1. A car has a 'Follow Me' system that uses a cruise control feature to allow the car to follow the car in front of it. It will keep the same speed and distance without the driver's intervention. The cruise control system is an example of an embedded system.

The car's system has Read Only Memory (ROM) and Random Access Memory (RAM).

i. State **two** items that will be stored in the ROM for the 'Follow Me' system.

1 _____

2 _____ **[2]**

ii. The RAM will store currently running data and instructions.

State **three** items of data that will be stored in the RAM for the 'Follow Me' system.

1 _____

2 _____

3 _____ **[3]**

iii. Explain why the 'Follow Me' system does not need virtual memory.

_____

_____

_____

_____ **[2]**

2(a). The following table has either the binary or denary value of 3 numbers.

Complete the table by converting the 8-bit binary number into denary and the denary number into 8-bit binary.

8-bit Binary	Denary
11110000	
	105
00011110	

[3]

(b). Complete the table by writing the answer to each statement.

Statement	Answer
The smallest denary number that can be represented by a 4-bit binary number	
The largest denary number that can be represented by a 6-bit binary number	
The maximum number of different colours that can be represented with a colour depth of 7-bits	
The minimum number of bits needed to represent 150 different characters in a character set	

[4]

(c). Show the result of a left binary shift of 4 places on the binary number 00001111.

[1]

(d). Describe how to convert a 2-digit hexadecimal number into denary.

Use an example in your answer.

[3]

(e). Add these two 8-bit binary numbers using binary addition.

Show your working out.

[2]

3(a). A musician uses a computer to make and record music.

i. Tick (✓) **one** box to identify the correct description of sound sampling.

- ☐ The frequency of the wave is measured a set number of times each second.
- ☐ The amplitude of the wave is measured at set intervals.
- ☐ The digital sound wave is measured a set number of times each second.
- ☐ The analogue sound wave's resolution is measured at set intervals.

[1]

ii. Explain how changing the bit depth will affect the sound file.

[2]

(b). The musician has run out of storage space on their secondary storage device and needs to buy a replacement.

i. Identify whether the musician should buy a magnetic secondary storage device or a solid state secondary storage device for their computer.

Justify your choice.

Type

Justification

[4]

ii. Identify **one other** type of secondary storage.

---

[1]

iii. Tick (✓) **one** box to identify the smallest secondary storage capacity.

- ☐ 2.1 GB
- ☐ 300 MB
- ☐ 200 000 KB
- ☐ 0.0021 TB

[1]

iv. The musician's recordings have an average (mean) file size of 3 MB. The musician has 1000 recordings.

Calculate an estimate of the storage space in GB that the 1000 files will require, assuming they are each 3 MB in size. Show your working out.

Working space:

Answer: ..... GB

[2]

4(a). Computers represent data in binary form.

Tick (✓) **one** box to identify the statement about binary that is true.

- ☐ Binary digits can only be the values 0, 1 and 2
- ☐ The left-most bit of a binary integer has the smallest value
- ☐ Binary is used because computers are made of switches that can only be on or off
- ☐ The smallest whole number that can be stored in 8 bits is the number 1

[1]

(b). Complete the table by writing the missing denary, 8-bit binary or hexadecimal values.

Denary	8-bit binary	Hexadecimal
	00000111	7
49		31
	01100110	66
244	11110100	

[4]

(c). Tick (✓) **one** box to identify the largest file size.

- ☐ 2 000 000 bytes
- ☐ 2300 KB
- ☐ 200 MB
- ☐ 0.1 GB

[1]

(d). Tick (✓) **two** boxes to identify the two file sizes that are equal to each other.

- ☐ 4 500 000 bytes
- ☐ 450 KB
- ☐ 4.5 MB
- ☐ 0.45 GB

[1]

(e). Complete the binary addition by adding these two 8-bit binary numbers.

Show all your working.

[2]

(f). Identify the binary shift that has been applied to the 8-bit binary number 10110000 to get the result 10000000.

---

[2]

5(a). Binary numbers can represent different forms of data.

One form of data is characters.

Complete the description of how computers represent characters in binary using the given list of terms. Not all terms will be used.

2	4	8	9	16	32	256	
71	72	74	76	78	80	81	
all	different	identical	one	repeated	similar	some	unique

A character set stores ..... of the characters that the computer can represent. Each character is given a ..... binary code. Lower-case and upper-case letters in a character set are given ..... binary codes.

