity of exactly one row **and** exactly one column, and the intersection of that row and

Solution 6

that column is the bit that is wrong — so the receiver can correct it, not just ask for a resend. Two errors in the same row cancel out and go undetected, which is the limitation to quote if a question asks for one. **Mark scheme**

---

1 mark for correct answer parity bit

- ↓
- 1
- 0
- 1
- 1
- 0
- 1

Solution 6

- 1
- 1
- 0
- 1
- 1
- 1
- 0
- 0
- 0
- 0
- 0

Solution 6

- 0
- 0
- 1
- 1
- 0
- 1
- 1
- 0
- 1
- 1
- 1

Solution 6

- 0
- 1
- 0
- 0 parity byte$\longrightarrow$
- 1
- 0
- 1
- 0
- 0
- 0
- 0

Solution 6

- 0

1

Solution 6

(d) Worked steps

File size is the number of pixels times the bits per pixel, converted to the unit asked for. Set the whole calculation out on one line before evaluating it — one mark is for the working.

```
(1000 * 2000 * 16) / (8 * 1000 * 1000)
```

Solution 6

- Pixels: $1000 \times 2000 = 2\,000\,000$
- Bits: $2\,000\,000 \times 16 = 32\,000\,000$
- Bytes: $\div 8 = 4\,000\,000$
- Megabytes: $\div 10^6 = \mathbf{4}$ MB

The shortcut the mark scheme also accepts: 16 bits is 2 bytes, so $1000 \times 2000 \times 2 \div 10^6$ reaches the same answer with one division fewer.

Divide by 8 **once**, at the point where bits become bytes — folding it in early is where the factor-of-eight errors come from. And answer in the unit the question names: the working ends in bytes and megabytes were asked for.

Solution 6

The word “estimate” is in the question because a real bitmap also carries a header, so the true file is slightly larger. Nothing needs adding for it; it is the reason the answer is an estimate rather than an exact size.

Mark scheme

1 mark for the working; 1 mark for the correct answer

- Working:
- (1000 * 2000 * 16) / (8 * 1000 * 1000)
- // (1000 * 2000 * 2 / (1000 * 1000)
- Answer: 4 megabytes

Question 6

9618/13 N24 ▪ Q6 ▪ 10 marks

6 A computer system stores text, images and sound.

(a) A character set is used to represent characters in a computer.

Identify **and** describe **one** character set.

Question 6

9618/13 N24 ▪ Q6 ▪ 10 marks

Question 6

9618/13 N24 ▪ Q6 ▪ 10 marks

Question 6

9618/13 N24 ▪ Q6 ▪ 10 marks

[2]

(b) The colour of each pixel in a bitmapped image is represented by 8 bits.

(i) State the largest number of different colours that can be represented by 8 bits.

Question 6

9618/13 N24 ▪ Q6 ▪ 10 marks

(ii) State **one** drawback of increasing the number of bits that represents each pixel in the bitmap image.

Question 6

9618/13 N24 ▪ Q6 ▪ 10 marks

(iii) A bitmap image can be compressed using lossy compression.

Explain the reasons why lossy compression is often suitable for a bitmap image.

Question 6

9618/13 N24 ▪ Q6 ▪ 10 marks

(c) **(i)** Explain how an analogue sound wave is converted into digital data.

Question 6

9618/13 N24 ▪ Q6 ▪ 10 marks

(ii) Describe **one** method of compressing a sound file using lossy compression.

Question 6

9618/13 N24 ▪ Q6 ▪ 10 marks

Solution 6

(a) Worked steps

Two marks: one for **naming** a character set, one for a description that **matches** the one you named. So decide first, then describe.

- **ASCII** — 7 or 8 bits per character, representing 128 or 256 characters, enough for the Latin alphabet, digits and punctuation.
- **Unicode** — 8, 16 or 32 bits per character, representing 256 to over 65 536 characters, enough for the characters of every language.

Solution 6

Pick one and stay with it. Naming ASCII and then describing 65 536 characters scores the identification mark only, and that pairing is exactly what "matching description" is testing.
The description has to be **quantitative**: give the bits per character or the number of characters. "It represents characters as binary" is true of both and distinguishes neither. **Mark scheme**

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1 mark for identification 1 mark for matching description

- e.g.
- ASCII
- 7/8 bits per character // represents 128/256 characters // represents all
- characters from Latin alphabet

Solution 6

- UNICODE
- 8/16/32 bits per character // represents 256/65536+ characters //
- represents all characters in all languages
- 2

Solution 6

(b)(i)

Worked steps

Colour depth is the number of bits per pixel, and the number of colours is how many different values those bits can take.

