Computer Science

CAIE Topical

Past Papers

2012-2020

all variants/previous codes

AS P1

papers dock

Table of Content

Information Representation

Question 1

4) A digital camera takes a bitmap image. The image is 2000 pixels wide by 1000 pixels high with a colour depth of 24-bits.

(a) Calculate an estimate of the file size for the image. Give your answer in megabytes. Show your working.

Working

.....

.....

.....

.....

.....

Answer..... MB [3]

(b) A second image is taken, this time in black and white. It has the same number of pixels, but the file size is smaller.

Explain why the file size is smaller.

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.....

[2]

(c) The digital camera allows a user to add text to an image. The text is encoded as ASCII values.

The table shows the ASCII denary values for five characters.

Character	ASCII denary value
a	97
b	98
c	99
d	100
e	101

(i) Give the 8-bit binary value for the ASCII character ‘b’.

.....

.....

[1]

(ii) Complete the table by writing the ASCII denary value for the character ‘t’ and its hexadecimal equivalent.

Character	t
ASCII denary value	
Hexadecimal value	

9608_s20_qp_11/q4

Question 2

(1b) Samira uses a computer to draw a logo for her hotel and saves it as a vector graphic. The logo will be placed on the multimedia presentation and elsewhere, such as on signs at the entrance of the hotel.

Samira emails the logo to a company that prints signs, and other documentation for the hotel.

(i) Describe how the logo is represented by the computer.

.....

.....

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.....

[3]

(ii) State **two** reasons why the hotel **logo** is saved as a vector graphic instead of a bitmapped graphic.

1 .....

.....

2 .....

.....

[2]

Question 3

2) Amir has created a sound file using his desktop computer.

(a) Complete the table by writing the missing definitions and term about sound.

Term	Definition
Sampling	....
....	The number of samples per unit time
Sampling resolution	....

[3]

(b) The file is too large to be emailed and the file size needs to be reduced.

(i) Name one lossless compression technique that can be used to reduce the size of the sound file.

.....

.....

[1]

(ii) Describe **one** lossy compression technique that can be used to reduce the size of the sound file.

.....

.....

.....

.....

[2] 9608/12/M/J/20/2

Question 4

(5b) Wei wants to compress the source code to transport it to another computer.

Identify the most appropriate compression technique he should use.

Justify your choice.

Compression technique .....

Justification .....

.....

.....

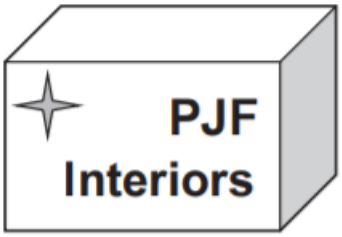
.....

.....

[3] 9608/13/M/J/20/5b

Question 5

7) Xiaoming created the following logo using bitmapped graphics software.



(a) Describe how **one** typical feature of bitmapped graphics software was used to create the logo.

.....

.....

.....

.....

[2]

(b) The finished logo is 160 pixels wide and 160 pixels high. The image has a colour depth of 3 bytes per pixel.

Calculate an estimate of the file size for the logo. Give your answer in kilobytes. Show your working.

Working .....

.....

.....

Answer ..... KB

[3]

(c) Xiaoming needs to use his logo on his business card, on his website and on large display boards. He is told that he should have created a vector graphic logo instead of a bitmapped graphic logo.

Describe one benefit of creating a vector graphic logo instead of a bitmapped graphic logo.

.....

.....

.....

.....

[2]

(d) The hexadecimal colour value of the background of Xiaoming's website is:

913C8E

Complete the following table by converting each hexadecimal value to denary value.

	Red	Green	Blue
Hexadecimal value	91	3C	8E
Denary value			

[2]

Question 6

(1d) A recording of a concert is stored as a file. The file is compressed using lossy compression before it is streamed to users.

(i) State why this file needs to be compressed.

.....

.....

[1]

(ii) Define the term **lossy compression**.

.....

.....

[1]

(iii) The file could be compressed using lossless compression.

Explain why lossy compression is a more appropriate compression technique than lossless for this file.

.....

.....

.....

.....

.....

.....

[3] 9608/11/M/J/19

Question 7

6) A student records a video using a digital camera.

(a) The recording uses interlaced encoding.

Describe **interlaced encoding**.

.....

.....

.....

.....

.....

.....

.....[3]

(b) State **one** benefit of using interlaced encoding compared to progressive encoding.

……

…… [1]

(c) A video can be compressed using spatial redundancy or temporal redundancy.

Explain how **temporal redundancy** compresses a video.

……

……

……

……

……[2]

(d) A sound track is recorded for the video.

(i) Describe how a computer encodes the sound track.

……

……

……

……

……

……[3]

(ii) Explain how the sampling rate and sampling resolution affect the file size of the sound track.

Sampling rate ……

……

Sampling resolution ……

……

[2]

Question 8

(b) The video is recorded using progressive encoding.

Describe **progressive encoding.**

……

……

……

…… **[2]**

9608/12/M/J/19/4b

Question 9

5) Xander creates a presentation that includes images, video and sound.

(a) The images are bitmap images. A bitmap image can be made up of any number of colours. Each colour is represented by a unique binary number.

Draw one line from each box on the left, to the correct box on the right to identify the minimum number of bits needed to store each maximum number of colours.

Maximum number of colours	Minimum number of bits
68	1
256	2
127	3
2	7
249	8
	9

[3]

(b) One of the videos has a frame rate of 40fps (frames per second).

(i) State what is meant by **40fps**.

.....

.....
[1]

(ii) One video uses interlaced encoding, and a second video uses progressive encoding.

Describe two differences between interlaced and progressive encoding.

1 .....

.....

.....

.....

2 .....

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.....

.....

[4]

(c) The sound track has a **sampling rate of 88.2 kHz** and a **sampling resolution of 32 bits**.

State what is meant by a sampling rate of 88.2 kHz and a sampling resolution of 32 bits.

Sampling rate of 88.2 kHz .....

.....

.....

Sampling resolution of 32 bits.....

.....

.....

[2]

Question 10

5 (a) The bit depth of an image dictates how many different colours can be represented by each pixel.

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

..... [1]

(ii) One binary colour is represented by 0100 1110

Convert the unsigned binary number 0100 1110 into denary.

..... [1]

(b) Convert the denary number −194 into 12-bit two's complement.

..... [1]

(c) (i) Convert the Binary Coded Decimal (BCD) value 0110 1001 into denary.

..... [1]

(ii) Identify one practical application where BCD is used.

.....

.....[1]

(d) One example of a character set used by computers is ASCII.

Describe how one character is represented in a character set.

.....

.....

.....

..... [2]

(e) Data can be compressed using either lossy or lossless compression.

Tick (✓) one box in each scenario to identify whether lossy or lossless compression should be used. Justify your choice.

(i) A program written in a high-level language.

Lossy	Lossless

Justification .....

.....

.....

.....[2]

Lossy	Lossless

(ii) A photograph that needs to be emailed to a friend.

Justification .....

.....

.....

.....[2]

(iii) You need to upload a video that you have created to a website.

Lossy	Lossless

Justification .....

.....

.....

[2]

Question 11

(d) Dominic's tablet captures a video of Dominic to send to other people. The video is made of a sequence of images and a sound file.

(i) Describe how the images and sound are encoded into a digital form.

Images.....
.....

.....

.....

Sound.....

.....

.....

.....

[4]

(ii) The sequence of images and the sound file create a video. This is sent over the Internet as a video stream. The video stream can use interlaced encoding or progressive encoding.

Describe the terms **interlaced encoding** and **progressive encoding**.

Interlaced encoding.....

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.....

Progressive encoding.....

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.....

[4]

(iii) Describe the following video terms.

Temporal redundancy .....

.....

.....

.....

Spatial redundancy .....

.....

..... [2]

Question 12

(2b) Leonardo uses the mobile phone to record his voice.

