Chapter 1: Information Representation

October/November 2019 - 9608/11

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.

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..... [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 .....

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..... [2]

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

Lossy	Lossless

Justification .....

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..... [2]

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

Lossy	Lossless

Justification .....

.....

.....

..... [2]

6 Dominic uses a tablet computer to complete work. He records videos of his work to send to his colleagues to watch at a later date.

(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 .....

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Sound .....

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[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]

(e) Dominic sends his videos to his colleagues over the Internet using bit streaming.

(iii) Describe the following video terms.

Temporal redundancy .....

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Spatial redundancy .....

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[2]

2 Leonardo's mobile phone has an operating system (OS).

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

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

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..... [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 44 100 Hz. The second recording has a sampling rate of 21 000 Hz.

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

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..... [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 .....

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2 .....

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[4]

4 **(a)** Convert the unsigned binary number 0101 1111 1100 into denary.

..... [1]

(b) Convert the denary number –239 into 12-bit two's complement.

..... [1]

(c) Convert the two's complement number 0110 0101 into denary.

..... [1]

(d) Convert the Binary Coded Decimal (BCD) value 0110 0101 into denary.

..... [1]

(e) Convert the denary number 222 into hexadecimal.

..... [1]

(d) 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.

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..... [3]

6 A student records a video using a digital camera.

(a) The recording uses interlaced encoding.

Describe interlaced encoding.

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..... [3]

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

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..... [1]

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

Explain how temporal redundancy compresses a video.

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..... [2]

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

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

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..... [3]

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

Sampling rate .....

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Sampling resolution .....

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[2]

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3 The fetch-execute cycle is shown in register transfer notation.

(d) The ASCII character code for 'A' is 65 in denary.

(i) Convert the denary ASCII character code for 'A' into 8-bit binary.

[1]

(ii) Convert the denary ASCII character code for 'A' into hexadecimal.

..... [1]

(iii) The Unicode character code for 'G' is 0047 in hexadecimal.

State, in hexadecimal, the Unicode character code for 'D'.

..... [1]

4 Shazia is creating a computer program that will be released to the public. The program includes a video.

(b) The video is recorded using progressive encoding.

Describe **progressive encoding**.

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..... [2]

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 40 fps (frames per second).

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

.....

..... [1]

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

Describe **two** differences between interlaced and progressive encoding.

1 .....

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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 .....

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Sampling resolution of 32 bits .....

.....

.....

[2]

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.

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.....[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.

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.....[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 .....

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Feature 2 .....

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[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**.

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.....[1]

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

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.....[2]

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

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

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.....[1]

4 The table shows assembly language instructions for a processor which has one general purpose register, the Accumulator (ACC) and an index register (IX).

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

X	1	0	1	1	1	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]

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 .....

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.....

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 .....

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.....

.....

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.

Description	Method	Compression type
Removes pixels	Crop the photograph	Lossy
Reduces number of pixels per inch	Use run-length encoding	Lossless
Uses fewer bits per pixel	Use fewer colours	
Stores colour code and count of repetitions		

[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 .....

.....

.....

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Reason 2 .....

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[4]

3 The following table shows assembly language instructions for a processor which has one general purpose register, the Accumulator (ACC) and an Index Register (IX).

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

X	1	1	0	0	0	0	0	1

(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]

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 50 000 pixels by 50 000 pixels. The colours are represented using 4 bytes per pixel.

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

Working .....

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.....

.....

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		

[4]

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

.....

.....

.....

.....

.....

.....[3]

2 The following table shows assembly language instructions for a processor which has one general purpose register, the Accumulator (ACC) and an Index Register (IX).

(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]

2 A logo is designed as a bitmap image.

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

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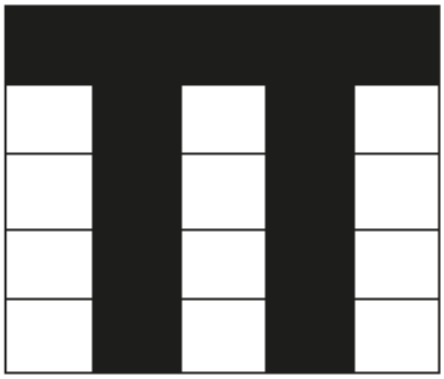
.....

.....

.....[2]

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



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

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.....[2]

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

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

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.....[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 .....

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.....

.....

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]

4 **(a)** The Accumulator is a register. The current contents of the Accumulator are:

1	1	0	1	1	0	1	1

The current contents of the Accumulator represent an unsigned binary integer.

(i) Convert the value in the Accumulator into denary.

.....[1]

(ii) Convert the value in the Accumulator into hexadecimal.

.....[1]

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

Convert the value in the Accumulator into denary.

.....[1]

(b) The binary integer represents a character from the computer's character set.

(i) Define the term **character set**.

.....

.....[1]

(ii) Explain the differences between the **ASCII** and **Unicode** character sets.

.....

.....

.....

.....[2]

(iii) The ASCII code for 'A' is 41 in hexadecimal.

Calculate the ASCII code in hexadecimal for 'Z'. Show your working.

Working .....

.....

.....

ASCII code in hexadecimal for 'Z' .....
[2]

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.

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.....

.....

.....[3]

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

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.....[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]

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3 A computer is designed using the Von Neumann model.

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

1	1	0	0	0	0	0	1

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).

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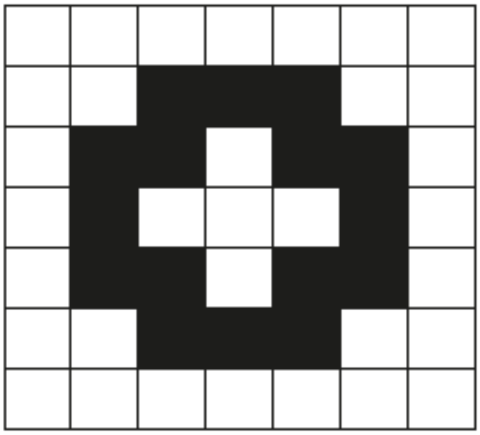
.....[1]

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 .....

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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 .....

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Feature 2 .....

Effect .....

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Feature 3 .....

Effect .....

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.....

[6]

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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.

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.....[1]

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

.....

.....[1]

October/November 2017 - 9608/12

- No question

October/November 2017 - 9608/13

- Questions same as October/November 2017 - 9608/11

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.

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.....[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]

May/June 2017 - 9608/12

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]

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- Questions same as May/June 2017 - 9608/11