A LEVEL CAMBRIDGE

COMPUTER SCIENCE

Paper 1
2017 — 2021

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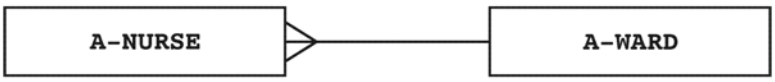
1 - (9608-S 2017-Paper 1/1-Q1) - *Information Representation*

A hospital is divided into two areas, Area A and Area B. Each area has several wards. All the ward names are different.

A number of nurses are based in Area A. These nurses always work on the same ward. Each nurse has a unique Nurse ID of `STRING` data type.



(a) Describe the relationship shown above.

.....

.....[1]

(b) A relational database is created to store the ward and nurse data. The two table designs for Area A are:

`A-WARD(WardName, NumberOfBeds)`

`A-NURSE(NurseID, FirstName, FamilyName, .....)`

(i) Complete the design for the `A-NURSE` table. [1]

(ii) Explain how the relationship in **part (a)** is implemented.

.....

.....

.....

.....[2]

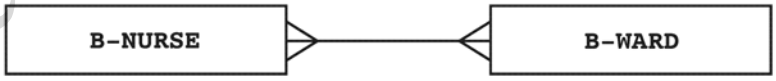
(c) In Area B of the hospital, there are a number of wards and a number of nurses.

Each Area B ward has a specialism.

Each Area B nurse has a specialism.

A nurse can be asked to work in any of the Area B wards where their specialism matches with the ward specialism.

The relationship for Area B of the hospital is:



(i) Explain what the degree of relationship is between the entities `B-NURSE` and `B-WARD`.

.....

.....[1]

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(ii) The design for the Area B data is as follows:

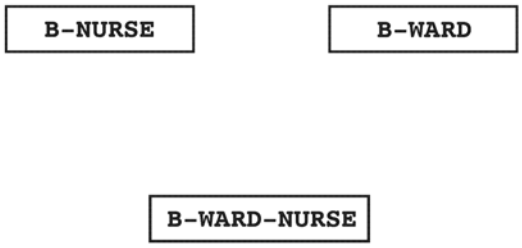
B-NURSE(NurseID, FirstName, FamilyName, Specialism)

B-WARD(WardName, NumberOfBeds, Specialism)

B-WARD-NURSE(.....)

Complete the attributes for the third table. Underline its primary key. [2]

(iii) Draw the relationships on the entity-relationship (E-R) diagram.



[2]

(d) Use the table designs in **part (c)(ii)**.

(i) Write an SQL query to display the Nurse ID and family name for all Area B nurses with a specialism of 'THEATRE'.

.....

.....

.....[3]

(ii) Fatima Woo is an Area B nurse with the nurse ID of 076. She has recently married, and her new family name is Chi.

Write an SQL command to update her record.

UPDATE .....

SET .....

WHERE .....

[3]

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2 - (9608-S 2017-Paper 1/1-Q3) - *Information Representation*

(a) A computer has a microphone and captures a voice recording using sound recording software.

Before making a recording, the user can select the sampling rate.

Define the term **sampling rate**. Explain how the sampling rate will influence the accuracy of the digitised sound.

Sampling rate .....

.....

.....

Explanation .....

.....

[2]

(b) The computer also has bitmap software.

(i) Define the terms **pixel** and **screen resolution**.

Pixel .....

.....

Screen resolution .....

.....

[2]

(ii) A picture has been drawn and is saved as a monochrome bitmap image.

State how many pixels are stored in one byte.

.....[1]

(iii) A second picture has width 2048 pixels and height 512 pixels. It is saved as a 256-colour image.

Calculate the file size in kilobytes.

Show your working.

.....

.....

.....

.....

.....

.....[3]

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(iv) The actual bitmap file size will be larger than your calculated value.

State another data item that the bitmap file stores in addition to the pixel data.

.....

.....[1]

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3 - (9608-S 2017-Paper 1/2-Q3) - *Information Representation*

(a) A computer has a microphone and captures a voice recording using sound editing software.