(i) Describe how sound sampling is used by the mobile phone to encode the sound.

.....

.....

.....

.....[2]

(ii) Leonardo records his voice twice. Each recording is the same length and has the same sampling resolution. The first recording has a sampling rate of 44100Hz. The second recording has a sampling rate of 21000Hz.

Describe how the different sampling rates will affect the recording and the sound file.

.....

.....

.....

.....

[2]

(iii) Leonardo transfers the recordings to his laptop computer. He uses sound editing

Software to delete some sections of the recordings, and copy and paste to replicate other sections.

Describe two other features of sound editing software Leonardo can use to edit the recordings.

1 .....

.....

.....

.....

2 .....

.....

.....[4]

Question 13

2) 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]

(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] 9608/11/M/J/18

Question 14

5 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.

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.....

.....[3]

(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 .....

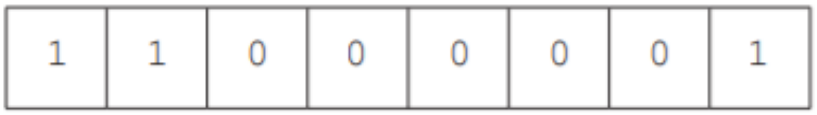
.....

.....

[4] 9608/12/M/J/18

Question 15

(c) H is a register. The current contents of H are:



The current contents of register H represent an unsigned binary integer.

(i) Convert the value in register H into denary.

.....[1]

(ii) Convert the value in register H into hexadecimal.

.....[1]

(iii) The current contents of register H represent a two's complement binary integer.

Convert the value in register H into denary.

.....[1]

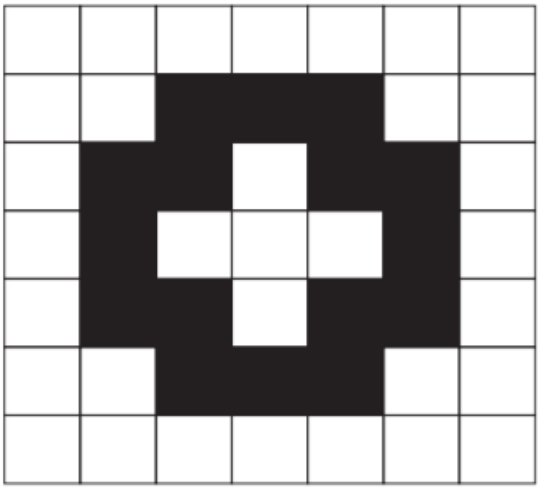
(iv) State why register H does not currently contain a Binary Coded Decimal (BCD).

.....

.....[1]

Question 16

6) 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]

(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]

Question 17

1) 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]

(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]

Question 18

(c) The current contents of a general purpose register (X) are:

(i) The contents of X represent an unsigned binary integer.

Convert the value in X into denary.

.....[1]

(ii) The contents of X represent an unsigned binary integer.

Convert the value in X into hexadecimal.

.....[1]

(iii) The contents of X represent a two's complement binary integer.

Convert the value in X into denary.

.....[1]

Question 19

1) A company is designing a website.

(a) The company creates a 4-colour bitmap image for the website as shown.

Each colour is represented by a letter, for example, G = grey, K = black.

G	R	G	K	W	R
G	R	G	K	W	R
G	R	G	K	W	R
G	R	G	K	W	R
G	G	G	K	K	R
W	W	W	W	K	R

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

..... [1]

(ii) Calculate the minimum file size of the image shown in part (a). Show your working.

Working .....

.....

.....

.....

File size .....[3]

(b) The company takes a photograph of their office to put on the website. The photograph has a resolution of 1000 pixels by 1000 pixels. Two bytes per pixel are used to represent the colours.

(i) Estimate the file size of the photograph in megabytes. Show your working.

Working .....

.....

.....

.....

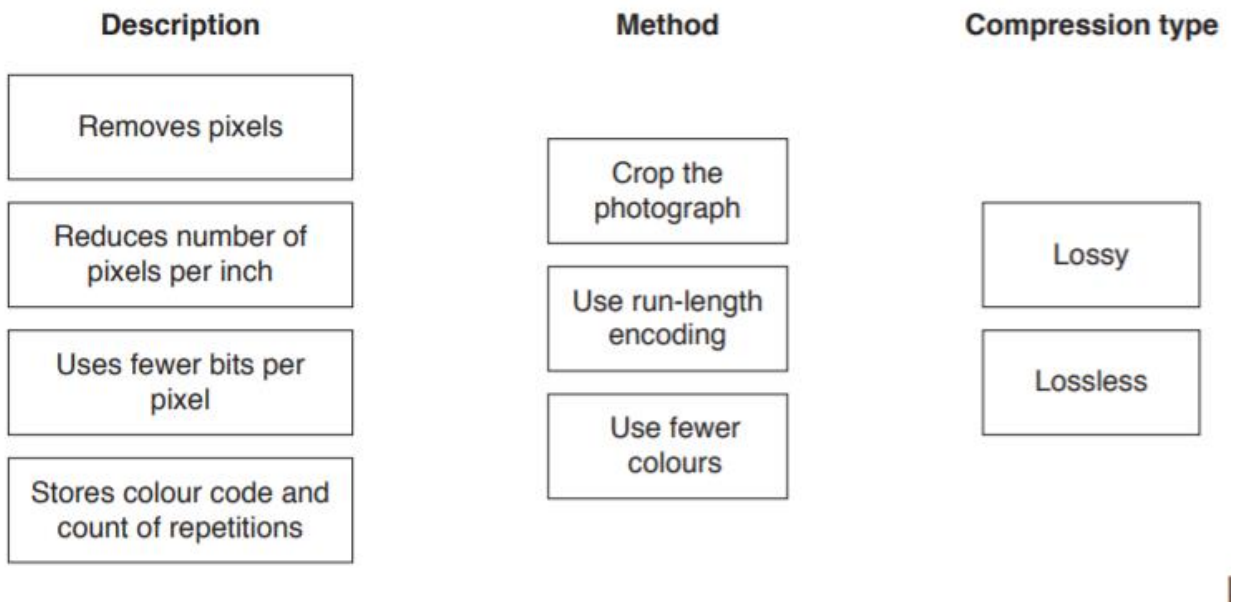
Estimated file size .....

[4]

(ii) The file size of the photograph needs to be reduced before it is placed on the website.

Draw lines to link each method of reducing the file size of the image to:

- Its description and
- Its compression type, where appropriate.



[5]

(c) The company has created a logo for the website. The logo is a vector graphic.

Describe **two** reasons why a vector graphic is a sensible choice for the logo.

Reason 1 .....

.....

.....

.....

Reason 2 .....

.....

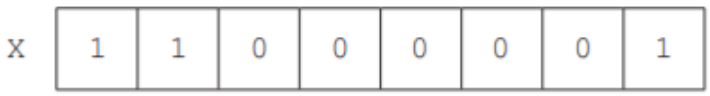
.....

.....

[4]

Question 20

(3c) the current contents of a general purpose register (X) are:



(i) The contents of X represent an unsigned binary integer.

Convert the value in X into denary.

..... [1]

(ii) The contents of X represent an unsigned binary integer.

Convert the value in X into hexadecimal.

..... [1]

(iii) The contents of X represent a two's complement binary integer.

Convert the value in X into denary.

..... [1]

Question 21

1) A product designer is creating a poster.

(a) The designer creates a 6-colour bitmap image for the poster as shown.

Each colour is represented by a letter, for example, R = red, B = blue.

R	R	P	P	P	G
B	R	R	P	G	G
B	W	B	B	O	O
B	W	W	P	P	O
B	B	R	P	G	O
B	R	R	P	G	O

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

.....[1]

(ii) Calculate the minimum file size of the image shown in part (a). Show your working.

Working .....

.....

.....

File size .....

[3]

(b) (i) The designer takes a photograph to put on the poster. The photograph has a resolution of 50000 pixels by 50000 pixels. The colours are represented using 4 bytes per pixel.

