5.6 Representing images, sound and more part 1

Name: _____

Class: _____

Date: _____

Time: **350 minutes**

Marks: **268 marks**

Comments:

Q1.

Cameras within a taxi take still images once every second for security purposes. The images are compressed using run-length encoding and stored on a flash memory card within the camera.

Describe how a digital image could be captured by a digital camera and compressed using run-length encoding.

(Total 6 marks)

Q2.

Figure 1 shows an image composed of four objects, represented digitally as a vector graphic. **Figure 2** shows the same image, represented digitally as a bitmap graphic.

The bitmap graphic has an image size of 50 × 50 pixels.

Each image uses four colours: white, black, yellow and blue.

Figure 1

Figure 2

(a) Describe how a vector graphic is represented.

Include an explanation of how the black rectangle in **Figure 1** would be represented in your description.

_____

_____

_____

_____

_____

_____

(3)

(b) Calculate the minimum amount of storage space that is required to store the bitmap image in **Figure 2** excluding metadata. Express your answer in bytes.

You **must** show your working.

_____

_____

_____

Answer _____

(2)

Figure 3 shows an enlarged view of part of one row of pixels from the image in **Figure 2**.

Figure 3

(c) Describe how a row of pixels, such as that shown in **Figure 3**, could be represented in compressed form by using run length encoding.

_____

_____

_____

_____

(2)

Figure 4 shows an image of a woodland scene.

(d) The image in **Figure 2** is compressed using run length encoding. The compressed file is 80% smaller than the original file.

The image in **Figure 4** is compressed using the same technique and the compressed file is approximately the same size as the original file.

Explain why the run length encoding method was not able to compress the image in **Figure 4** as much as it could compress the image in **Figure 2**.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q3.

One method that can be used to compress text data is run length encoding (RLE). When

RLE is used the compressed data can be represented as a set of character/frequency pairs. When the same character appears in consecutive locations in the original text it is replaced in the compressed text by a single instance of the character followed by a number indicating the number of consecutive instances of that character. Single instances of a character are represented by the character followed by the number 1.

Figure 1 and **Figure 2** show examples of how text would be compressed using this method.

Figure 1

Original text: `AAARRRRGGGHH`
Compressed text: `A 3 R 4 G 3 H 2`

Figure 2

Original text: `CUTLASSES`
Compressed text: `C 1 U 1 T 1 L 1 A 1 S 2 E 1 S 1`

What you need to do

Task 1
Write a program that will perform the compression process described above. The program should display a suitable prompt asking the user to input the text to compress and then output the compressed text.

Task 2
Test the program works by entering the text `AAARRRRGGGHH`.

Task 3
Test the program works by entering the text `A`.

Evidence that you need to provide

(a) Your PROGRAM SOURCE CODE.

(12)

(b) SCREEN CAPTURE(S) for the test showing the output of the program when `AAARRRRGGGHH` is entered.

(1)

(c) SCREEN CAPTURE(S) for the test showing the output of the program when `A` is entered.

(1)

(Total 14 marks)

Q4.

The Vernam cipher is a more sophisticated cipher system that, under certain circumstances, offers perfect security.

State **two** conditions that must be met for the Vernam cipher to offer perfect security.

Condition 1

_____

_____

Condition 2

_____

_____

(Total 2 marks)

Q5.

A message is to be transmitted from Computer A to Computer B. For security reasons, the message will be encrypted.

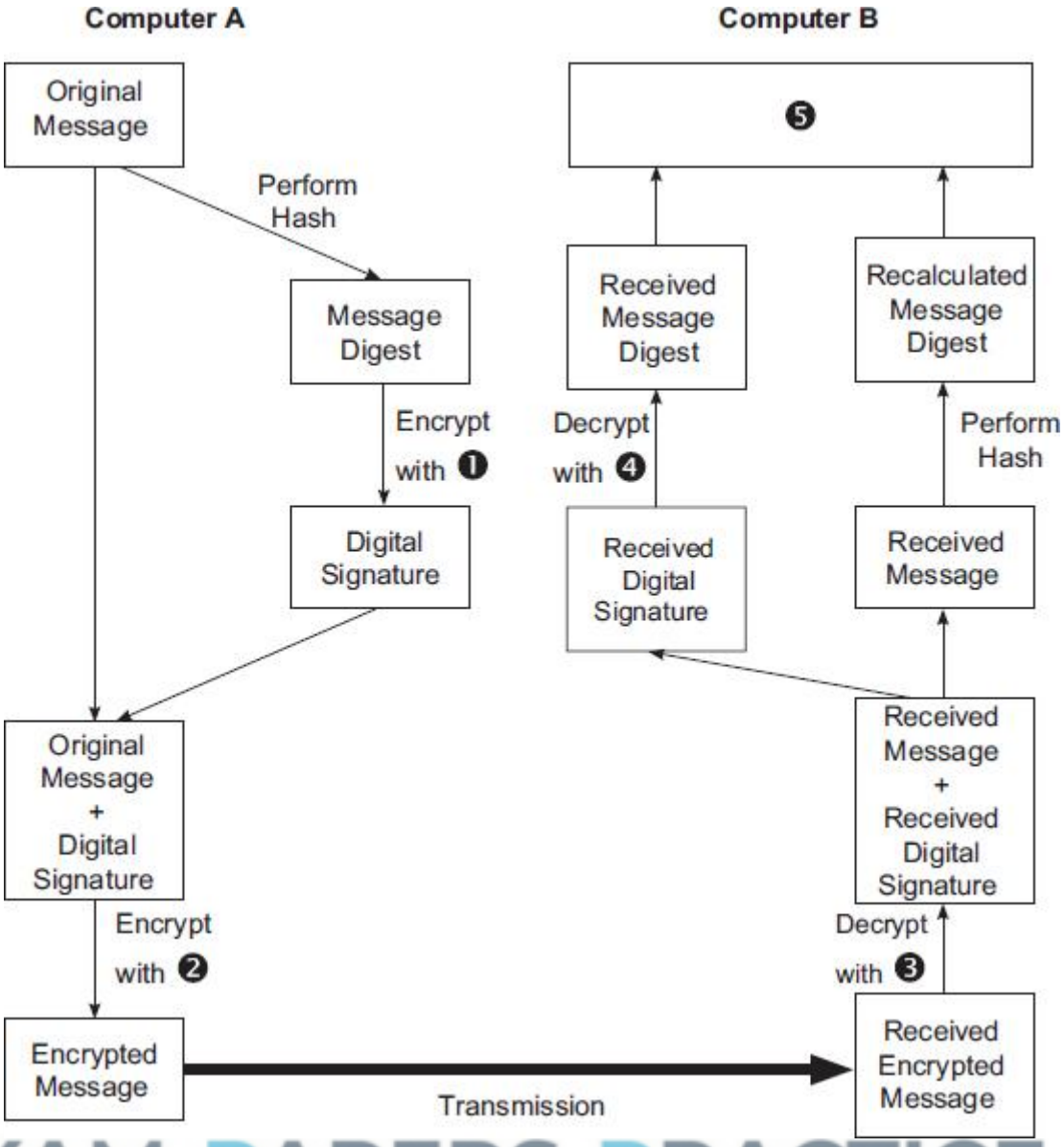
(a) What is encryption?

_____

_____

(1)

The message that is being transmitted will be encrypted and decrypted using public and private keys. The figure below shows the encryption and decryption processes. The symbols ❶ to ❹ in the figure represent the names of keys.



(b) State the names of the keys that are represented by each of the symbols ❶ to ❹.

Label	Key Name
❶	
❷	
❸	
❹	

(2)

(c) Describe the process that will take place at the position labelled ❺.

_____

_____

_____

(1)

(d) State **two** purposes of the addition of the digital signature to the message.

Purpose 1: _____

_____

Purpose 2: _____

_____

(2)

(Total 6 marks)

Q6.

A well-established use for robots in industry is the spraying of car bodies on a car production line.

A robotics researcher is investigating the feasibility of developing and installing in a car a computer-based control system to take over completely the driving of the car on public highways.

She has identified some of sources of inputs into the control system already:

- high resolution video camera
- stereoscopic digital camera
- long range radar
- short range radar
- Global Positioning Satellite receiver.

And some of the outputs:

- position of steering wheel (in degrees from the vertical)
- forces on accelerator and brake pedals.

