GCST

1.2 MEMORY AND STORAGE

TOPIC WISE EXAM QUESTIONS

GCSE OCR

GCST

1.2 – Memory and storage

1.2.1 Primary storage (Memory)

- ☐ The need for primary storage
- ☐ The difference between RAM and ROM
- ☐ The purpose of ROM in a computer system
- ☐ The purpose of RAM in a computer system
- ☐ Virtual memory

Required

- ✓ Why computers have primary storage
  - How this usually consists of RAM and ROM
- ✓ Key characteristics of RAM and ROM
- ✓ Why virtual memory may be needed in a system
- ✓ How virtual memory works
  - Transfer of data between RAM and HDD when RAM is filled

1.2.2 Secondary storage

- ☐ The need for secondary storage
- ☐ Common types of storage:
  - Optical
  - Magnetic
  - Solid state
- ☐ Suitable storage devices and storage media for a given application
- ☐ The advantages and disadvantages of different storage devices and storage media relating to these characteristics:
  - Capacity
  - Speed
  - Portability
  - Durability
  - Reliability
  - Cost

Required

- ✓ Why computers have secondary storage
- ✓ Recognise a range of secondary storage devices/media
- ✓ Differences between each type of storage device/medium
- ✓ Compare advantages/disadvantages for each storage device
- ✓ Be able to apply their knowledge in context within scenarios

Not required

- × Understanding of the component parts of these types of storage

1.2.3 Units

- ☐ The units of data storage:
  - Bit
  - Nibble (4 bits)
  - Byte (8 bits)
  - Kilobyte (1,000 bytes or 1 KB)
  - Megabyte (1,000 KB)
  - Gigabyte (1,000 MB)
  - Terabyte (1,000 GB)
  - Petabyte (1,000 TB)
- ☐ How data needs to be converted into a binary format to be processed by a computer
- ☐ Data capacity and calculation of data capacity requirements

Required

- ✓ Why data must be stored in binary format
- ✓ Familiarity with data units and moving between each
- ✓ Data storage devices have different fixed capacities
- ✓ Calculate required storage capacity for a given set of files
- ✓ Calculate file sizes of sound, images and text files
  - sound file size = sample rate x duration (s) x bit depth
  - image file size = colour depth x image height (px) x image width (px)
  - text file size = bits per character x number of characters

Alternatives

- Use of 1,024 for conversions and calculations would be acceptable
- Allowance for metadata in calculations may be used

1.2.4 Data storage

Numbers

- ☐ How to convert positive denary whole numbers to binary numbers (up to and including 8 bits) and vice versa
- ☐ How to add two binary integers together (up to and including 8 bits) and explain overflow errors which may occur
- ☐ How to convert positive denary whole numbers into 2-digit hexadecimal numbers and vice versa
- ☐ How to convert binary integers to their hexadecimal equivalents and vice versa
- ☐ Binary shifts

Required

- ✓ Denary number range 0 – 255
- ✓ Hexadecimal range 00 – FF
- ✓ Binary number range 00000000 – 11111111
- ✓ Understanding of the terms 'most significant bit', and 'least significant bit'
- ✓ Conversion of any number in these ranges to another number base
- ✓ Ability to deal with binary numbers containing between 1 and 8 bits
  - e.g. 11010 is the same as 00011010
- ✓ Understand the effect of a binary shift (both left or right) on a number
- ✓ Carry out a binary shift (both left and right)