Estimate the file size of the photograph in gigabytes. Show your working.

Working .....

.....

.....

.....

Estimated file size .....[4]

(ii) The photograph needs to be sent by email but the file size is too big. It needs to be compressed.

The table lists several methods of making an image file size smaller.

Tick (✓) one box on each row to indicate whether each method is lossy or lossless

Compression method	Lossy	Lossless
Cropping the image		
Reducing the resolution of the image		
Using run-length encoding (RLE)		
Reducing the colour depth of the image		

(c) Explain how run-length encoding would compress the image in **part (a).**

.....

.....

.....

.....

.....

.....[3]

Question 22

(b) The current contents of a general purpose register (X) are:

X	1	1	1	1	0	0	1	0

(i) The contents of X represent an unsigned binary integer.

Convert the value in X into denary.

.....[1]

(ii) The contents of X represent an unsigned binary integer.

Convert the value in X into hexadecimal.

.....[1]

(iii) The contents of X represent a two's complement binary integer.

Convert the value in X into denary.

.....[1]

Question 23

3 (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]

(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]

Question 24

3 (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]

Question 25

3 (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]

(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]

Question 26

1 **(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]

Question 27

2 **(a)** Convert the following denary integer into 8-bit binary.

55

[1]

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

10000011

.....[1]

(c) Convert the following denary integer into 8-bit two's complement.

-102

[2]

(d) Convert the following hexadecimal number into denary.

4E

.....[1]

Question 28

4 A group of students broadcast a school radio station on a website. They record their sound clips (programmes) in advance and email them to the producer.

(a) Describe how sampling is used to record the sound clips.

.....

.....

.....

.....

.....

.....[3]

(b) The students use software to compress the sound clips before emailing them.

(i) Circle your chosen method of compression and justify your choice.

Lossy / Lossless

Justification: .....

.....

.....

.....[3]

Students also email images to the radio station for use on its website.

These are compressed before sending using run-length encoding (RLE).

(ii) Explain what is meant by run-length encoding.

.....

.....

.....

.....

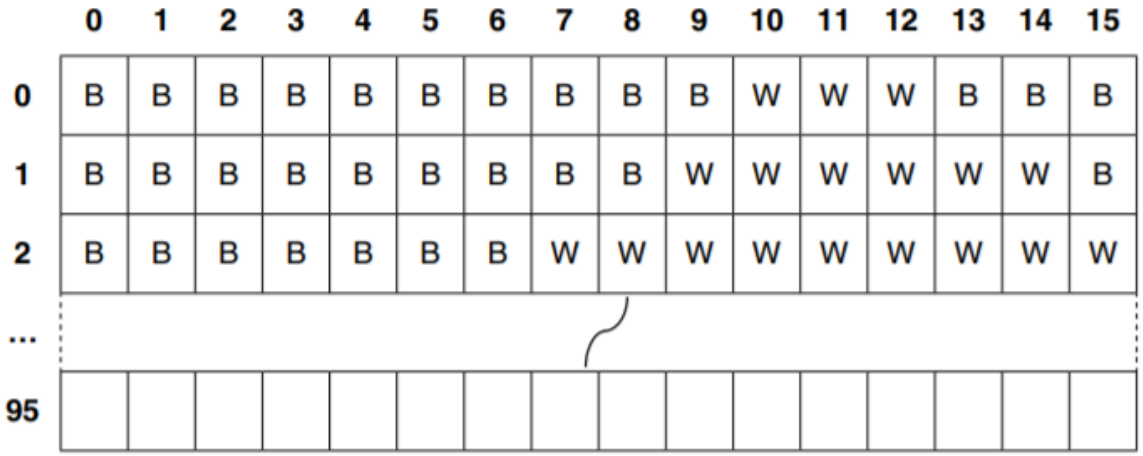
.....

.....[3]

(iii) The following diagrams show:

- the denary colour code that represents each colour
- the first three rows of a bitmap image

Colour symbol	Colour code (denary)
B	153
W	255



Show how RLE will compress the first three rows of this image.

Row 1: .....

Row 2: .....

Row 3: .....[2]

Question 29

2 **(a)** Convert the following 8-bit binary integer into denary.

01001101

.....[1]

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

82

.....[1]

(c) Convert the following two's complement integer number into denary.

11001011

.....

.....

.....[2]

(d) Convert the following denary number into hexadecimal. Show your working.

198

.....[2]

Question 30

3 **(a)** **(i)** Convert the denary number 46 to an 8-bit binary integer.

.....

.....[1]

(ii) Convert the denary integer –46 to an 8-bit two's complement form.

.....

.....[1]

(iii) Convert the denary number 46 into hexadecimal.

.....

.....[1]

(b) Binary Coded Decimal (BCD) is another way of representing numbers.

(i) Describe how denary integers larger than 9 can be converted into BCD.
Give an example in your answer.

.....

.....

.....

.....[2]

(ii) Describe how an 8-bit BCD representation can be converted into a denary integer.
Give an example in your answer.

.....

.....

.....

.....[2]

Question 31

(b) The images contained in the magazines are produced using either bitmap or vector graphics software.

Give **four** differences between bitmap and vector graphics.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....[4]

Question 32

2 **(a)** When recording a video, state what is meant by frame rate.

.....

.....[1]

(b) Video streaming can use either interlaced encoding or progressive encoding.

Describe what is meant by the following terms.

Interlaced encoding

.....

.....

.....

.....

Progressive encoding

.....

.....

.....

.....[4]

(c) (i) Name the video terms described below:

Description	Term
Pixels in two video frames have the same value in the same location. There is duplication of data between frames.	.....
A sequence of pixels in a single video frame have the same value.	.....

[2]

(ii) Give **one** file technique that could be applied when either of the two features, described in **part (c)(i)**, are present.

.....

.....[1]

Question 33

4 Hexadecimal, Binary Coded Decimal (BCD) and binary values are shown below.

Draw a line to link each value to its correct denary value.

Hexadecimal, BCD, binary	Denary
	93
Hexadecimal: 3A	-65
BCD representation: 0100 1001	58
	-63
Binary integer: 01011101	73
Two's complement binary integer: 11000001	49
	-93

[4]

Question 34

1 (i) Convert the following binary number into hexadecimal.

1 0 1 1 1 0 0 0

.....[1]

(ii) Convert the following denary number into BCD format.

9 7

.....[1]

(iii) Using two's complement, show how the following denary numbers could be stored in an 8-bit register:

114 | | | | | | | | |

- 93 | | | | | | | | |

[2]

Question 35

2 (a) Sound can be represented in a computer in a digital format.

(i) Give the definition of the term sampling.

.....

.....

.....[1]

(ii) Give one reason why 16-bit sampling is used in an audio compact disc (CD).

.....

.....[1]

(iii) Explain what is meant by the term sampling resolution.

.....

.....

.....

.....[2]

(iv) Give one benefit and one drawback of using a higher sampling resolution.

Benefit .....

.....

Drawback .....

.....[2]

(b) Describe two typical features found in software for editing sound files.

1.....

.....

2.....

..... [2]

(c) Explain the difference between lossless and lossy data compression techniques.

.....

.....

.....

.....

.....

.....[3]

Question 36

1 (a) (i) Using two's complement, show how the following denary numbers could be stored in an 8-bit register:

124 | | | | | | | | |

–77 | | | | | | | | |

[2]

(ii) Convert the two numbers in **part (a) (i)** into hexadecimal.

124 .....

–77 .....

[2]

(b) Binary Coded Decimal (BCD) is another way of representing numbers.

(i) Write the number 359 in BCD form.

..... [1]

(ii) Describe a use of BCD number representation.

.....

..... [2]

Question 37

8 **(a)** Six computer graphics terms and seven descriptions are shown below.

Draw a line to link each term to its correct description.