One example of a character set is ASCII. This character set uses ..... bits for each character. If the code value for the character 'F' is 70 then the code value for the character 'L' is ..... .

[5]

(b). Binary numbers can also represent images.

The table shows the colours that are used in an image and the binary value for each colour.

Colour	Binary value
Red	0000
Green	0010
Blue	1000
Purple	0110

The metadata states that the image is 3 pixels wide by 4 pixels high.

The data in the file starts in the top left of the image and goes from left-to-right, top-tobottom.

i. State what is meant by **metadata** in an image file.

_____

_____ **[1]**

ii. The binary data stored for the image is given:

0000000001101000001010000110011001100000000101000

A grid is given for the image. Each square is one pixel.

Write the name of the colour in each square that the pixel will show for this image.

[2]

iii. A colour depth of 4 is used. This means 4 bits are used to store the colour for each pixel.

State the maximum number of different colours that can be represented in 4-bits.

[1]

iv. The colour depth is increased to 2 bytes.

State **two** effects that this change can have on the image.

1 _____

_____

2 _____

[2]

(c). A student has a text document and an image file that need to be compressed separately.

The student needs to reduce the file size of both of these files as much as possible.

i. Identify the most suitable type of compression for the **text** document. Justify your choice.

Type of compression _____

Justification _____

_____

_____

_____ **[3]**

ii. Identify the most suitable type of compression for the **image** file. Justify your choice.

Type of compression _____

Justification _____

_____

_____

_____ **[3]**

6. An artist has a computer that they use to create images.

Their computer has both hardware and software.

The hardware includes primary and secondary storage.

i. Explain why a computer needs both primary **and** secondary storage.

_____

_____

_____

_____ **[2]**

ii. Give **one** example of a secondary storage device that the artist's computer will have **and** an example of the data that will be stored on it.

Secondary storage device _____

Example data _____

_____ **[2]**

iii. The computer has Virtual Memory (VM).

The table has four statements about VM. Not all of the statements are correct.

Tick (✓) the **True** column for the statements that are correct.

Re-write any statement that is incorrect in the **False** column by changing the statement to make it true.

Statement	True (✓)	False – rewrite the statement to make it true
A section of primary storage is partitioned to act as virtual memory		
Data from ROM is transferred into VM		
VM is needed when RAM is full, or nearly full		
Data from VM is transferred back to secondary storage when needed		

[4]

7(a). Computers represent data in binary form.

Tick (✓) **one** box in each row to identify the binary unit equivalent of each of the given file sizes.

File size	2 megabytes	2 petabytes	2 kilobytes	2 bytes	2 gigabytes
2000 bytes					
2000 terabytes					
16 bits					
4 nibbles					

[4]

(b). Convert the denary number 221 into 8 bit binary. Show your working.

[2]

(c). Convert the hexadecimal number 2F into denary. Show your working.

[2]

(d). Convert the binary number 10110000 into hexadecimal.

[1]

(e). Identify how many unique values can be represented by 4 bits.

[1]

(f). Perform a binary shift of 3 places right on the binary number 10001110.

[1]

8(a). A student is creating a range of documents for a school project.

The student records a podcast about computer science.

i. Describe how an analogue sound wave is converted into digital form.

[3]

ii. Tick (✓) **one or more** boxes on each row to identify the effect(s) that each change will have on the sound file.

Change	File size increases	File size decreases	Accuracy increases	Accuracy decreases
Duration changes from 10 minutes to 20 minutes				
Sample rate changes from 44 kilohertz to 8 kilohertz				
Bit depth changes from 8 bits to 16 bits				

[3]

(b). A student writes a report about volcanoes.

i. The computer stores text using the ASCII character set.

Part of the ASCII character set is shown:

Character	ASCII denary code
M	77
N	78
O	79
P	80
Q	81

Identify the character that will be represented by the ASCII denary code 84.

_____ **[1]**

ii. Identify a second character set.

_____ **[1]**

(c). A student takes a photograph of their science experiment. The image file includes metadata.

Identify **three** pieces of metadata that is often stored with an image.

1 _____

2 _____

3 _____

[3]

(d). A student compresses all their documents before emailing them to their teacher.

(i) Give **two** benefits of compressing the data before it is emailed.

1 _____

_____

2 _____

_____

[2]

ii. Explain why lossy compression may **not** be appropriate to compress all of the student's files.

_____

_____

_____

[2]

9(a). A smart television allows the user to search the Internet and watch videos online.

A smart television has both RAM and ROM.

i. State the difference between RAM and ROM.