Discuss why automated car control is a harder programming problem to solve than developing programmed control of a robot for spraying car bodies on a car production line, and what processing of input data will be necessary and why to obtain sufficient information to safely and reliably control the driving of the car by computer. Include in your discussion the sources of input that you have used and the information derived from these by processing.

(Total 9 marks)

Q7.

A flight recorder is an electronic recording device placed in an aircraft for the purpose of facilitating the investigation of aviation accidents and incidents. The image below shows an example of a flight recorder. It is a requirement for every commercial aircraft to have a type of flight recorder called a cockpit voice recorder.

(a) Current cockpit voice recorders use solid-state memory chips to store the digital audio data. Alternatively, the data could be stored on a traditional hard disk drive.

Give **two** reasons why cockpit voice recorders store data using solid-state memory instead of using a traditional hard disk drive.

_____

_____

_____

_____

_____

_____

(2)

(b) Audio from the cockpit is sampled at a rate of 8000 Hz and 16 bits are allocated to each sample.

How many kilobytes would be needed to store 360 seconds of audio?
Show your working.

_____

_____

_____

_____

_____

Answer _____

(3)

(c) Explain why the highest audio frequency in the sampled audio from the cockpit cannot be greater than 4000 Hz.

_____

_____

_____

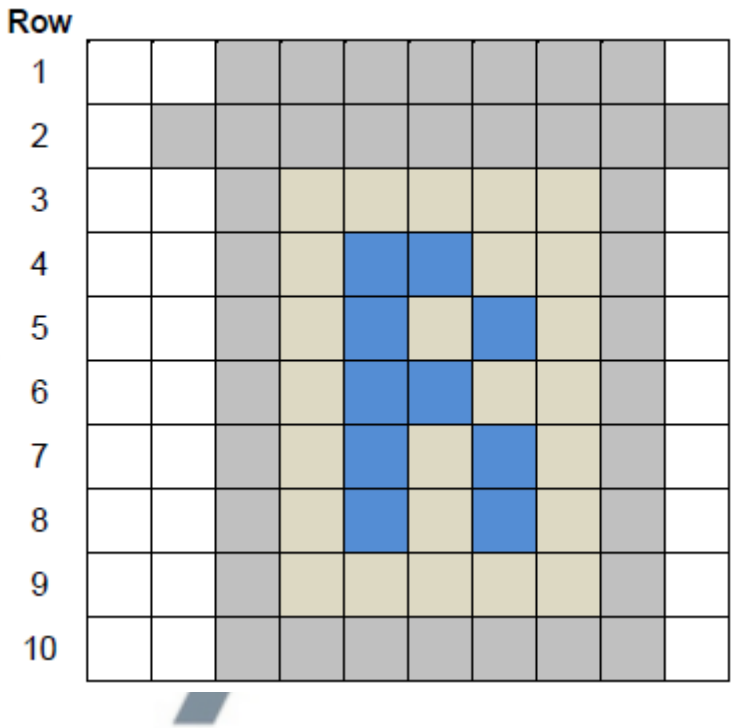
_____

(2)

(Total 7 marks)

Q8.

The icon below is represented in a computer's memory as a bitmap image.



Four different colours have been used in the icon.

Row 1 of the icon is represented in the computer's memory as the bit pattern:

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

(a) What are the bit patterns that have been used to represent a grey pixel and a white pixel?

Grey pixel: _____ White pixel: _____

(1)

(b) State **one** possible 20-bit representation for **Row 4** of the icon.

(1)

(c) Calculate the number of bytes required to represent all the pixel data in the icon as a bitmap.

Show your working.

_____

_____

_____

_____

Answer _____

(2)

(d) When the bitmap is saved as a file, the file size is bigger than the answer to (c). This is because metadata is saved in the file with the pixel data

State **one** item of metadata that would be stored in a bitmap file.

_____

_____

(1)

(e) Run-length encoding (RLE) is an example of a compression method that could be used to reduce the amount of memory required to store the icon.

Describe the principle used by RLE to compress a file and explain why RLE is an appropriate compression method for compressing images such as icons.

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q9.

Images are often represented in a computer's memory using vector graphics. A vector graphic consists of a collection of objects.

(a) State **three** items of data that would need to be stored about a circle object if it is to be represented using vector graphics.

_____

_____

_____

(3)

(b) Instead of representing an image as a vector graphic, it could be represented as a bitmapped image.

Describe how an image can be represented as a bitmapped image in a computer's memory.

(3)

(c) Describe **three** advantages of using vector graphics instead of bitmaps to represent images.

(3)

(Total 9 marks)

Q10.

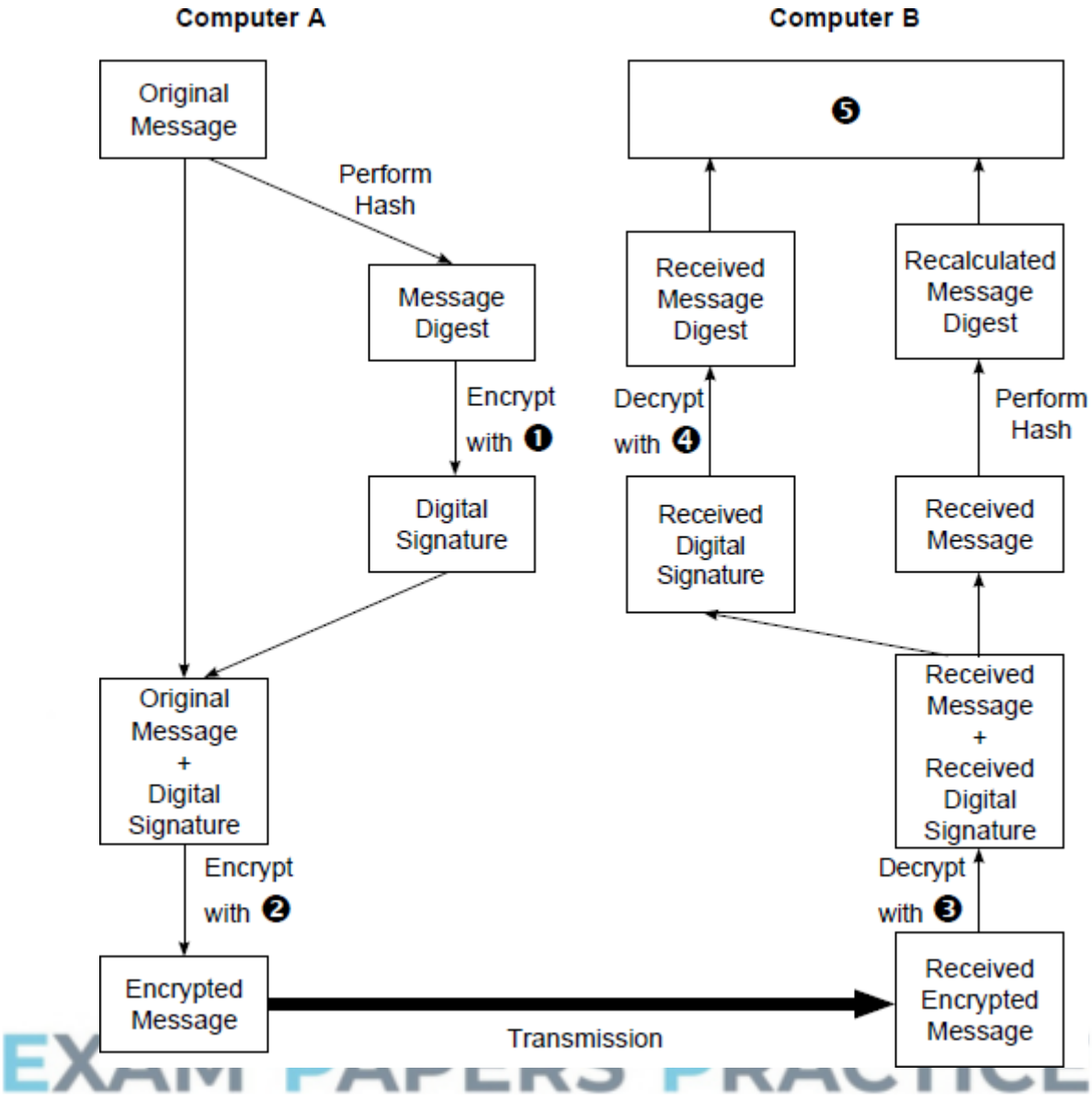
A message is to be transmitted from Computer A to Computer B. For security reasons, the message will be encrypted.