Term	Description
Bitmap graphic	Measured in dots per inch (dpi); this value determines the amount of detail an image has
Image file header	Picture element
Image resolution	Image made up of rows and columns of picture elements
Pixel	Image made up of drawing objects. The properties of each object determine its shape and appearance.
Screen resolution	Specifies the image size, number of colours, and other data needed to display the image data
Vector graphic	Number of samples taken per second to represent some event in a digital format
	Value quoted for a monitor specification, such as 1024 × 768. The larger the numbers, the more picture elements will be displayed.

[6]

(b) **(i)** A black and white image is 512 pixels by 256 pixels.

Calculate the file size of this image in kilobytes (KB) (1 KB = 1024 bytes).
Show your working.

.....

.....

.....

.....

.....[2]

(ii) Give a reason why it is important to estimate the file size of an image.

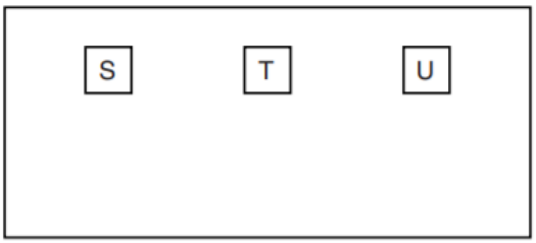
.....

.....

.....[1]

Question 38

3 A touch screen has three squares where a selection can be made:



(a) The x-coordinate of the centre of the three squares is held in three memory locations:

	Address	Memory contents
S	40	0000 1011 0100
T	41	0010 0101 0100
U	42	0100 0110 1100

(i) Give the hexadecimal value of the memory contents for U.

.....

.....[1]

(ii) Convert the denary number 40 into binary.

.....

.....[1]

(b) Bitmap graphics are used to represent squares S, T and U.

These can be saved in a number of different image resolutions.

(i) Give the number of bits required to store each pixel for a black and white bitmap.

.....[1]

(ii) Identify how many bits are required to store each pixel for a 256-colour bitmap.

Explain your answer.

.....

.....

.....[2]

(c) Images can be compressed to reduce file size.

(i) Describe how lossless compression techniques work.

.....

.....

.....

.....[2]

(ii) Describe how lossy compression techniques work.

.....

.....

.....

.....[2]

Question 39

4 **(a)** Sound can be represented digitally in a computer.

Explain the terms sampling resolution and sampling rate.

Sampling resolution .....

.....

.....

.....

Sampling rate .....

.....

.....

.....[4]

(b) The following information refers to a music track being recorded on a CD:

- music is sampled 44 100 times per second
- each sample is 16 bits
- each track requires sampling for left and right speakers

(i) Calculate the number of bytes required to store one second of sampled music.
Show your working.

.....

.....

.....

.....[2]

(ii) A particular track is four minutes long.

Describe how you would calculate the number of megabytes required to store this track.

.....

.....

.....

.....[2]

(c) When storing music tracks in a computer, the MP3 format is often used. This reduces file size by about 90%.

Explain how the music quality is apparently retained.

.....

.....

.....

.....

.....

.....[3]

Question 40

(c) The program used the ASCII coding system for character codes. An alternative coding system is Unicode.

(i) Give **two** disadvantages of using ASCII code.

1 .....

.....

2 .....

.....[2]

(ii) Describe how Unicode is designed to overcome the disadvantages of ASCII.

.....

.....

.....

.....[2]

Answers

Answer 1

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>1 mark per bullet point

• 2000 * 1000 * 24 = 48 000 000 bits
• 48 000 000 / 8 / 1024 / 1024
• = 6 MB or 5.7 MB</td><td>3</td></tr>
<tr><td>4(b)</td><td>1 mark per bullet point to max 2

• Only 1 bit needed to store the colour of each pixel ...
• ... so number of pixels * bit depth is 2000 * 1000 * 1 (rather than 2000 * 1000 * 24)
• ... so the calculation (in part 4(a)) results in smaller figure for file size</td><td>2</td></tr>
<tr><td>4(c)(i)</td><td>0110 0010</td><td>1</td></tr>
<tr><td>4(c)(ii)</td><td>1 mark for each correct line

<table><tr><th>Character</th><th>t</th></tr><tr><td>ASCII denary value</td><td>116</td></tr><tr><td>Hexadecimal value</td><td>74</td></tr></table></td><td>2</td></tr>
</table>

Answer 2

<table>
<tr><td>1(b)(i)</td><td>1 mark per bullet point to max 3

• It is a series of (geometric) shapes / lines / objects
• Stored coordinates
• Contains a drawing list
• Commands / formulae for creating each individual object
• and the attributes/property for that object
• E.g. the colour, thickness of line etc.</td><td>3</td></tr>
<tr><td>1(b)(ii)</td><td>1 mark per bullet point to max 2

• Needs to be large for the signs without becoming pixelated.
• Smaller file size means faster transfer rates are possible.
• Smaller file size reduces storage requirements when stored many times (on multiple documents).</td><td>2</td></tr>
</table>

Answer 3

2(b)(i)	**1 mark** only from: • Run-length encoding • Huffman Coding • Any other valid encoding method	**1**
2(b)(ii)	**1 mark** per bullet point to **max 2** • Reduce sampling rate • ... fewer samples taken per second means less data is being stored Or • Reduce sample resolution • ... fewer bits are used to represent each sample, so less data is stored	**2**

Answer 4

5(b)	**1 mark** for a lossless technique **1 mark** per bullet point for justification to **max 2** • Lossless does not lose any data • Any lost data will mean the program will not work	**3**

Answer 5

Question	Answer	Marks
7(a)	**1 mark** for each feature and **1 mark** for further related expansion to **max 2** • Colour select • Select all pixels of the same colour • Add text • To show the name of the company • Resize the star shape • To fit the space available in the box • Fill an area with colour • To shade the side of the box • Select • 'Grab' a number of pixels to perform a task with/to • Copy • Replicate a number of pixels	**2**
7(b)	**1 mark** per bullet point • 160 * 160 (= 25600 pixels) • 25600 * 3 (= 76800 bytes) • 75 KB (divide by 1024) or 76.8 KB (divide by 1000)	**3**
7(c)	**1 mark** per bullet point to **max 2** • The logo can be enlarged without becoming pixelated • because the instructions to create the logo are stored **or** • (Usually) smaller file size • only coordinates and calculations stored instead of individual pixels	**2**

7(d)	**1 mark** for **1 or 2 correct** answers **2 marks** for **3 correct** answers			**2**

	Red	Green	Blue
Hexadecimal value	**91**	**3C**	**8E**
Denary value	145	60	142

Answer 6

1(d)(i)	**1 mark** per bullet point to **max 1** • The data files are very large • It would take a long time to send the uncompressed file // Compressed files will download faster • A higher bandwidth would be needed to transmit the uncompressed file	**1**
1(d)(ii)	**1 mark** per bullet point to **max 1** • Data is lost • The decompressed file is not the same as the original	**1**
1(d)(iii)	**1 mark** per bullet point to **max 3** • Lossy creates a smaller file than lossless // lossy compresses further than lossless • The recording of the concert is a large file size and needs significant reduction in size • Lossy removes detail which can be lost without people noticing • By example e.g. reduction in sound quality will not be noticed	**3**

Answer 7

Question	Answer	Marks
6(a)	**1 mark** per bullet point to **max 3** • The data from a single frame is split into two separate fields • One field has data for the odd numbered rows/lines and the other field has data for the even numbered rows/lines • Odd numbered line fields alternate with even numbered line fields • The viewer sees data from two frames simultaneously	**3**
6(b)	**1 mark** per bullet point to **max 1** • Produces what appears to be a higher refresh rate • Lower bandwidth needed // Halves the bandwidth requirements	**1**
6(c)	**1 mark** per bullet point to **max 2** • Identifies pixels that do not change between frames • Records only the differences between the frames	**2**