_____

[1]

ii. Give **two** examples of data that a smart television could store in RAM.

1 _____

2 _____

[2]

(b). A smart television has secondary storage.

i. State, using an example, why the smart television needs secondary storage.

_____

_____

_____

[2]

ii. Identify **one** appropriate type of secondary storage for the smart television. Justify your choice.

Secondary storage type _____

Justification _____

_____

_____

_____

_____

_____

[4]

10(a). Layla is an artist. She draws images by hand. The image is then scanned and stored on a computer. Layla stores her images on a secondary storage device.

i. Each image has a fixed size of 1 MB. The storage device has a capacity of 3 GB.

Calculate how many images can be saved on the storage device. Show your working.

_____

_____

images

_____

[2]

ii. Layla uses the images to make videos. These videos are stored on her computer's internal storage device.

Identify the most appropriate type of storage device for Layla to use in her computer. Justify your choice.

Type of storage device .....

Justification

[3]

iii. The videos include sound. The table has **four** statements about the storage of sound in a computer.

Tick **(✓) one** box in each row to identify if the statement is true or false

	True	**False**
The sample rate is the number of times the amplitude is recorded per second		
The smaller the bit depth the smaller the range of sounds recorded		
The larger the sample rate the larger the bit depth		
The frequency and pitch of the sound wave are measured		
Sound is stored using pixels		

[3]

(b). Layla uploads her images and videos to a website.

i. Explain why Layla compresses the images and videos before uploading them.

[2]

ii. Layla wants to reduce the file size of the images and videos by the largest amount possible.

Identify the method of compression that would be most appropriate. Justify your choice.

Compression method .....

Justification

[3]

11(a). The ASCII code for the character J is the denary number 74.

i. State what is meant by a character set.

[1]

ii. ASCII has 8 bits per character.

Identify the maximum number of different characters that ASCII can represent.

[1]

iii. A text file uses the ASCII character set. The text file has 2000 characters in it.

Calculate an estimate of the file size of the text file in Kilobytes. Show your working.

_____Kilobytes

iv. Identify **one** other character set.

[2]

(b). Write the 8-bit binary number for the ASCII character J in the following boxes:

[1]

(c). Give the hexadecimal number for the ASCII character K.
Show your working.

[2]

(d). A binary shift can be performed on a binary integer.

Identify which shift will multiply a number by 8.

[2]

12. Layla is an artist. She draws images by hand. The image is then scanned and stored on a computer.

The table has **four** statements about the storage of images on a computer.

Tick **(✓) one** box in each row to identify if the statement is true or false.

	True	**False**
Each colour has a unique binary code		
Metadata stores the colour of each pixel in the image		
A bitmap is made of pixels		
The higher the colour depth, the smaller the number of different colours that can be displayed		

[2]

13(a). A computer records an audio file of someone playing a guitar.

Convert the binary number 11001011 into denary.

[1]

(b). Complete a 2-place shift to the right on the binary number 11001011.

[1]

(c). Explain the effect of performing a 2-place shift to the right on the binary number 11001011.

[2]

14. The table gives the ASCII code for the characters.

Character	ASCII code
L	76
M	77
N	78
O	79
P	80

Explain how the word MOP will be represented in ASCII.

[2]

15(a). Nina wants to transfer photos from a digital camera to an external secondary storage device.

Define what is meant by 'secondary storage'.

[1]

(b). Identify the **three** common types of storage Nina can choose from.

1

2

3

[3]

(c). State **four** characteristics of secondary storage devices that Nina should consider when choosing a device.

1 _____

2 _____

3 _____

4 _____

[4]

16(a). A satellite navigation system (Sat Nav) uses RAM and ROM.

Tick (✓) **one** box in each row to show whether each of the statements is **true** for the RAM or ROM in a Sat Nav.

	RAM	**ROM**
Stores the boot up sequence of the Sat Nav.		
The contents are lost when the Sat Nav is turned off.		
Holds copies of open maps and routes.		

[3]

(b). The Sat Nav contains an embedded system. Define what is meant by an 'embedded system'.

_____

_____ **[1]**

(c). Identify **three** devices, other than a Sat Nav, which contain embedded systems.

1 _____

2 _____

3 _____

[3]

17(a). A computer records an audio file of someone playing a guitar.

Describe what happens when the computer converts the music into a file.

[2]

(b). The sample rate is increased on the computer when recording the guitar.

Give **two** effects this will have on the recording.

1

2

[2]

END OF QUESTION PAPER