(a) What is encryption?

(1)

The data that are being transmitted will be encrypted and decrypted using public and private keys. The diagram below shows the encryption and decryption processes.

The symbols ❶ to ❹ in the figure represent the names of keys.



(b) State the names of the keys that are represented by each of the symbols ❶ to ❹.

Label	Key Name
❶	
❷	
❸	
❹	

(2)

(c) Describe the process that will take place at the position labelled ❺.

_____

_____

(1)

(d) State **two** purposes of the addition of the digital signature to the message.

Purpose 1 _____

_____

Purpose 2 _____

_____

(2)

(Total 6 marks)

Q11.

A performance by a music band is to be recorded and distributed on CD.

Figure 1 shows three samples stored in a computer's memory that have been taken from an analogue signal as part of the recording process. A sampling rate of 44,000Hz (Hertz) has been used.

1Hz is one sample per second.

Figure 1

0000	0001	1000	1110
0000	0001	1000	1110
0000	0001	1000	0011

(a) What sampling resolution has been used?

_____

_____

(1)

(b) If the original analogue signal lasts 100 seconds, how many bytes of storage will be required to store all the samples taken in the recording process?

You may use the space below for rough working. You may get some marks for your working, even if your answer is incorrect.

Answer _____

(3)

(c) The average human can hear frequencies up to 20,000Hz (Hertz).

Explain why a sampling rate of 44,000Hz has been chosen for the recording.

_____

_____

_____

_____

(2)

(d) The CD recording is processed to create a version of the performance that can be downloaded from the band's website.

The sound quality of the version of the recording stored on the web server is not as good as the sound quality of the CD version.

State **one** possible cause of this reduction in sound quality.

_____

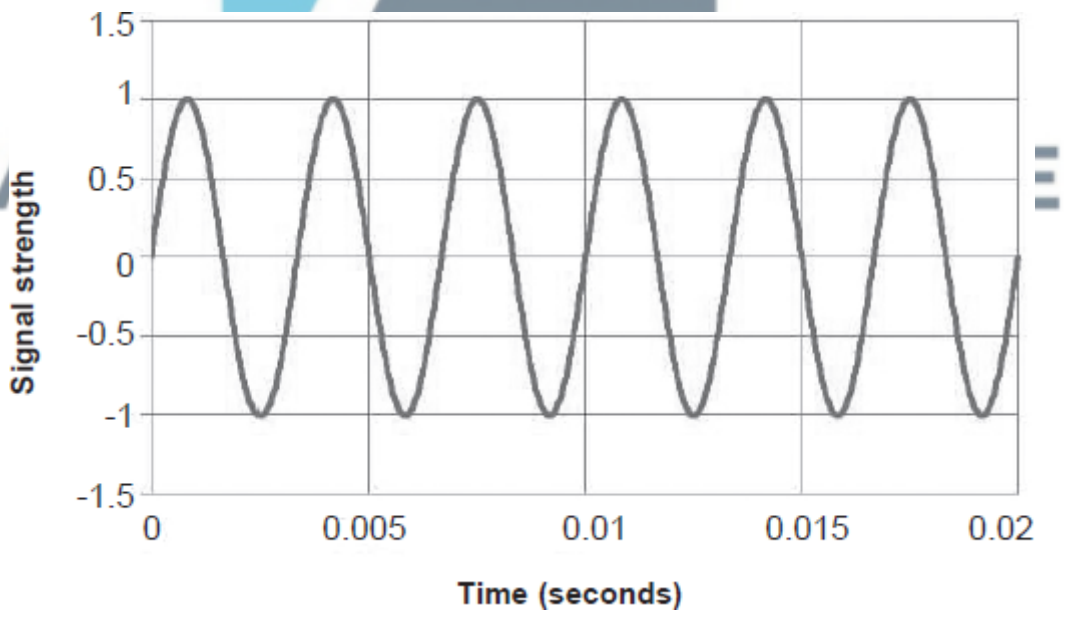
_____

(1)

(Total 7 marks)

Q12.

To record sound a computer needs to convert the analogue sound signal into a digital form. During this process samples of the analogue signal are taken. The diagram below shows part (0.02 seconds) of an analogue sound wave.



The **frequency** of an analogue sound wave is determined by how many waves of oscillation occur per second and is measured in Hertz (Hz) – the number of waves of oscillation per second.

(a) If the part of the analogue sound shown in the diagram above is the highest frequency in the entire sound to be sampled, what is the **minimum sampling rate** (in Hz) that should be used?

Use the space below. You may get some marks for your working even if your answer is incorrect.

Answer _____

(2)

(b) Describe clearly the steps taken by an ADC (analogue-to-digital converter) in the conversion of an analogue sound wave to an equivalent digital signal.

_____

_____

(3)

(c) MIDI is an alternative method for storing sound digitally that does not use sound waves; instead, information about each musical note is stored.

State **one** advantage of using the MIDI representation for storing sound digitally.

_____

_____

(1)

(d) State an item of data, other than the note itself, that might be stored about a musical note in a MIDI file.

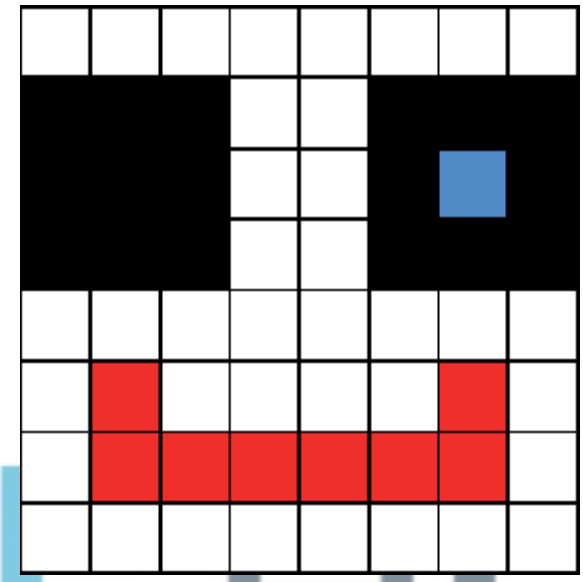
_____

(1)

(Total 7 marks)

Q13.

A bitmapped image consists of pixels.The diagram below shows a bitmapped representation of an image of a winking, happy face consisting of red, blue, black and white pixels only.



(a) Why must at least two bits be used to represent each pixel?

_____

_____

(1)

(b) The second line of pixels (from the top) shown in the image above has been represented in a computer's memory as the bit pattern `1111 1100 0011 1111`. A black pixel is coded as `11`.

Suggest a suitable 16-bit bit pattern that could be used to represent the third line of pixels (from the top) in the image above.

(2)

(c) What, in bytes, is the minimum file size for the bitmapped image above?

Use the space below. You may get some marks for your working even if your answer is incorrect.

Answer _____

(3)

(d) Instead of representing the face as a bitmapped image, vector graphics could have been used.

State **three** items of data that would need to be stored about an eye object, similar to those shown in the image above, if it is to be represented using vector graphics.

_____

_____

_____

(3)

(e) Describe **two** advantages of using vector graphics instead of bitmaps to represent an image.

_____

_____

_____

_____

(2)

(Total 11 marks)

Q14.

Software is being developed to allow secure transmission of data over the Internet.

The two computers involved in a communication will be known as A and B.

(a) What is *encryption?*

_____

_____

_____

(1)

(b) The data that are being transmitted will be encrypted using public and private keys.

A and B will each have a public key and a private key.

A will encrypt the data that it is sending using B's public key.

Explain why the data should **not** be encrypted using:

(i) A's public key.

_____

_____

_____

(1)

(ii) A's private key.

_____

_____

_____

(1)

(c) The communication will be made more secure by the use of a digital signature attached to the end of the message.

- State the purpose of the digital signature.
- Explain how it will be created and used in the data transmission process from A to B.

In your answer you will be assessed on your ability to use good English, and to organise your answer clearly in complete sentences, using specialist vocabulary where appropriate.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 9 marks)

Q15.

Images are often represented in a computer's main memory using bitmapped graphics. Bitmapped images consist of **pixels.** A pixel is the smallest addressable part of an image.