6(d)(i)	**1 mark** per bullet point to **max 3** ∞ The amplitude of the wave is measured /sound wave is sampled ∞ At set/regular time intervals ∞ Each sample is stored as a binary number ∞ Samples are stored in order in a file	**3**
6(d)(ii)	**1 mark** per bullet point to **max 1** for each Sample rate: ∞ Increasing the sample rate means more samples per second hence more bits per second and larger file size ∞ Decreasing the sample rate means fewer samples per second hence fewer bits per second and smaller file size Sample resolution: ∞ A higher sampling resolution means more bits per sample and a larger file size ∞ A lower sampling resolution means fewer bits per sample. a smaller file size	**2**

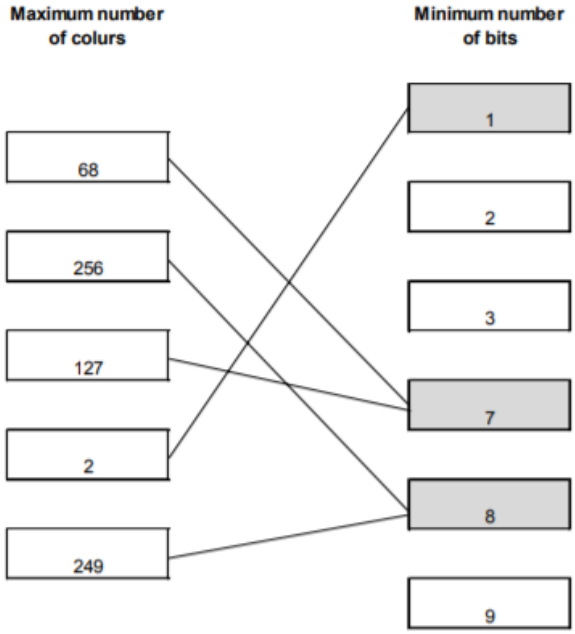
Answer 8

4(b)	**1 mark** per bullet to **max 2** • Stores all the scan lines for an entire frame // displays / records all the frame data at the same time // not split into fields • Complete frames are displayed in sequence • The rate of picture display is the same as the frame rate.	**2**

Answer 9

5(b)(ii)	**1 mark** per bullet to **max 4** ∞ Progressive – each frame contains (all the lines for) the complete image ∞ Interlaced – each frame contains half the (number of lines) of the complete image ∞ Progressive – frames are not divided into fields ∞ Interlaced – each frame divided into two fields // One field contains the data for the even numbered rows / lines and the other has the data for the odd numbered rows / lines. ∞ Progressive – complete frames are displayed in sequence ∞ Interlaced – data from two frames is displayed simultaneously	**4**

	∞ Progressive – the number of images stored is the same as the frame rate // the rate of picture display is the same as the frame rate. ∞ Interlaced – the rate of picture display (the field rate) is twice the rate of image frame display (the frame rate). ∞ Progressive means the entire frame is refreshed each time ∞ Interlaced means only half the frame is refreshed ∞ Progressive has high bandwidth requirements ∞ Interlaced halves the transmission bandwidth requirements.	

Question	Answer	Marks
5(a)	**1 mark** for each correctly linked box on the right  	**3**
5(b)(i)	**1 mark** for correct answer 40 images or frames are <u>displayed/recorded</u> each second	**1**

Question	Answer	Marks
5(c)	**1 mark** per bullet 88.2 kHz ∞ The sound wave is sampled <u>88200</u> times per second 32 bits ∞ Each sample is stored as a 32-bit binary number	**2**

Answer 10

Question	Answer	Marks
5(a)(i)	256	1
5(a)(ii)	78	1
5(b)	1111 0011 1110	1
5(c)(i)	69	1
5(c)(ii)	Any scenario where a single digit needs to be transmitted / displayed e.g. calculator / digital clock	1
5(d)	**1 mark** per bullet to **max 2** • Each character is represented by a **unique** • … denary / hexadecimal / binary number	2
5(e)(i)	**1 mark** per bullet to **max 2** Lossless: • All the data is needed // the original file is fully restored • If any data is lost, the program will not run • Probably does not require significant reduction in file size // a program written in a high-level language is just text, so does not need much reduction in size	2
5(e)(ii)	**1 mark** per bullet to **max 2** Lossy: • All the data is not required • The number of colours / resolution can be reduced without the user noticing • Email requires a significantly smaller file size // takes less time to transmit Lossless: • A high quality image may be needed • All of the data is needed // cannot afford to lose any data // the original file is fully restored	2
5(e)(iii)	**1 mark** per bullet to **max 2** Lossy: • Some loss of quality will not be noticed // high quality video not needed on the website • A more significant reduction may be needed • Takes a shorter time to upload / download // requires less bandwidth Lossless: • A high quality video may be needed • Might only be a short video clip • All of the data is needed // cannot afford to lose any data // the original file is fully restored	2

Answer 11

6(d)(i)	**1 mark** per bullet point to **max 4** **Max 3** for image **Max 3** for sound **Images** • The images are stored as bitmaps • Each image is **made up** of pixels • … each pixel is of a single colour • Each colour has a **unique** binary number • **Store** the sequence of binary numbers for each image / frame // **store** the binary value of each pixel **Sound** • Measure the height/amplitude of the sound wave • A **set number** of times per second // at **regular** time intervals • Each amplitude has a **unique** binary number • **Store** the sequence of binary numbers for each sample	**4**
6(d)(ii)	**1 mark** per bullet point **max 2** for each coding term. **Interlaced encoding** • The data from a single frame are encoded as two separate fields • One containing the data for the even numbered rows / lines and the other has the data for the odd numbered rows / lines • The image is rendered by alternating between the even field and the odd field of each successive frame • The viewer sees data from two frames simultaneously • The rate of picture display (the field rate) is twice the rate of image frame display (the frame rate) • Produces what appears to the eye to be a high refresh rate • Halves the transmission bandwidth requirements **Progressive encoding** • Stores the data for an entire frame • Displays all the frame data at the same time • The rate of picture display is the same as the frame rate • High bandwidth requirements	**4**

Question	Answer	Marks
6(e)(i)	**1 mark** per bullet to **max 3** • The data is compressed before transmitting • The video is transmitted continuously as a series of bits • The video is hosted on a media server • On download, the server sends the data to a buffer on the client computers // The buffer stores the data from the server • The recipient / user's software receives bit stream from the buffer	**4**
6(e)(ii)	**1 mark** for: On-demand **1 mark** for justification from: • The video does not need to be broadcast live // the video is already recorded • Dominic's colleagues will watch the video at a later date // at their convenience	**2**

6(e)(iii)	**1 mark** per description **Temporal Redundancy** • Pixels in a sequence of **consecutive** video frames have the same value in the same location **Spatial Redundancy** • A sequence of **consecutive** pixels in a single video frame have the same value	**2**

Answer 12

Question	Answer	Marks
2(b)(i)	**1 mark** per bullet point to **max 2** • The amplitude of the wave is measured • … at set, regular time intervals • The value is stored as a binary number	**2**
2(b)(ii)	**1 mark** per bullet point • Sampling resolution of 44100 Hz takes more samples per second, so the file size will be larger // Sampling resolution of 21000 Hz takes fewer samples per second, so the file size will be smaller • At a resolution of 44100 Hz, the sound recording is a closer / more accurate representation of Leonardo's voice // At a resolution of 21000 Hz, the sound recording is a less accurate representation of Leonardo's voice	**2**
2(b)(iii)	**1 mark** for naming a feature, **1 mark** for description, **max 2** marks for each feature e.g. • Amplify • ... Increase the volume of a section of sound • Change pitch • ... Increase/decrease frequency of section(s) • Change sampling resolution • … to change the accuracy of the sound / file size	**4**

Answer 13

Question	Answer	Marks
2(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**
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**
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**
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**

Question	Answer	Marks
2(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**

Answer 14

Question	Answer	Marks
5(a)	**1 mark** per bullet to **max 3** • Amplitude (of the sound wave) measured • At <u>set / regular</u> time intervals / per time unit / time period • Value of the sample is recorded as a binary number	**3**
5(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**
5(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**