The user can select the sampling resolution before making a recording.

Define the term **sampling resolution**. Explain how the sampling resolution will affect the accuracy of the digitised sound.

Sampling resolution .....

.....

.....

Explanation .....

.....

[3]

(b) The computer also has bitmap software.

(i) Define the term **image resolution**.

.....

.....[1]

(ii) A picture is drawn and is saved as a 16-colour bitmap image.

State how many bits are used to encode the data for one pixel.

.....[1]

(iii) A second picture has width 8192 pixels and height 256 pixels. It is saved as a 256-colour bitmap.

Calculate the file size in kilobytes.

Show your working.

.....

.....

.....

.....

.....[3]

(iv) The actual bitmap file size will be larger than your calculated value as a bitmap file has a file header.

State **two** items of data that are stored in the file header.

1 .....

2 .....[2]

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4 - (9608-S 2017-Paper 1/3-Q3) - *Information Representation*

(a) A computer has a microphone and captures a voice recording using sound recording software.

Before making a recording, the user can select the sampling rate.

Define the term **sampling rate**. Explain how the sampling rate will influence the accuracy of the digitised sound.

Sampling rate .....

.....

.....

Explanation .....

.....

[2]

(b) The computer also has bitmap software.

(i) Define the terms **pixel** and **screen resolution**.

Pixel .....

.....

Screen resolution .....

.....

[2]

(ii) A picture has been drawn and is saved as a monochrome bitmap image.

State how many pixels are stored in one byte.

.....[1]

(iii) A second picture has width 2048 pixels and height 512 pixels. It is saved as a 256-colour image.

Calculate the file size in kilobytes.

Show your working.

.....

.....

.....

.....

.....

.....[3]

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(iv) The actual bitmap file size will be larger than your calculated value.

State another data item that the bitmap file stores in addition to the pixel data.

.....

.....[1]

5 - (9608-W 2017-Paper 1/1-Q1) - *Information Representation*

(a) Each of the following bytes represents an integer in two's complement form.

State the denary value.

(i) 0111 0111 Denary ..... [1]

(ii) 1000 1000 Denary ..... [1]

(iii) Express the following integer in two's complement form.

-17

[1]

(iv) State in denary, the range of integer values that it is possible to represent in two's complement integers using a single byte.

Lowest value .....

Highest value ..... [1]

(b) (i) Convert the following denary integer into Binary Coded Decimal (BCD).

653

.....[1]

(ii) A 3-digit BCD representation has been incorrectly copied. It is shown as:

0	1	0	0	1	1	1	0	0	0	1	0

State how you can recognise that this is not a valid BCD representation.

.....

.....[1]

(iii) Describe a practical application where BCD is used.

.....

.....[1]

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6 - (9608-W 2017-Paper 1/3-Q1) - *Information Representation*

(a) Each of the following bytes represents an integer in two's complement form.

State the denary value.

(i) `0111 0111` Denary ..... [1]

(ii) `1000 1000` Denary ..... [1]

(iii) Express the following integer in two's complement form.

`-17`

[1]

(iv) State in denary, the range of integer values that it is possible to represent in two's complement integers using a single byte.

Lowest value .....

Highest value ..... [1]

(b) **(i)** Convert the following denary integer into Binary Coded Decimal (BCD).

`653`

.....[1]

(ii) A 3-digit BCD representation has been incorrectly copied. It is shown as:

0	1	0	0	1	1	1	0	0	0	1	0

State how you can recognise that this is not a valid BCD representation.

.....

.....[1]

(iii) Describe a practical application where BCD is used.

.....

.....[1]

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7 - (9608-S 2018-Paper 1/1-Q2) - *Information Representation*

A logo is designed as a bitmap image.

(a) Describe what is meant by a **bitmap image**.