Sub topic	Guidance
Characters ☐ The use of binary codes to represent characters ☐ The term 'character set' ☐ The relationship between the number of bits per character in a character set, and the number of characters which can be represented, e.g.: ○ ASCII ○ Unicode **Images** ☐ How an image is represented as a series of pixels, represented in binary ☐ Metadata ☐ The effect of colour depth and resolution on: ○ The quality of the image ○ The size of an image file **Sound** ☐ How sound can be sampled and stored in digital form ☐ The effect of sample rate, duration and bit depth on: ○ The playback quality ○ The size of a sound file	**Required** ✓ How characters are represented in binary ✓ How the number of characters stored is limited by the bits available ✓ The differences between and impact of each character set ✓ Understand how character sets are logically ordered, e.g. the code for 'B' will be one more than the code for 'A' ✓ Binary representation of ASCII in the exam will use 8 bits **Not required** × Memorisation of character set codes **Required** ✓ Each pixel has a specific colour, represented by a specific code ✓ The effect on image size and quality when changing colour depth and resolution ✓ Metadata stores additional image information (e.g. height, width, etc.) **Required** ✓ Analogue sounds must be stored in binary ✓ Sample rate – measured in Hertz (Hz) ✓ Duration – how many seconds of audio the sound file contains ✓ Bit depth – number of bits available to store each sample (e.g. 16-bit)
1.2.5 Compression	
☐ The need for compression ☐ Types of compression: ○ Lossy ○ Lossless	**Required** ✓ Common scenarios where compression may be needed ✓ Advantages and disadvantages of each type of compression ✓ Effects on the file for each type of compression **Not required** × Ability to carry out specific compression algorithms

2023

Computers represent data in binary form.

(a) 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.

```
  0 1 1 1 0 0 0 1
+ 1 0 0 1 1 1 1 0
  ---------------
```

[2]

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

.....

..... **[2]**

Binary numbers can represent different forms of data.

(a) 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-to-bottom.

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

.....

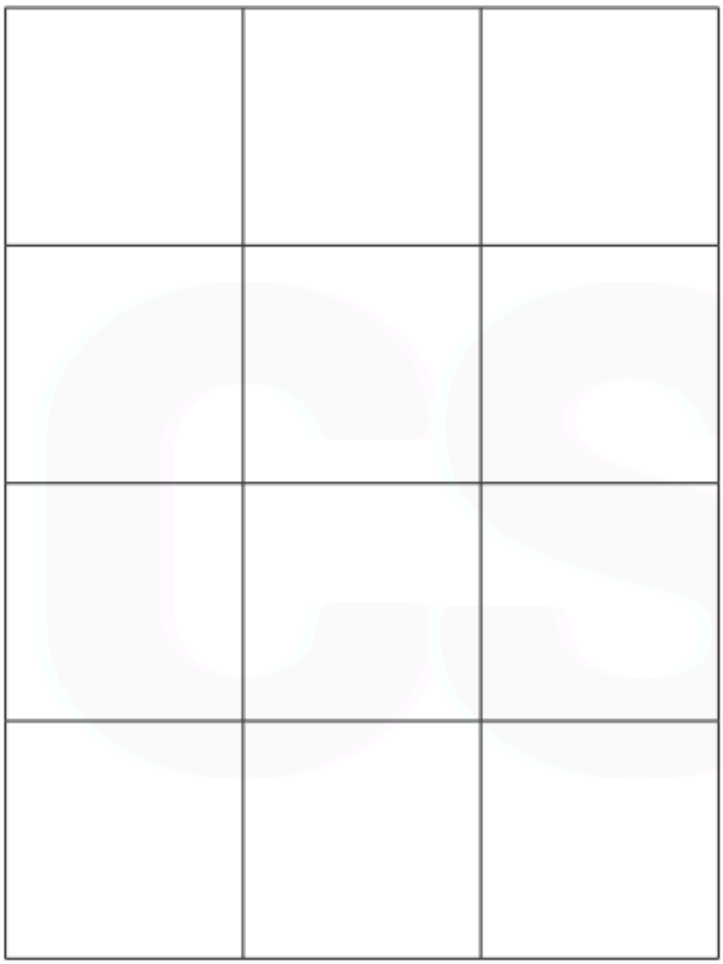
..... **[1]**

(ii) The binary data stored for the image is given:

000000000110100000101000011001100110000000101000

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]

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

Their computer has both hardware and software.

(a) The hardware includes primary and secondary storage.

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

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.....

.....

..... **[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 .....

.....

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[2]

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]

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2022

Computers represent data in binary form.

(a) 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.

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..... **[2]**

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

.....

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..... **[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]

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

(a) The student records a podcast about computer science.

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

.....

.....

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.....

..... [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) The 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) The 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]

A smart television allows the user to search the Internet and watch videos online.

(a) The smart television has both RAM and ROM.

(i) State the difference between RAM and ROM.

.....

..... **[1]**

(ii) Give **two** examples of data that the smart television could store in RAM.

1 .....

2 .....