Question	Answer	Marks
5(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**

Answer 15

3(c)(i)	193	**1**
3(c)(ii)	C1	**1**
3(c)(iii)	− 63	**1**
3(c)(iv)	The first 4 bits / first nibble (would give 12 which) is > 9 / 2 digits (which is not valid for BCD)	**1**

Answer 16

Question	Answer	Marks
6(a)	1	**1**
6(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**
6(c)	5	**1**

Question	Answer	Marks
6(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**
6(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**

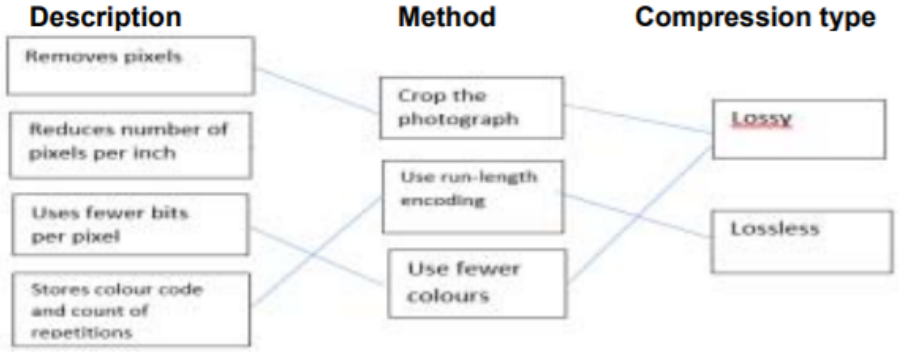
Answer 17

Question	Answer	Marks
1(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**
1(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**
1(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**
1(d)(i)	60 images are recorded per second	**1**
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**
1(e)	**1 mark** per bullet point to **max 1** • A meta file / wrapper • Contains various different types of data	**1**

Answer 18

4(c)(i)	186	**1**
4(c)(ii)	BA	**1**
4(c)(iii)	–70	**1**

Answer 19

Question	Answer	Marks
1(a)(i)	2	**1**
1(a)(ii)	**1 mark** per bullet point • Number of pixels: 6 × 6 // 36 • Number of bits: Number of pixels (36) × 2 … • … = 72 bits // 9 bytes	**3**
1(b)(i)	**1 mark** per bullet point • Number of pixels: 1000 × 1000 // 1 000 000 • Number of bytes: Number of pixels (1 000 000) × 2 // 2 000 000 // Number of bits: Number of pixels (1 000 000) × 16 // 16 000 000 • Conversion to megabytes • 2 (MB) // 1.91 (MB)	**4**
1(b)(ii)	**1 mark** per method correctly linked to its description **max 3** **1 mark** for each compression type correctly linked to its method(s). **max 2** 	**5**
1(c)	**1 mark** per bullet point. **Max 2** marks for each reason. • Smaller file size • Can be transferred quicker/downloaded quicker • Enlarges without pixilation • Needs to be used on different screens / devices / resolutions	**4**

Answer 20

3(c)(i)	193	**1**
3(c)(ii)	C1	**1**
3(c)(iii)	–63	**1**

Answer 21

Question	Answer	Marks
1(a)(i)	**3**	**1**
1(a)(ii)	**1 mark** per bullet point • Number of pixels: 6 × 6 = 36 • Number of bits: Number of pixels (36) × 3 • 108 bits / 13.5 bytes	**3**
1(b)(i)	**1 mark** per bullet point • Number of pixels: 50 000 × 50 000 = 2 500 000 000 • Number of bytes: Number of pixels (2 500 000 000) × 4 // 10 000 000 000 // Number of bits: Number of pixels (2 500 000 000) × 32 // 80 000 000 000 • Conversion to gigabytes • 10 GB / 9.3 GB	**4**
1(b)(ii)	**1 mark** for correct tick in each row.	**4**
1(c)	**1 mark** per bullet point to **max 3** • Looks for runs of consecutive pixel of the same colour • Stores the colour value once and the number of times it occurs • Lossless method of compression • Reference to the given image in context	**3**

Compression method	Lossy	Lossless
Cropping the image	✓	
Reducing the resolution of the image	✓	
Using run-length encoding (RLE)		✓
Reducing the colour depth of the image	✓	

Answer 22

2(b)(i)	**242**	**1**

Question	Answer	Marks
2(b)(ii)	**F2**	**1**
2(b)(iii)	**–14**	**1**

Answer 23

Question	Answer	Marks
3(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**
3(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**
3(b)(ii)	8	**1**
3(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**
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**

Answer 24

Question	Answer	Marks
3(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**
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**
3(b)(ii)	4	**1**
3(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**
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**

Answer 25

Question	Answer	Marks
3(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
3(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
3(b)(ii)	8	1
3(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
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

Answer 26

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

Answer 27

2 **(a)** 00110111 **[1]**

(b) 83 **[1]**

(c) 10011010 **[2]**

Marks allocated as follows:

1 mark for the most significant bit
1 mark for the remaining 7 bits

(d) 78 **[1]**

Answer 28

4 **(a)** **Three** from: **[3]**

- The height/amplitude of the (sound) wave is determined.
- At set (time) intervals // by example of sensible time period.
- To get an approximation of the sound wave
- And encoded as a sequence of binary numbers // and converted to a digital signal.
- Increasing the sampling rate will improve the accuracy of the recording.

(b) **(i)** **No mark** awarded for identifying method. **Three marks** for justification. **[3]**

Lossy – Three points from:

- The human ear will not notice that the decompressed stream will not be identical to the original (file) / that parts of the original data have been discarded / removed / deleted.
- File size reduction is greater than using lossless.
- Email has limits on file sizes (on attachments) / a smaller file will take less time to transmit.
- The file may not need to be of high precision / accuracy.
- The producer has requested an mp3 file.

Lossless – Three points from:

- The file needs to be high precision / accuracy.
- None of the original data is lost / the decompressed file will be identical to the original.
- The producer has requested a flac file.

(ii) **Three** points from: **[3]**

- Lossless method of compression.
- Reduces (the physical size of) a string of adjacent, identical characters/pixels / bytes etc..
- The repeating string (a run) is encoded into two values.
- One value represents the number of (identical) characters in the run (the run count).
- The other value is the code of the character / colour code of pixel etc. in the run (the run value).
- The run value and run count combination may be preceded by a control character.
- Any valid example given.

(iii) **Two marks** for **three** correct rows, **one mark** for **two** correct rows. **[2]**

Row 1: 153 10 255 3 153 3
Row 2: 153 9 255 6 153 1
Row 3: 153 7 255 9

Alternative correct answer:

Row 1: 153 9 255 2 153 2
Row 2: 153 8 255 5 153 0
Row 3: 153 6 255 8

Answer 29

2 **(a)** 77 **[1]**

(b) 1000 0010 **[1]**

(c) −53 **[2]**

One mark for '**53**' and **one** mark for '**–**'

(d) C6 **[2]**

One mark for the answer, <u>one</u> mark for the method

- Working e.g. 198 / 16 = 12, 198 − (12*16) = 6

Answer 30

3 (a) (i) 0 0 1 0 1 1 1 0 [1]

(ii) 1 1 0 1 0 0 1 0 [1]

(iii) 2 E [1]

(b) (i) **One mark** for the explanation and **one mark** for the example

- Each denary digit is written as a 4-bit binary number
- Example: 46 = 0100 0110 [2]

(ii) **One mark** for the explanation and **one mark** for the example

- Binary number is split up into groups of 4 bits (starting from the right) // Each group of 4 bits is converted to a denary digit
- Example: 0011 0111 = 37

[2]

Answer 31

(b) **Four** from:

- Bitmap is made up of pixels // Vector graphic store a set of instructions about how to draw the shape
- Bitmap files are usually bigger than vector graphics files // Take up more memory space
- Enlarging a bitmap can mean the image is pixelated // vector graphic can be enlarged without the image becoming pixelated
- Bitmap images can be compressed (with significant reduction in file size) // Vector graphic images do not compress well
- Bitmaps are suitable for photographs / scanned images // Vector graphics are suitable for more geometric shapes
- Bitmap graphics use less processing power than vector graphics
- Individual elements of a bitmap cannot be grouped // Individual elements of a vector graphic can be grouped
- Vector graphics need to be 'rasterised' in order to display or print [4]

Answer 32

2 **(a)** The number of images / frames recorded per second / unit time.
// The frequency with which the images/frames are recorded.