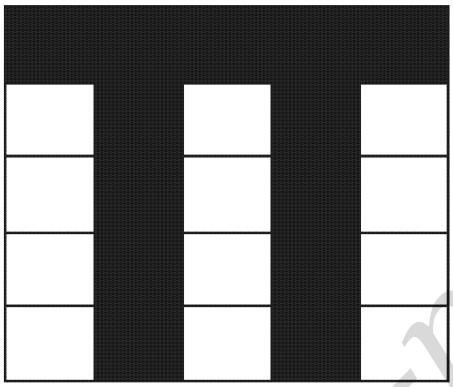
.....

.....

.....

.....[2]

(b) A black and white bitmap image is shown.



(i) Explain how a computer can store this bitmap image.

.....

.....

.....

.....[2]

(ii) The image is compressed before it is attached to an email.

Explain how run-length encoding (RLE) will compress the image.

.....

.....

.....

.....[2]

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(c) The finished logo is 500 pixels by 1000 pixels and uses 35 different colours.

Estimate the file size for the logo. Give your answer in kilobytes. Show your working.

Working .....

.....

.....

.....

.....

Answer .....

[4]

(d) The logo is redesigned as a vector graphic.

State **two** benefits of a vector graphic compared to a bitmap image. Give a reason for each benefit.

Benefit 1 .....

.....

Reason 1 .....

.....

Benefit 2 .....

.....

Reason 2 .....

.....

[4]

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8 - (9608-S 2018-Paper 1/2-Q5) - *Information Representation*

A student has recorded a sound track for a short film.

(a) Explain how an analogue sound wave is sampled to convert it into digital format.

.....

.....

.....

.....

.....

.....[3]

(b) Explain the effects of increasing the sampling resolution on the sound file.

.....

.....

.....

.....[2]

(c) The original sound was sampled at 44.1 kHz. The sample rate is changed to 22.05 kHz.

Explain the effects of this change on the sound file.

.....

.....

.....

.....

.....

.....

.....

.....[3]

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(d) The student uses sound editing software to edit the sound file.

Name **two** features of sound editing software the student can use to edit the sound file.

Describe the purpose of each feature.

Feature 1 .....

Purpose .....

.....

.....

Feature 2 .....

Purpose .....

.....

.....

[4]

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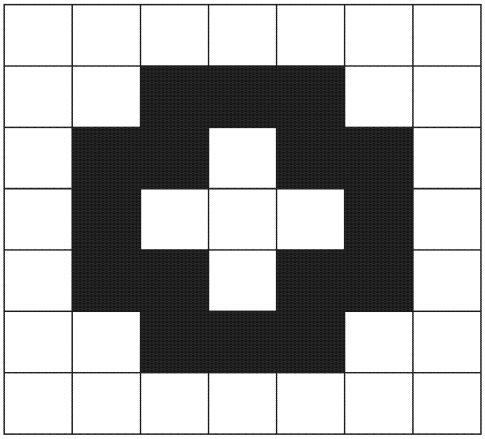
9 - (9608-S 2018-Paper 1/3-Q6) - *Information Representation*

A black and white bitmap image is shown.



(a) State the **minimum** number of bits needed to represent each pixel in this image.

.....[1]

(b) Run-length encoding (RLE) is used to store the image with the following colour codes.

Colour	Code
Black	1A
White	3B

Show how run-length encoding is used to store the image.

.....

.....

.....[3]

(c) An image has 30 different colours.

State the **minimum** number of bits needed to represent each pixel in the 30-colour image.

.....[1]

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(d) When the image is saved, a header is added to the file.

State the purpose of the **file header**. Give **two** examples of the file header contents.

Purpose .....

.....

Example 1 .....

.....

Example 2 .....

.....

[3]

(e) Graphics software is used to edit a digital photograph.

Give **three** features of graphics software that can be used to edit the photograph.

Describe the effect each has on the photograph.

Feature 1 .....

Effect .....

.....

.....

Feature 2 .....

Effect .....

.....

.....

Feature 3 .....

Effect .....

.....

.....

[6]

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10 - (9608-W 2018-Paper 1/1-Q1) - *Information Representation*

A student is creating a short video and needs to record music to play in the background.