- 8 bits per pixel, so $2^8 = \mathbf{256}$ colours.

The rule generalises: *n* bits give 2^n colours, so 1 bit is 2 colours (black and white), and 24-bit "true colour" is 2^{24}, about 16.7 million.

Mark scheme

1 mark for:

- 256 // 28

Solution 6

(b)(ii)

Mark scheme

1 mark for:

- Increased file size

Solution 6

(b)(iii) Worked steps

Two marks from:

- The change is often **not noticeable** — the data removed is usually beyond what the eye detects, for example small differences in shade or fine detail.
- Lossy produces a **much larger reduction** in file size than lossless does.

Both halves are needed for a full answer: lossy is worth using because it saves a great deal *and* because what it discards is not missed. Either point alone is one mark. **Mark scheme**

1 mark for each bullet point (max 2)

- e.g.
- The change may not be noticeable // Data removed is usually not noticed

Solution 6

- by the human eye
- … for example, changes in shade/detail
- It produces a larger decrease in file size compared to lossless // Lossy
- decreases file size considerably
- 2

Solution 6

(c)(i) Worked steps

Describe **sampling**, in two steps.

- The **magnitude of the analogue sound wave is measured** a set number of times each second, at regular intervals.
- Each measurement is **given a binary value and stored in sequence**.

Solution 6

The two marks correspond to the two things a sampling rate and a sampling resolution control: how often you measure, and how finely each measurement is recorded. An answer that says only "the sound is converted to binary" describes the outcome without the method.

Mark scheme

1 mark for each bullet point (max 2)

- Value/magnitude/size of the analogue sound wave is measured a set
- number of times each second/time / at set intervals
- Each sample/reading/measurement is given the binary number and
- stored in sequence
- 2

Solution 6

(c)(ii) Worked steps

Each mark is a **method plus its explanation**, so give both halves of each point.

- **Decrease the sample rate** — fewer measurements are stored per second, so fewer bits per second of sound.
- **Decrease the sample resolution** — each measurement is stored in fewer bits.
- **Remove sounds outside the range of human hearing** — frequencies nobody can hear need not be stored at all.

Solution 6

A bare list of three methods earns three marks at most out of six. The pattern the mark scheme uses throughout this paper is *point, then expansion*, and the expansion is where the understanding shows.

Note the trade-off worth mentioning: the first two reduce quality — a lower rate loses high frequencies, a lower resolution adds quantisation noise — while the third is lossy in name only, since what it discards was never audible. **Mark scheme**

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1 mark for each correct point and 1 mark for matching expansion

- e.g.
- Decrease sample rate
- … fewer samples/readings/measurements stored per second // fewer bits
- per second stored

Solution 6

- Decrease sample resolution
- ... fewer bits per sample/reading/measurement // each sample has
- fewer bits
- Sound outside of set/human hearing range is removed
- ... fewer measurements are stored / decreases the number of possible
- binary values so fewer bits are stored
- 2

Question 7

9618/12 N24 ▪ Q7 ▪ 7 marks

A student takes a photograph of a science experiment.

(a)(i) Define the following bitmap terms. **[2]**

(a)(ii) Explain why changing the image resolution will affect the image quality and file size. **[2]**

(a)(iii) Identify **one** lossless method of compressing an image. **[1]**

(b) The student draws a picture on paper that is scanned into the computer and saved as a vector graphic.

Define the vector graphic terms property and drawing list. **[2]**

Solution 7

(a)(i)

Mark scheme

1 mark for each correct definition

- Colour depth:
- the number of bits used to represent a colour // the number of colours that can be represented in an image
- File header:
- stores data about the image file / metadata

Solution 7

(a)(ii) Mark scheme

1 mark for each correct explanation

- Image quality:
- Decreasing resolution means details within the image are lost because there are fewer pixels // Increasing resolution means the image is more detailed because there are more pixels
- File size:
- Decreasing the resolution will decrease the file size because there are fewer pixels therefore less data // Increasing the resolution will increase the file size because there are more pixels therefore more data

Solution 7

(a)(iii)

Mark scheme

1 mark for correct method

- For example:
- Run-Length Encoding

Solution 7

(b) Mark scheme

1 mark for each correct definition

- Property:
- an attribute of a drawing object // data about a shape // defines one aspect of the appearance of a drawing object
- Drawing list:
- all the drawing objects/shapes in an image // stores the commands/descriptions / mathematical equations required to draw each object
- 2