[1]

(b) **ONE** mark per bullet point below. **MAX THREE** marks per type of encoding.

Interlaced encoding

- The data from a single frame are encoded as two separate **fields**.
- One containing the data for the even numbered rows / lines and the other has the data for the odd numbered rows / lines.
- The image is rendered by alternating between the even field and the odd field (of each successive frame).
- The viewer sees data from two frames simultaneously
- The rate of picture display (the field rate) is twice the rate of image frame display (the frame rate).
- Originally used in television broadcasting and adapted for video recordings.
- Produces what appears to the eye to be a high refresh rate.
- Halves the transmission bandwidth requirements.

Progressive encoding

- Stores the data for an entire frame and displays all the frame data at the same time.
- The rate of picture display is the same as the frame rate.
- Used by traditional film / video digitised from a film camera / computer displays progressive encoding.
- High bandwidth requirements.

[4]

(c) **(i)** **ONE** mark per term.

Description	Term
Pixels in two video frames have the same value in the same location. There is duplication of data between frames.	**Temporal redundancy**
A sequence of pixels in a single video frame have the same value.	**Spatial redundancy**

[2]

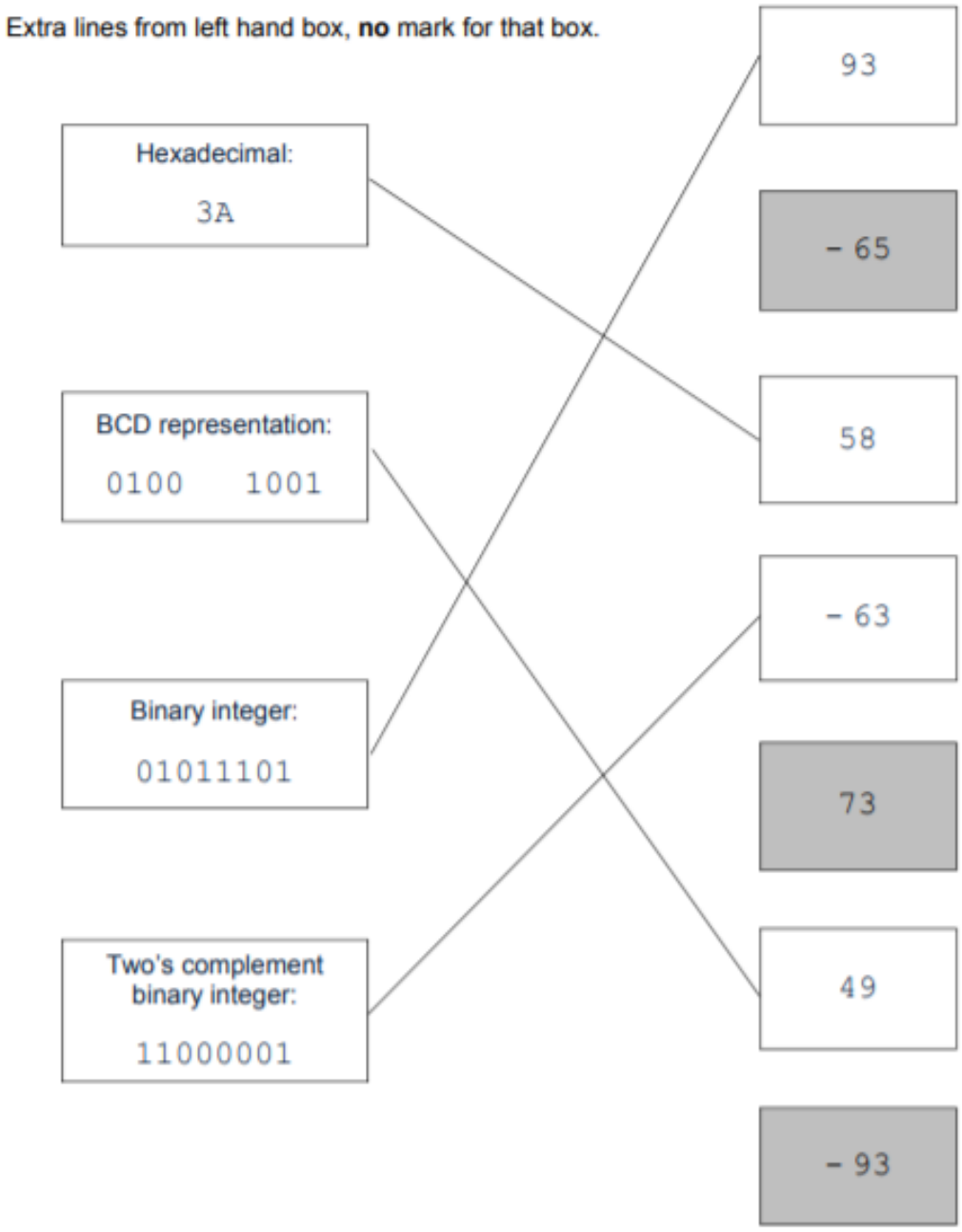
(ii) (File) compression

[1]

Answer 33

4 **ONE** mark for each correct line.

Extra lines from left hand box, **no** mark for that box.



[4]

Answer 34

1 **(i)** B 8

(ii) 1 0 0 1 0 1 1 1

(iii)

114	**0**	**1**	**1**	**1**	**0**	**0**	**1**	**0**
– 93	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**

Answer 35

2 **(a)** **(i)** Any **one** from:

- amplitude of sound wave taken at different points in time
- measurement of value of analogue signal at regular time intervals/a point in time **[1]**

(ii) Any **one** from:

- bit depth/sampling resolution sufficient for good quality sound
- higher bit depth/sampling resolution would mean bigger files
- ...hence less (music) content on each CD
- can represent dynamic range of about 90 dB
- 90 dB is basically the maximum dynamic range of human hearing
- compromise between quality and reasonable file size **[1]**

(iii) Any **two** from:

- resolution is the number of distinct values available to encode/represent each sample
- specified by the number of bits used to store/record each sample
- sometimes referred to as bit depth
- the higher the sampling resolution, the smaller the quantization error
- a higher sampling resolution results in less distortion of the sound
- usually 8 bit, 16 bit, 24 bit or 32 bit **[2]**

(iv) **1 mark** for benefit and **1 mark** for drawback.

benefit

- allows for larger dynamic ranges
- ...as dynamic range is approximately six times the bit depth
- more accurate representation/crisper sound quality

drawback

- bigger files/occupies more memory/storage
- longer to transmit data/download music
- greater processing power needed **[2]**

(b) Any **two** from:

- edit start time, stop time and duration of any sound/timeline
- extract/delete/save part of a clip
- frequency, amplitude, pitch alteration
- fade in/out of a clip
- mix/merge multiple sound sources/tracks
- combine different sources at various volume levels
- pan between tracks/channels
- use of filters
- playback to speakers, processors or recording medium
- conversion between different audio file formats
- etc...

(c) Any **three** from:
For full marks both techniques must be mentioned.