(a) The student uses a microphone to capture the music.

Explain how the microphone captures the music.

.....

.....

.....

.....

.....

.....[3]

(b) An analogue-to-digital converter uses sampling to encode the sound.

Explain how different sampling resolutions affect the sound file and the sound it represents.

.....

.....

.....

.....

.....

.....[3]

(c) The student needs to edit the sound file.

Describe **two** features of sound editing software that can be used to edit the sound file.

Feature 1 .....

.....

.....

.....

Feature 2 .....

.....

.....

.....

[4]

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(d) The video is recorded with a frame rate of 60 frames per second (fps) and uses progressive encoding.

(i) Describe what is meant by **a frame rate of 60 fps**.

.....

.....[1]

(ii) Describe what is meant by **progressive encoding** in video recording.

.....

.....

.....

.....[2]

(e) MP4 multimedia container format is used to save the video.

State what is meant by **multimedia container format**.

.....

.....[1]

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ANSWERS

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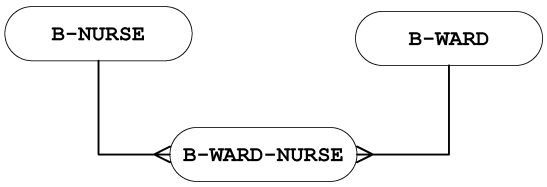
1 - (9608-S 2017-Paper 1/1-Q1) - *Information Representation*

(a)	Many-to-one	**1**
(b)(i)	A-NURSE(NurseID, FirstName, FamilyName, **WardName**)	**1**
(b)(ii)	• The primary key WardName in the A-WARD table ... 1 • ... links to the foreign key WardName in the A-NURSE table. 1	**2**
(c)(i)	Many-to-many relationship	**1**
(c)(ii)	B-WARD-NURSE(WardName, NurseID) Both attributes (with no additions) 1 Joint primary key correctly underlined 1	**2**
(c)(iii)	 Correct relationship between B-NURSE and B-WARD-NURSE 1 Correct relationship between B-WARD and B-WARD-NURSE 1	**2**
(d)(i)	SELECT NurseID, FamilyName 1 FROM B-NURSE 1 WHERE Specialism = 'THEATRE'; 1	**3**
(d)(ii)	UPDATE **B-NURSE** 1 SET **FamilyName = 'Chi'** 1 WHERE **NurseID = '076';** 1	**3**

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2 - (9608-S 2017-Paper 1/1-Q3) - *Information Representation*

(a)	*Sampling rate* The number of samples taken per unit time // the number of times the amplitude is measured per unit time 1 Increasing the sampling rate will increase the accuracy / precision of the digitised sound // Increasing the sampling rate will result in smaller quantisation errors. 1	**2**
(b)(i)	*Pixel* Smallest picture element which can be drawn 1 *Screen resolution* The number of pixels which can be viewed horizontally and vertically on the screen // or by example - A typical screen resolution is 1680 pixels × 1080 pixels. 1	**2**
(b)(ii)	8	**1**
(b)(iii)	*Working*: **Max two** from: • Number of pixels is 2048 × 512 1 • One pixel will be stored as one byte 1 • Number of kilobytes = (2048 × 512) / 1024 1 *Answer:* **One** mark: Number of kilobytes = 1024 KB 1	**3**
(b)(iv)	**One** from: • Confirmation that the file is a BMP 1 • File size 1 • Location/offset of image data within the file 1 • Dimensions of the image in pixels // image resolution 1 • Colour depth (bits per pixel) 1 • Type of compression used, if any 1	**1**

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3 - (9608-S 2017-Paper 1/2-Q3) - *Information Representation*