(a) What is meant by the **resolution** of a bitmapped graphic image?

(2)

(b) What is meant by the **colour depth** of a bitmapped graphic image?

(2)

(c) An image has 10 x 10 pixels. It is stored in an image format that is limited to 16 colours.

Calculate the image size in bytes.

(2)

(d) Instead of using bitmapped graphics, images may be represented in a computer's main memory using vector graphics.

State **one** advantage of vector graphics compared with bitmapped graphics.

_____

_____

(1)

(Total 7 marks)

Q16.

(a) If you borrow a shop bought music CD and "rip" (copy) the tracks to your hard disk before you give the CD back to your friend, you have probably broken a law.

State which law you are likely to have broken.

_____

(1)

(b) Alternatively, you could download music from an official music website on the Internet. The website owners might protect this music using Digital Rights Management.

Give **two** examples of how Digital Rights Management could prevent you from sharing downloaded music with a friend.

1. _____

_____

2. _____

_____

(2)

(Total 3 marks)

Q17.

To record sound a computer needs to convert the analogue sound into a digital form. During this process samples of the sound have to be taken. The table below shows 6 samples that have been stored in a computer's memory. These samples have been taken from the analogue signal over a period of one hundredth of a second.

Sample 6	01101100
Sample 5	01101100
Sample 4	01100000
Sample 3	00001101
Sample 2	00001000
Sample 1	00011011

Look at the digital representation, shown in the table above, of the analogue sound.

One Hertz (Hz) is one sample per second.

(a) What sampling rate, in Hertz, has been used?

_____

(2)

(b) What sampling resolution has been used?

_____

(1)

(c) State Nyquist's theorem

_____

_____

_____

_____

(2)

(Total 5 marks)

Q18.

Discuss the arguments for and against the use of Digital Rights Management (DRM) to protect digital music and videos.

In this question you will also be assessed on your ability to use good English and to organise your answer clearly in complete sentences, using specialist vocabulary where appropriate.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 6 marks)

Q19.

(a) Bitmapped graphic images are composed of **pixels**.

State what is meant by a pixel.

_____

_____

_____

_____

(2)

(b) Any black and white image will require only a single bit to encode each pixel.

Figure 1 shows a black and white bitmapped image.
Figure 2 shows the memory locations where the image is stored.
The first byte used for the pixel data is at location 187.
The pixel data are stored row-by-row, starting with row 1:

- black pixels are encoded with the bit set to 1
- white pixels are encoded with the bit set to 0 .

Figure 1

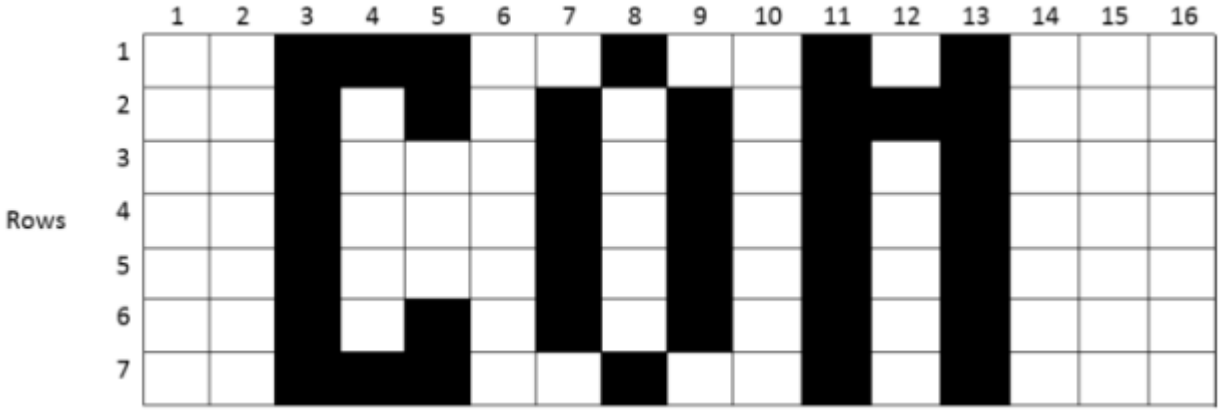


Figure 2

Location	Contents
187	0011 1001

188	0010 1000
189	
190	
:	
:	
:	
200	0010 1000

(i) What will be the contents of location 189 in **binary**?

Use the grid for rough working.

(1)

(ii) What will be the contents of location 190 in **denary**?

_____

_____

(1)

(c) Colour images can also be encoded as bitmaps.

(i) Explain how the colour of each pixel is encoded.

_____

_____

(1)

(ii) How many bits are required to store each pixel for a 256-colour image?

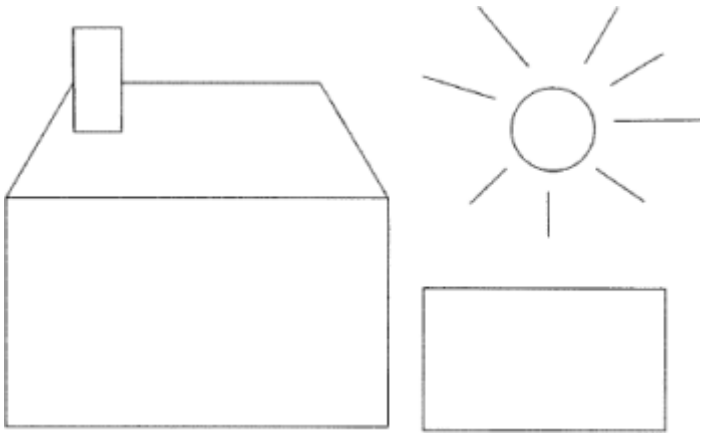
_____

_____

(1)

(d) The image in **Figure 3** was created with a vector graphics program.

Figure 3



(i) Describe how a vector graphics program stores the data about the image.

_____

_____

_____

_____

(2)

(ii) Name **three** properties that would be stored for a circle object.

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

Q20.

A company sells music to its customers over the Internet. The music can be downloaded as files and saved on the user's computer. It is protected by Digital Rights Management (DRM).

(a) What is DRM and why does the company use it to protect the music that it sells?

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(b) Explain how the company could use DRM to protect its music.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(Total 5 marks)

Q21.

(a) (i) Explain what is meant by a pixel.

_____

_____

(1)

(ii) How are pixels encoded to form a bitmapped image?

_____

_____

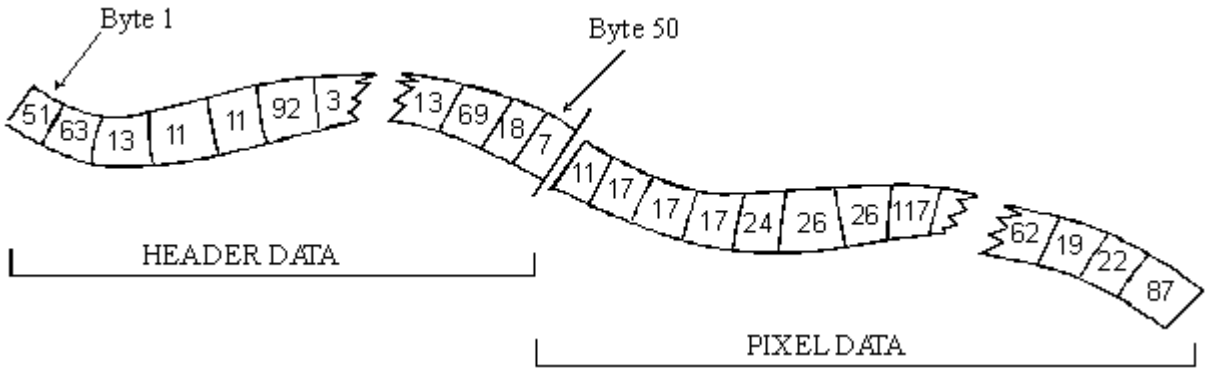
(1)

(b) Images can be saved in a bitmapped image file as a **'256 colour bitmap'**.

How many bytes are used to store each pixel? _____

(1)

(c) The first 50 bytes of these bitmapped files are used for **header data**. See **Figure 1**.



Name **two** items of data which should be included and stored in the file header.

1. _____

2. _____

(2)

(d) A high level programming language has a function `ReadImageByte` which is used to read the contents of a bitmapped image file.