- lossless designed to lose none of the original detail/lossless allows original file to be recreated exactly
- lossless technique based on some form of replacement
- mention of type of replacement, for example RLE, FLAC etc.
- by example: e.g. 000–1111–222222–333 = 3–0, 4–1, 6–2, 3–3 etc.
- maximum compression about 50%
- lossy may result in loss of detail compared to original file/lossy does not allow original file to be re-created exactly
- lossy techniques make decision about what parts of sound/sound file are important and discards other information
- only keeps sounds human ear can process/discards sounds most people cannot hear
- ... then applies lossless technique, for further reduction
- lossy compression can reduce to about 10%
- an example of jpeg, mp3 or other correct examples of compressed formats.

No double credit to opposite answers, e.g. lossless maintains detail, but lossy loses detail just one mark.

[3]

Answer 36

1(a) (i)

124 = 0 1 1 1 1 1 0 0

-77 = 1 0 1 1 0 0 1 1

(ii) 124: 7 C

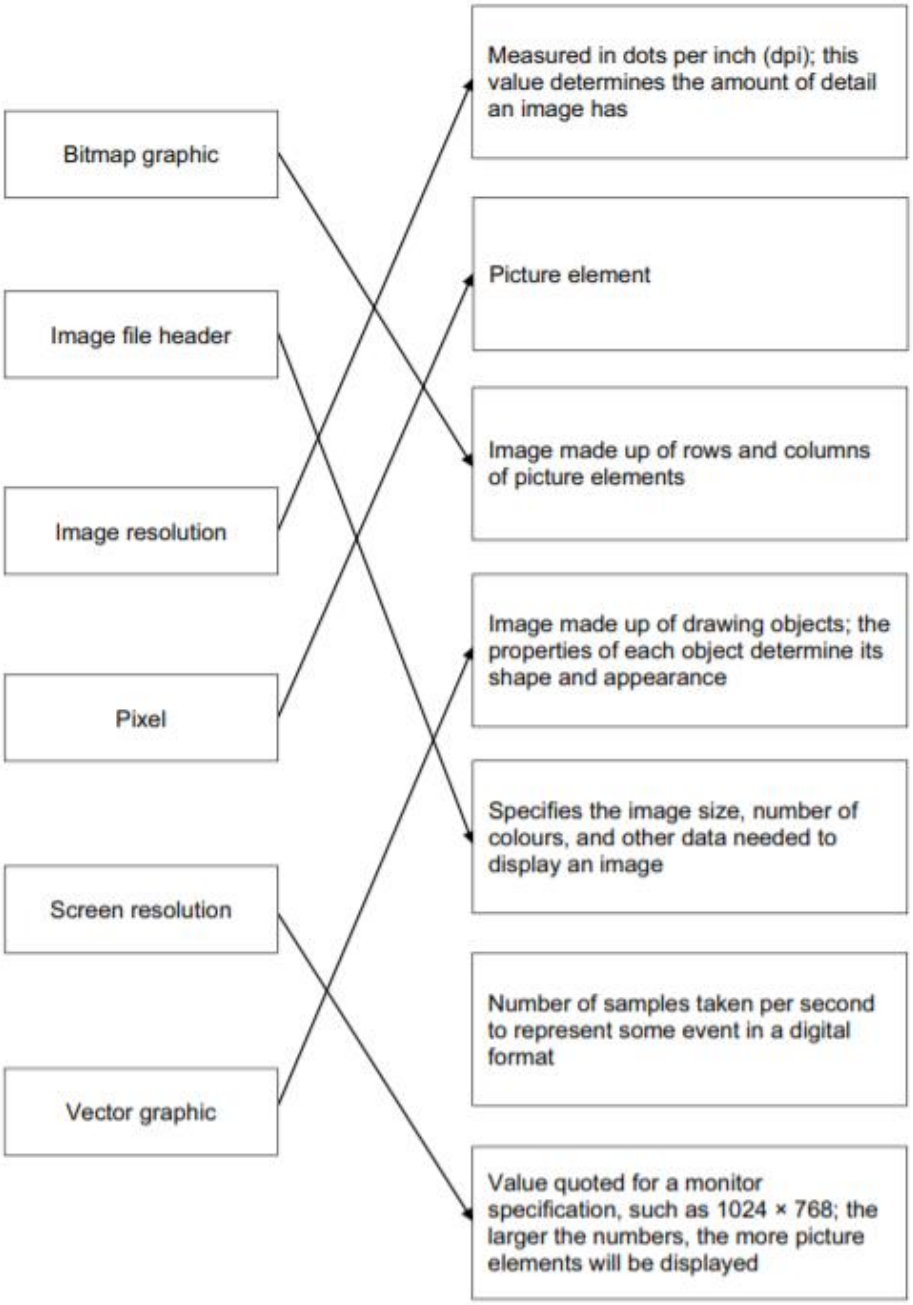
–77: B 3 [2]

(b) (i) 0 0 1 1 0 1 0 1 1 0 0 1 [1]

(ii)
- when denary numbers need to be electronically coded
- e.g. to operate displays on a calculator where each digit is represented
- decimal fractions can be accurately represented [2]

Answer 37

8 (a)



1 mark for each correct line, two lines from one box is incorrect [6]

(b) (i) $\frac{512 \times 256}{8 \times 1024} = 16$ KB

1 mark for numerator + 1 mark for denominator [2]

(ii) so it is possible to estimate how many images can be stored / to decide if it can be sent as an email attachment [1]

Answer 38

3 (a) (i) 4 6 C [1]

(ii) 1 0 1 0 0 0 [1]

(b) (i) 1 bit [1]

(ii)
- 8 bits are needed
- Each colour is represented by one of 256 values
- values 0 to 255/0000 0000 to 1111 1111
- $256 = 2^8$ [2]

(c)

Lossless

- lossless designed to lose none of the original detail/lossless allows original file to be recreated exactly
- lossless technique based on some form of replacement
- mention of type of replacement, for example RLE, FLAC etc.
- by example: e.g. 000–1111–222222–333 = 3–0, 4–1, 6–2, 3–3 etc.
- maximum compression about 50%

Lossy

- lossy may result in loss of detail compared to original file/lossy does not allow original file to be re-created exactly
- lossy techniques make decision about what parts of sound/sound file are important and discards other information
- only keeps sounds human ear can process/discards sounds most people cannot hear
- ... then applies lossless technique, for further reduction
- lossy compression can reduce to about 10%
- an example of jpeg, mp3 or other correct examples of compressed formats.

Answer 39

4 (a) Sampling resolution (two marks)

- representation used to write samples in digital sound recording
- resolution is the number of distinct values available to encode/represent each sample
- specified by the number of bits used to store/record each sample
- sometimes referred to as bit depth
- the higher the sampling resolution the smaller the quantization error
- a higher sampling resolution results in less distortion of the sound
- usually 8 bit, 16 bit, 24 bit or 32 bit

Sampling rate (two marks)

- number of times that the amplitude of (analogue) sound wave is taken/measured
- per unit time/per second
- higher sampling rate results in more accurate digital representation [4]

(b) (i) one mark for correct calculation, **one mark** for the answer

$$\frac{44100 \times 16 \times 2}{8}$$ (1 mark)

176 400 bytes (1 mark)

[2]

(ii) Allow follow through from part **(i)** on 176 400

$$\frac{4 \times 60 \times 176400}{1024 \times 1024}$$

one mark for numerator
one mark for denominator [2]

(c) any **three** from:

- mp3 is a lossy compressed format
- uses psycho-acoustic modelling
- and perceptual music/noise shaping
- certain parts of the music can be eliminated without significantly degrading the listener's experience
- removes sound that the human ear can't hear
- only keeps sounds human ear can hear better than others
- discards softer sound if two sounds played together [3]

Answer 40

(c) (i) Any **two** from:

- Only 128 / 256 characters can be represented
- Uses values 0 to 127 (or 255 if extended form) / one byte
- Many characters used in other languages cannot be represented
- In extended ASCII the characters from 128 to 255 may be coded differently in different systems [2]

(ii) Any **two** from:

- Uses 16, 24 or 32 bits / two, three or four bytes
- Unicode is designed to be a superset of ASCII
- Designed so that most characters (in other languages) can be represented

[2]

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