(a)	*Definition*: **Max two** from: • The number of distinct values available to encode/represent each sample 1 • Specified by the number of bits used to encode the data for one sample 1 • Sometimes referred to as bit depth 1 *Explanation:* **Max two** from: • A larger sampling resolution will mean there are more values available to store each sample 1 • A larger sampling resolution will improve the accuracy of the digitised sound // A larger sampling resolution will decrease the distortion of the sound 1 • Increased sampling resolution means a smaller quantization error 1	**Max 3**
(b)(i)	**One** from: • The number of pixels per unit measurement 1 • The number of pixels in an image 1 • The number of pixels wide by the number of pixels high 1 • Number of pixels per row by the number of rows 1	**1**
(b)(ii)	4	**1**
(b)(iii)	*Working*: **Max two** from: • Number of pixels is 8192 × 256 1 • One pixel will be stored as one byte 1 • Number of kilobytes = (8192 × 256) / 1024 1 *Answer:* **One** mark: Number of kilobytes = 2048 KB 1	**3**
(b)(iv)	**Two** from: • Confirmation that the file is a BMP 1 • File size 1 • Location/offset of image data within the file 1 • Dimensions of the image (in pixels) // image resolution 1 • Colour depth (bits per pixel, 1, 4, 8, 16, 24 or 32) 1 • Type of compression used, if any 1	**Max 2**

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4 - (9608-S 2017-Paper 1/3-Q3) - *Information Representation*

(a)	*Sampling rate* The number of samples taken per unit time // the number of times the amplitude is measured per unit time 1 Increasing the sampling rate will increase the accuracy / precision of the digitised sound // Increasing the sampling rate will result in smaller quantisation errors. 1	**2**
(b)(i)	*Pixel* Smallest picture element which can be drawn 1 *Screen resolution* The number of pixels which can be viewed horizontally and vertically on the screen // or by example - A typical screen resolution is 1680 pixels × 1080 pixels. 1	**2**
(b)(ii)	8	**1**
(b)(iii)	*Working*: **Max two** from: • Number of pixels is 2048 × 512 1 • One pixel will be stored as one byte 1 • Number of kilobytes = (2048 × 512) / 1024 1 *Answer:* **One** mark: Number of kilobytes = 1024 KB 1	**3**
(b)(iv)	**One** from: • Confirmation that the file is a BMP 1 • File size 1 • Location/offset of image data within the file 1 • Dimensions of the image in pixels // image resolution 1 • Colour depth (bits per pixel) 1 • Type of compression used, if any 1	**1**

5 - (9608-W 2017-Paper 1/1-Q1) - *Information Representation*

(a)(i)	119	**1**
(a)(ii)	–120	**1**
(a)(iii)	1 1 1 0 1 1 1 1	**1**
(a)(iv)	Lowest value: −128 Highest value: +127	**1**
(b)(i)	0110 0101 0011	**1**
(b)(ii)	The second block of four binary digits represents a digit larger than 9 // 14	**1**
(b)(iii)	A string of digits on any electronic device displaying numeric values	**1**

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6 - (9608-W 2017-Paper 1/3-Q1) - *Information Representation*

(a)(i)	119	**1**
(a)(ii)	–120	**1**
(a)(iii)	1 1 1 0 1 1 1 1	**1**
(a)(iv)	Lowest value: −128 Highest value: +127	**1**
(b)(i)	0110 0101 0011	**1**
(b)(ii)	The second block of four binary digits represents a digit larger than 9 // 14	**1**
(b)(iii)	A string of digits on any electronic device displaying numeric values	**1**

7 - (9608-S 2018-Paper 1/1-Q2) - *Information Representation*

(a)	**1 mark** per bullet, **max 2** • Made up of pixels • Each pixel has one colour • Colour of each pixel stored as a binary number	**2**
(b)(i)	**1 mark** per bullet, **max 2** • Each pixel requires only one bit (as there are only two colours) • Black represented by 1 and white by 0 (or vice versa) • Bits are stored for each pixel in sequence • 11111 01010 01010 01010 01010	**2**
(b)(ii)	**1 mark** for the explanation • Stores the colour and the number of times it occurs **1 mark** for example from • An example from the bitmap given e.g. B5, W1, B1 and so on	**2**
(c)	**1 mark** per bullet • Number of pixels 500*1000 (= 500 000) • 35 colours require 6 bits per pixel • Number of bytes (500 000 * 6) / 8 = 3 000 000 / 8 (= 375 000) • = **375 Kb**	**4**