It is defined in the help files as follows:

Function `ReadImageByte : Byte` The function `ReadImageByte` returns the next byte of data from a bitmapped image.

The pseudo-code that describes the process of reading the contents of the file header data is shown below.

```
Procedure ReadHeaderData
  For Position ← 1 To 50 Do
    CurrentHeader [Position] ← ReadImageByte
  EndFor
EndProcedure
```


(i) Complete the identifier information in the table below for this pseudo-code.

Variable Identifier	Data Type	Description
`Position`	Integer	
`Current Header`		Stores theheader data

(2)

The first four bytes of the header data are:

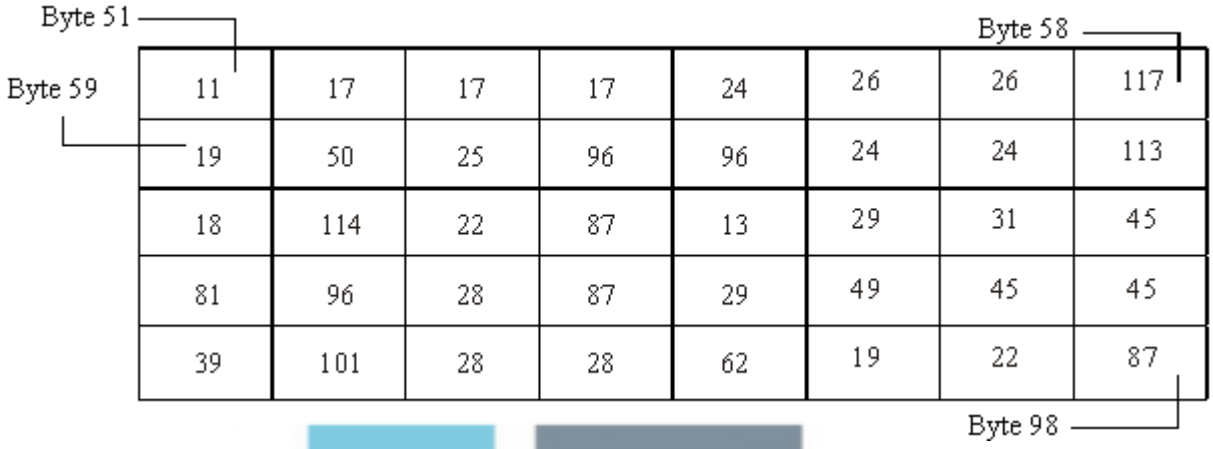
First	Second	Third	Fourth
51	63	13	11

(ii) What **binary value** will be assigned to variable `CurrentHeader[3]`?

(1)

(e) The width and height of the bitmapped image are stored by variables `ThisWidth` and `ThisHeight`.

A procedure `ReadPixelData` is to read the remaining contents of a bitmap image i.e. the byteswhich represent the individual pixels and to organise these as an image grid as shown in Figure 2.



11	17	17	17	24	26	26	117
19	50	25	96	96	24	24	113
18	114	22	87	13	29	31	45
81	96	28	87	29	49	45	45
39	101	28	28	62	19	22	87

(i) Complete the gaps in the pseudo-code below.

```
Procedure ReadPixelData
  For X ← 1 To ThisHeight Do
    For Y ← 1 To _____ Do
      ThisByte ← ReadImageByte
      ByteData [ _____, Y] ← ThisByte
    EndFor
  EndFor
EndProcedure
```

(2)

(ii) What data structure has the programmer used for variable `ByteData`?

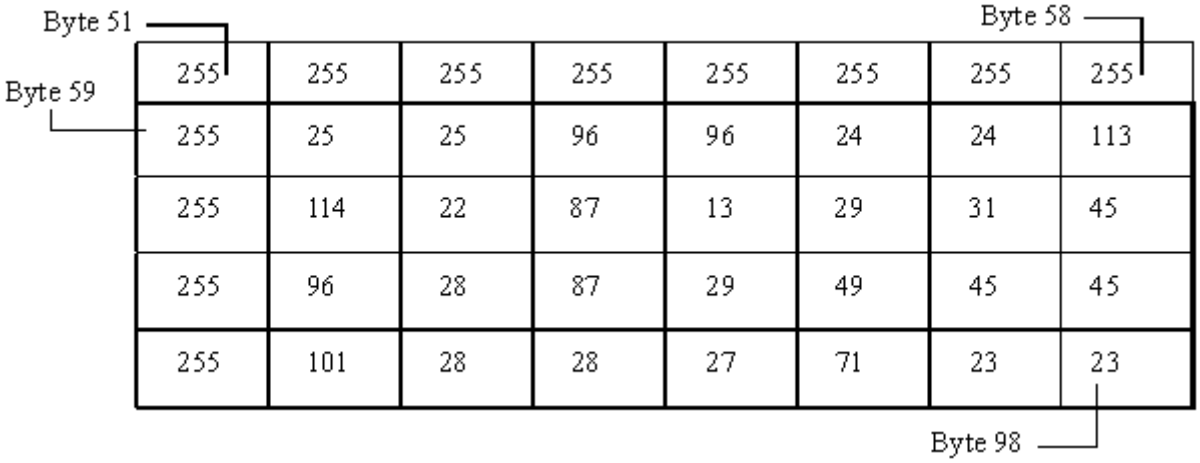
_____

(1)

(f) A graphics studio has produced all the graphic images for a new computing textbook.

The images all need to be 'tidied up' and, rather than edit every one with graphics software, it is suggested that the task be given to a computer programmer who will, for each image:

- remove the top row of pixels, and
- remove all the pixels in the first two columns - see **Figure 3**.



255	255	255	255	255	255	255	255
255	25	25	96	96	24	24	113
255	114	22	87	13	29	31	45
255	96	28	87	29	49	45	45
255	101	28	28	27	71	23	23

The `ReadPixelData` procedure is to be refined so that not all pixels will be retained. **The enclosed pixels in Figure 3 are those to be retained** and these bytes will be written to an array `Final`. These pixels, together with the header data bytes, will form the amended bitmapped file.

The test pixel data shown in **Figure 3** are to be used to trace the amended `ReadPixelData` procedure.

```
1    ThisWidth = 8
2    ThisHeight = 5
3    Call ReadPixelData

Procedure ReadPixelData
  Counter ← 0
  For X ← 1 to ThisHeight Do
    For Y ← 1 to ThisWidth Do
      ThisByte ← ReadImageByte
      If(X>1 AND Y>2)Then
        Final [Counter] ← ThisByte
        Counter ← Counter + 1
      EndIf
    EndFor
  EndFor
EndProcedure
```


Trace the execution of the pseudo-code **for two iterations only** of the outer loop (the loop controlled by variable X) by completing **Figure 4**.

ThisWidth	ThisHeight	Counter	X	Y	This Byte		Final
8	5					[0]	
						[1]	
						[2]	
						[3]	
						[4]	
						[5]	
						[6]	
						[7]	
						[8]	
						[9]	
						[10]	
						[11]	
						[12]	
						[13]	
						[14]	
						[15]	

(6)

(g) In this question identifier names have been used in the design for variables and procedure and function names.

(i) Name **one** other program element for which the programmer would allocate an identifier name.

_____

(1)

(ii) Programming languages impose restrictions about the choice of identifier names; for example a <Space> character cannot be included.

State **two** other restrictions in a programming language with which you are familiar.

_____

_____

(2)

(Total 20 marks)

Q22.

SSL (Secure Socket Layer) is a protocol used by Internet browsers to transmit information securely. It uses a combination of *Symmetric Key and Public Key encryption.*

(a) Explain the difference between Symmetric Key and Public Key encryption.

_____

_____

_____

(3)

(b) Amy uses her computer for online banking. When she logs on to her bank's website, her computer (computer A) and the bank's server (computer B) start a secure session using SSL. Computer B sends a symmetric key to computer A to encrypt all the personal data that is passed between the computers. This symmetric key is discarded at the end of the session.

(i) When and how is the Public Key encryption used in this session?

_____

_____

_____

(3)

(ii) Why is the symmetric key encryption on its own not enough to protect the personal data during transmission between computer A and computer B?

_____

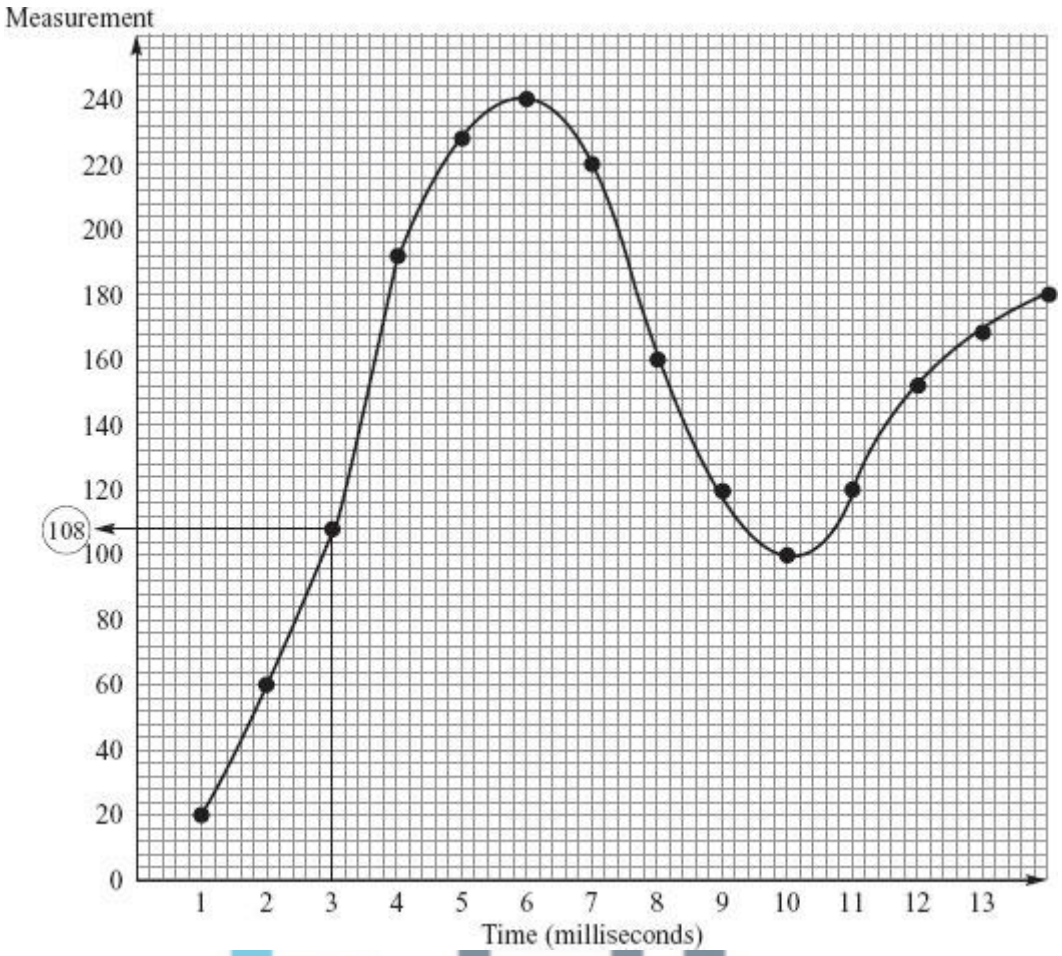
_____

(1)

(Total 7 marks)

Q23.

The figure below shows a very small part of a sound wave recorded through a microphone connected to a computer.



The dots each represent a recorded measurement of the sound wave. The recorded measurements are stored in main memory shown in the table below, with the first measurement stored in main memory location 700.

Memory Address	Measurement
700	0001 0100
701	0011 1100
702	(e)
703	1011 1101
704	1110 0011
705	1111 0000
706	1101 1100
707	1010 0000
708	0111 0111
709	0110 0100

(a) Name **two** items of essential software which **must** be in the main memory at the time this recording process takes place.

1. _____

2. _____

(2)

(b) (i) Explain what is meant by the **sampling rate**.

_____

(1)

(ii) Study the figure above and state what the sampling rate is for this recording.

(1000 milliseconds = 1 second).

_____

(1)

(c) Study the table above. How many bits are allocated to each sample?

_____

(1)

(d) (i) State **one** advantage of increasing the number of bits allocated to each sample.

_____

(1)

(ii) State **one** disadvantage of increasing the number of bits allocated to each sample.

_____

(1)

(e) Study the figure above. What will be the binary value stored at location 702 shown in the table?

_____

(1)

(f) In the table each of the binary values represents part of a sound file.
Give **three** other possible interpretations of one or more bytes held in main memory when the computer is being used for any application (excluding part of a picture or other media file).

1. _____

2. _____

3. _____

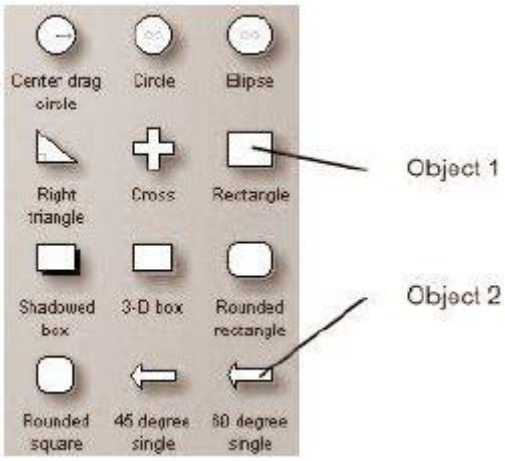
(3)

(Total 11 marks)

Q24.

(a) **Figure 1** shows some of the drawing objects available with a vector graphics drawing software package.

Figure 1



(i) Name **two properties** which are common to Object 1 and Object 2.

1. _____

2. _____

(2)

(ii) When a designer creates a drawing, the size of various objects is often increased/decreased/moved as the drawing is being developed.

Explain why no distortion occurs in vector graphics when the size of various objects is changed.

_____

_____

(2)

(iii) With vector graphics software, each new drawing is created as a set of vectored objects. Each drawing is created and saved in a file format specific to that brand of software. The software has an 'export' facility so that a bitmapped version of any drawing can be produced which can then be used as appropriate e.g. included in a word processed document.

Why is this arrangement preferable to bitmapped-based software which only creates and saves a bitmapped file?

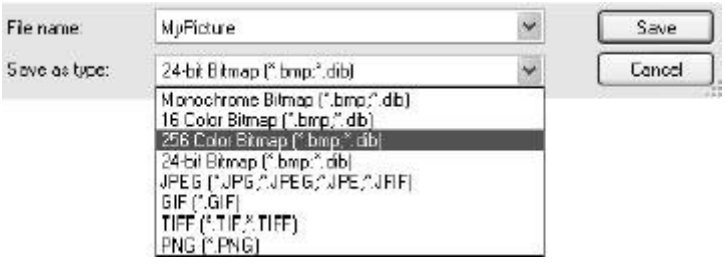
_____

_____

(1)

(b) Bitmapped software saves the picture as pixels, with a range of different possible colour resolutions as shown in **Figure 2**.

Figure 2



(i) If the graphic is saved as shown as a '256 color bitmap', how many bytes will be used to store each pixel?

_____

(1)

(ii) A picture is downloaded from a camera-phone and saved as a '256 color bitmap'. The picture has a width of 1280 pixels and height 768 pixels.

What is the file size in Kilobytes?

_____

(1)

(iii) The same picture as in part (ii) is later loaded into bitmapped software on a PC and saved to a new file as a '16 color bitmap'.

What is the size of this file in Kilobytes?

_____

(1)

(Total 8 marks)

Q25.

E-mail may be more easily intercepted and altered than paper mail without the knowledge of either the sender or the recipient.

In symmetric encryption, the same key is used to encrypt and decrypt a message. In asymmetric encryption, one key is used to encrypt a message and another key is used to decrypt the message.

(a) Why is symmetric encryption not used for encrypting e-mail messages?

_____

_____

(1)

(b) In asymmetric encryption, one key is made publicly available (the public key) and the other key is kept secret by its owner (the private key).
Jack and Jill want to communicate with each other confidentially, and they each have a private and a public key.

(i) Which key should Jack use to encrypt a message to send to Jill, which only Jill can read?

_____

(1)

(ii) Which key can Jill use to decrypt the message sent by Jack?