(d)	**1 mark** per bullet to **max 2** marks per benefit • Can resize it without pixilation • Image is redrawn/recalculated with each adjustment • Smaller file size • Storing points/equations/commands etc., not individual pixels	**4**

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8 - (9608-S 2018-Paper 1/2-Q5) - *Information Representation*

(a)	**1 mark** per bullet to **max 3** • Amplitude (of the sound wave) measured • At set / regular time intervals / per time unit / time period • Value of the sample is recorded as a binary number	**3**
(b)	**1 mark** per bullet to **max 2** • (Increasing the sampling resolution means) more bits per sample // larger range of values • Larger file size • More accurate representation of sound	**2**
(c)	**1 mark** per bullet to **max 3** • Fewer samples (per unit time) • File size will decrease • Larger gaps / spaces between samples // Greater quantization errors • Sound accuracy will reduce // not as close to original sound	**3**

(d)	**1 mark** for naming feature/tool, **1 mark** for description. **Max 2** features e.g. • Fading • Change the volume of a section of the sound for it get louder/quieter • Removing sound / elements • Delete sections of the sound wave, for example, background noise • Copy • Repeat elements of the sound wave	**4**

9 - (9608-S 2018-Paper 1/3-Q6) - *Information Representation*

(a)	1	**1**
(b)	**1 mark** for correct method (colour code and number of pixels) **1 mark** for first 7 groups correct **1 mark** for remainder correct • 3B9 1A3 3B3 1A2 3B1 1A2 3B2 • 1A1 3B3 1A1 3B2 1A2 3B1 1A2 3B3 1A3 3B9	**3**
(c)	5	**1**

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(d)	**1 mark** for purpose • Stores data about the file contents/image/metadata **Max 2 marks** for examples of contents • Confirmation that the file is a BMP // confirmation of file type • File size • Location / offset of image data within the file • Dimensions of the image (in pixels) // image resolution • Colour depth (bits per pixel, 1, 4, 8, 16, 24 or 32) • Type of compression used (if any)	**3**
(e)	**1 mark** for naming tool, **1 mark** for describing effect **on the photograph** e.g. • Resize • Increase / decrease the size of the image • Crop • Remove part of the image • Blur • Reduce the focus • Red eye reduction • Reduces red (light reflected from human eyes)	**6**

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10 - (9608-W 2018-Paper 1/1-Q1) - *Information Representation*

(a)	**1 mark** per bullet point to **max 3** • The microphone has a diaphragm • The incoming sound waves cause vibrations • … causing a coil to move past a magnet (dynamic microphone) // changing the capacitance (condenser microphone) • An electric current is generated / changed	**3**
(b)	**1 mark** per bullet point • The sampling resolution number of bits used to store each sample • Increasing the (sampling) resolution means a larger file size // Decreasing the (sampling) resolution means a smaller file size • Increasing the (sampling) resolution gives a more accurate representation of the analogue sound // Decreasing the (sampling) resolution gives a less accurate representation of the analogue sound • Increasing the (sampling) resolution means a greater range of values can be stored // Decreasing the (sampling) resolution gives a smaller range of values that can be stored • Increasing the (sampling) resolution reduces the quantization errors // Decreasing the (sampling) resolution causes greater quantization errors	**3**
(c)	For **2 features** **1 mark** for identifying feature, **1 mark** for describing what it does. For example: • Cut/delete • ... Remove part of the sound file • Copy and paste • ... Replicate part of the sound • Amplify • ... Increase the volume of a section of sound	**4**
(d)(i)	60 images are recorded per second	**1**
(d)(ii)	**1 mark** per bullet point to **max 2** • Each frame contains (all the lines for) the complete image • All the frame data is recorded at the same time • Each frame contains all the scan lines • The number of images stored is the same as the frame rate	**2**
(e)	**1 mark** per bullet point to **max 1** • A meta file / wrapper • Contains various different types of data	**1**

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