_____

(1)

(c) A digital signature authenticates the message, that is, it verifies that the message came from the given sender and that it has not been tampered with.

(i) How is a digital signature produced?

_____

_____

_____

_____

(3)

(ii) If Jack digitally signs the message sent to Jill, how can Jill verify Jack's digital signature?

_____

_____

_____

_____

_____

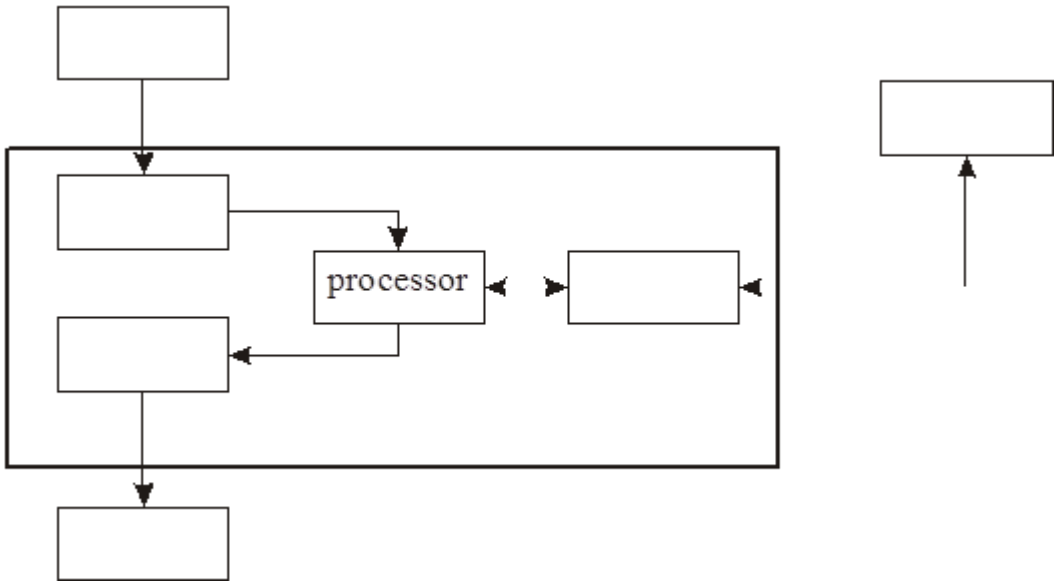
_____

(4)

(Total 10 marks)

Q26.

(a) The diagram represents a computer system which is used to both record and playback sound files.



The components in the diagram above are:

1 Loudspeaker
2 Digital to analogue converter
3 Secondary storage
4 Microphone
5 Main memory
6 Analogue to digital converter

Label the components in the diagram, using the numbers 1 to 6.

(6)

(b) (i) Explain what is meant by synthesised sound.

_____

_____

(1)

(ii) Give an example where synthesised sound would be produced and used.

_____

_____

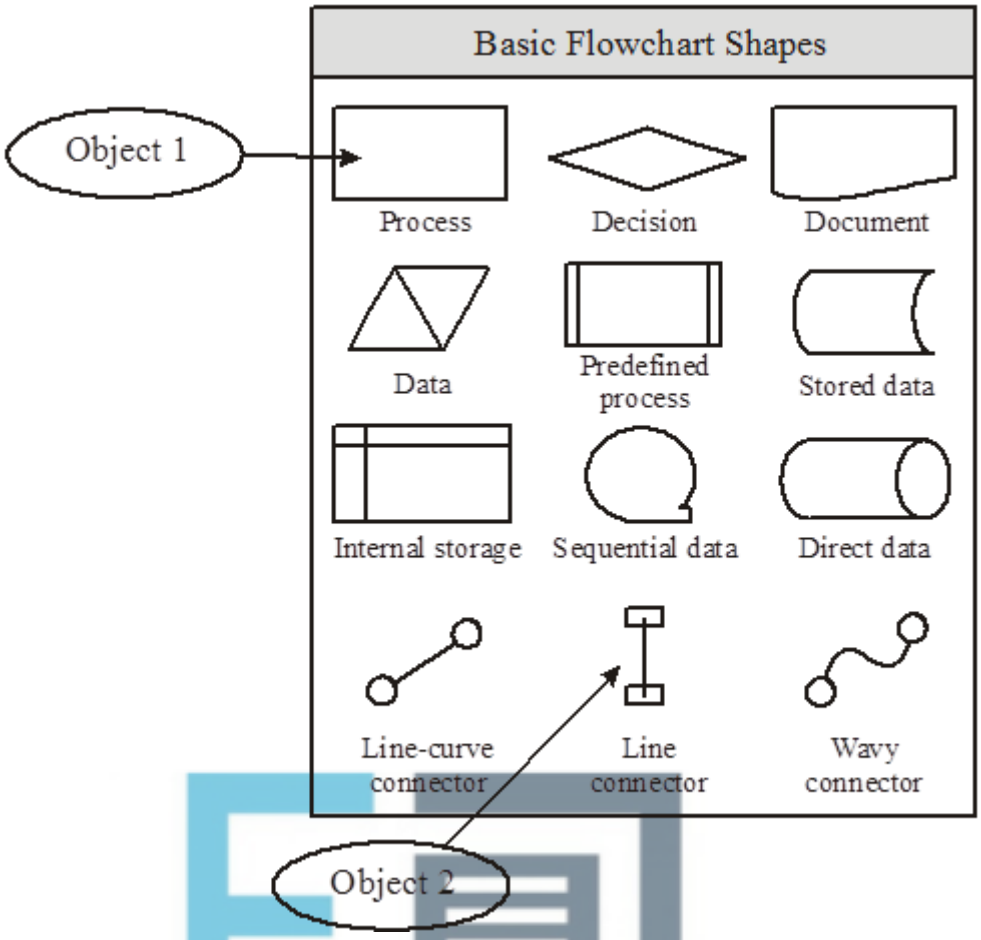
(1)

(Total 8 marks)

Q27.

(a) **Figure 1** shows a number of drawing objects from the toolbox of a vector graphics drawing program.

Figure 1



(i) For object 1 and object 2, state **two** properties common to both types of object, which would be recorded when used in a drawing.

1. _____

2. _____

(2)

(ii) State **one** other property for object 1 which would be recorded when used in a drawing.

_____

(1)

(iii) Graphics can be created with either vector graphics software or bit-mapped software. If the graphic is enlarged it may become distorted if created with bit-mapped software but show no distortion if created with vector graphics software.

Explain this statement.

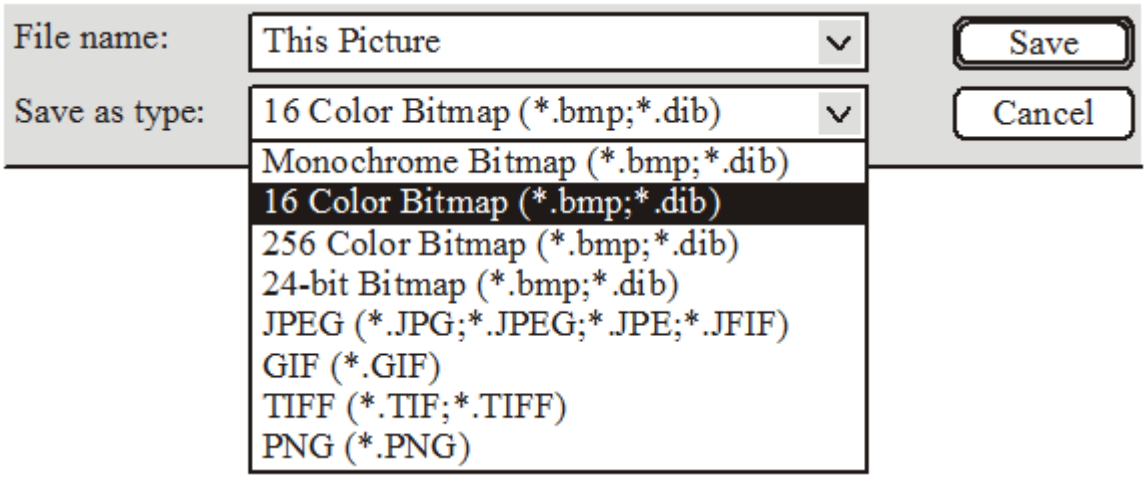
_____

_____

(2)

(b) **Figure 2** below shows the file type options available when saving a file with bit-mapped graphics software.

Figure 2



(i) How many bits are used to store each pixel if the resolution selected is as shown ('16 color bitmap')?'

_____

(1)

(ii) '256 color' images are stored with 1 byte per pixel. Explain this statement.

_____

_____

(1)

(iii) Read again the statement in part (ii).

A picture with size 1024 by 768 pixels is saved as a '256 color' image. Calculate the picture size in Kilobytes.

_____

_____

(1)

(iv) Black and white (monochrome) bit-mapped files store each pixel with a single bit.

A black and white image of size 512 by 256 pixels has a calculated file size of 16 Kilobytes. The actual file size is larger than this calculated size as the bitmap file contains other data.

What is this other data?

_____

_____

(1)

(Total 9 marks)

Q28.

What could you do to ensure that your e-mails are not read by unauthorised people?

_____

(Total 1 mark)

Q29.

A home computer is used to transfer picture files from a camera-phone to the hard disk of a computer using communications software and a Universal Serial Bus (USB) cable.

(a) What is meant by serial data communication?

_____

_____

(1)

(b) The picture files on the camera are each 768 by 1024 pixels. The pictures are encoded as 256-colour images.

(i) How many bytes are needed to store one pixel?

_____

(1)

(ii) How many kilobytes are needed to store five pictures?

_____

(1)

(c) The camera-phone also plays MP3 sound files. These sound files are produced from music CDs using software on the user's PC. The software has the option to encode the MP3 files at either 64kbps or 128kbps. The MP3 files are then uploaded from the PC to a memory card in the camera-phone.

Give **one** advantage and **one** disadvantage to the user of producing the files at the higher bit rate.

Advantage

_____

_____

Disadvantage

_____

_____

(2)

(Total 5 marks)

Q30.

Why is data often encrypted when transmitted over a network? Give **two** reasons.

1. _____

2. _____

(Total 2 marks)

Q31.

When a member of staff logs onto a computer in a particular organisation, they enter their User_name and password. The password has to be at least 8 characters long and must include both letters and numbers.

(a) Why do organisations set rules for acceptable user passwords?

_____

(1)

The file **Password** is used by the computer system to authenticate (check) the identity and password typed at a keyboard when a user logs onto the system. The password is input to the logon program as an alphanumeric string and converted to a two-byte integer using a hashing function or algorithm before being sent across a network for authentication (checking).

(b) Outline **three** major steps that a typical hashing function / algorithm would use to convert an alphanumeric string into a two-byte integer.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(Total 4 marks)

Q32.

When data is sent between **two** computer systems - the sender and the receiver - it is sometimes necessary to *encrypt* the data.

(a) What is encryption?

_____

_____

(1)

(b) A digital certificate consists of a public key and a private key. Anyone can know the public key but the private key should never be disclosed by its owner, the holder of the digital certificate.

Person A and Person B want to communicate via e-mail. Each has their own digital certificate and B has previously sent a digitally signed message to A. A wants to

send B a message that only B can understand.

(i) Which key should A use to encrypt this message?

_____

(1)

(ii) Which key does B have to use to decrypt the message?

_____

(1)

(c) B wants to send a reply to A.

A digital signature can be used to authenticate a message, that is, to show that it really has been sent by B and that it has not been tampered with.

B adds a digital signature to her message,

(i) List the steps needed to generate the digital signature for B's message.

_____

_____

_____

(3)

(ii) What are the steps needed to check that B's message is authentic?

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

Q33.

A computer system, connected to a microphone, can be used to record sound.

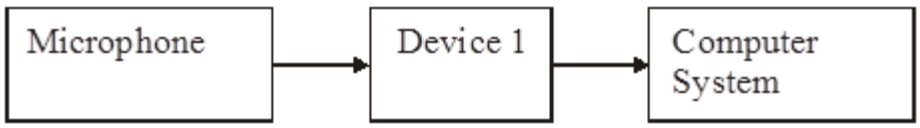


Figure 1

(a) (i) In **Figure 1** above name the device labelled Device 1.

Device 1 _____

(1)

(ii) Why is this device necessary?

_____

_____

_____

(2)

The sound can subsequently be reproduced.

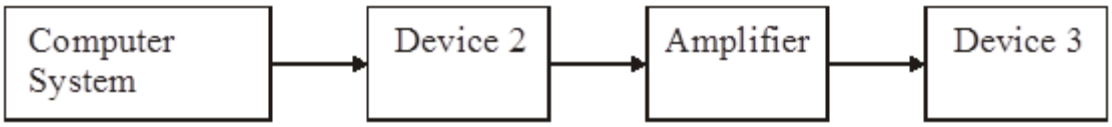


Figure 2

(b) In **Figure 2** name the devices labelled Device 2 and Device 3.

Device 2 _____

Device 3 _____

(2)

(c) Describe how sound is encoded when it is stored in a computer system.

_____

_____

_____

_____

(2)

(d) Give **two** features of the coding system that will affect the quality of the sound that is reproduced.

1. _____

2. _____

(2)

(Total 9 marks)

Q34.

Bit patterns can be interpreted in a number of different ways. A computer word contains the bit pattern 0011 0100.

(a) What is its decimal value if it represents:

a pure binary integer; _____

(1)

(b) (i) The ASCII value for the character '0' (zero) is 48. What character is represented by 0011 0100?

_____

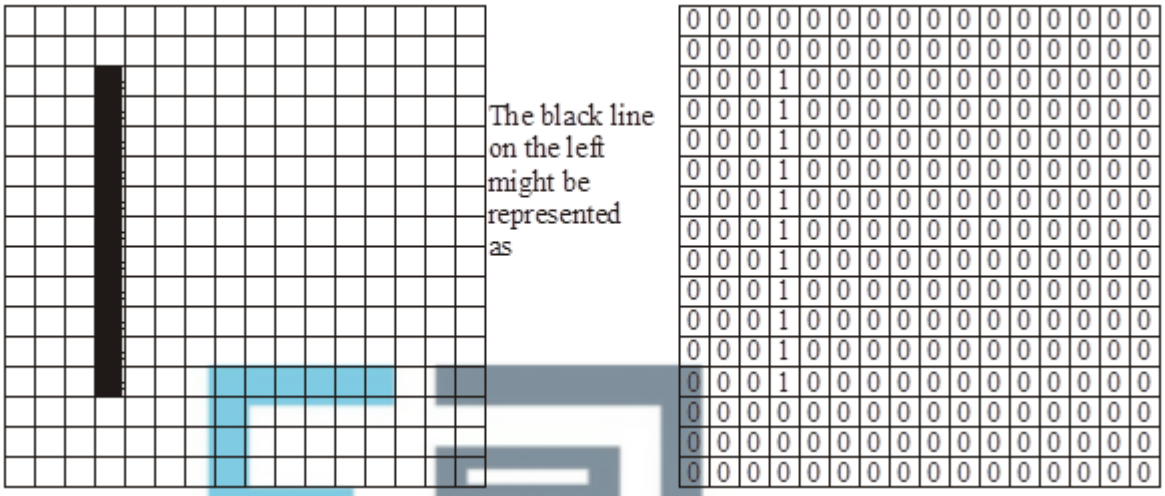
(1)

(ii) Name one other standard coding system for coding information expressed in character or text-based form.

_____

(1)

(c) One method of representing graphics in a computer system is as bit mapped graphics.



(i) Describe how a coloured line might be represented.

_____

_____

_____

(2)

(ii) Describe how a line would be stored using vector graphics.

_____

_____

_____

_____

(3)

(Total 8 marks)

Q35.

(a) Sound can be stored in a computer system. In order to store signals from a microphone in a form that the computer system can use, a special piece of hardware is needed.

(i) Give the name of this special piece of hardware.

_____

(1)

(ii) Describe the way that sound is coded in a computer system.

_____

_____

_____

(2)

(b) Graphics can also be stored in a computer system. What is meant by **each** of the following terms?

(i) Bit-mapped graphics;

_____

_____

(1)

(ii) Vector graphics.

_____

_____

(1)

(c) Give **two** advantages of vector graphics over bit-mapped graphics.

1. _____

2. _____

(2)

(d) (i) How are alphabetic characters represented in a computer system?

_____

_____

(1)

(ii) Name **one** character coding system.

_____

(1)

(Total 9 marks)