(b) The 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]

GCST

SAMPLE

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

(a) 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 .....

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

(a) 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]

(a) 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]

(a) Convert the binary number 11001011 into denary.

.....

..... **[1]**

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

.....

..... **[1]**

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

.....

.....

.....

..... **[2]**

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]**

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2021

A computer system has a 2.5 GHz processor and 5 GB of RAM.

(a) Complete the paragraph about memory by writing the missing terms in the spaces, using the words provided.

cache	data	hard drive	instructions	changed	closing
operator	primary	random	read	secondary	start-up
translator	memory stick	virtual	write		

ROM stands for ..... only memory. This stores the ..... instructions for a computer and cannot be ..... .

RAM stands for ..... access memory. This stores the instructions and ..... that are currently being used. If the computer does not have enough RAM to run a process it can make use of ..... memory.

RAM and ROM are both examples of ..... memory. Memory located close to the processor that allows faster access than from RAM is called ..... memory. **[8]**

Charlie has purchased a new tablet computer. The tablet has an internal secondary storage device.

(a) Describe what the internal secondary storage device will store.

.....

.....

.....

..... **[2]**

(b) The storage device is a solid state device.

(i) Give **three** benefits of the tablet having a solid state device instead of a magnetic device.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(ii) Give **two** drawbacks of the tablet having a solid state device instead of a magnetic device.

1 .....

.....

2 .....

.....

[2]

ASCII, extended ASCII and Unicode are all examples of character sets.

(a) Tick (✓) **one or more** boxes in each row to identify whether each statement applies to each character set.

	ASCII	Extended ASCII	Unicode
Can represent thousands of different characters, including Russian and Chinese symbols.			
Can represent European characters such as ç or â.			
Uses different character codes for upper-case and lower-case letters.			

[3]

(b) The character **D** is represented by the binary ASCII code **1000100**

Give the ASCII code for the following characters in binary.

E .....

.....

H .....

.....

(c) Sound data is also sampled and stored in binary.

A 30-second section of sound data is sampled at a rate of 48 KHz using 24 bits per sample.

(i) Describe the data that is recorded when sound is sampled.

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.....

..... **[2]**

(ii) Explain what is meant by a sample rate of **48 KHz**.

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..... **[2]**

(iii) Describe how the file size of the sound recording could be reduced.

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..... [4]

(a) Convert the denary value **178** into an 8-bit binary number.

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..... [2]

(c) Convert the binary value **1100 0111** into hexadecimal.

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.....

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..... [2]

(d) Azmi says, "hexadecimal is used because it takes up less storage space in the computer's memory than binary."

Tick **one** box to identify whether Azmi is correct. Justify your answer.

	Tick (✓)
Correct	
Incorrect	

Justification .....

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.....

[2]

(e) Binary shifts can be used for multiplication and division.

Draw **one** line from each shift on the left to its correct outcome on the right.

Binary shift	Outcome
Right shift of 2 places on 1010 1000	0011 1010, divides by 4 with a loss of precision
Left shift of 1 place on 0010 1101	0010 1010, divides by 4
Right shift of 2 places on 1110 1001	0101 1010, multiplies by 2
Left shift of 3 places on 0001 1111	1111 1000, multiplies by 8

[3]

(f) Add the following 8 bit binary integers, giving your answer in binary.

```
  0 0 1 1 0 1 1 0
+ 1 0 0 1 0 1 1 0
-----------------
```

[2]

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GCST

2020

(d) Ali's tablet computer also has ROM (read only memory).

Describe the purpose of ROM in Ali's tablet computer.

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.....

.....

..... **[2]**

(f) Ali's tablet computer has 100 GB of secondary storage. There is currently 80 GB available.

Ali wants to transfer a series of video clips onto his tablet. Each video is, on average, 200 000 kilobytes.

Calculate an estimate of the number of video clips Ali can fit onto his tablet.

Show your working.

Working: .....

.....

.....

.....

Answer: .....

[4]

(a) Convert the binary value **1110 0011** into hexadecimal.

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..... **[2]**

(b) Convert the denary value **105** into an 8 bit binary number.

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..... **[2]**

(c) Give **two** reasons why computer scientists use hexadecimal to represent numbers instead of binary.

1 .....

.....

2 .....

.....

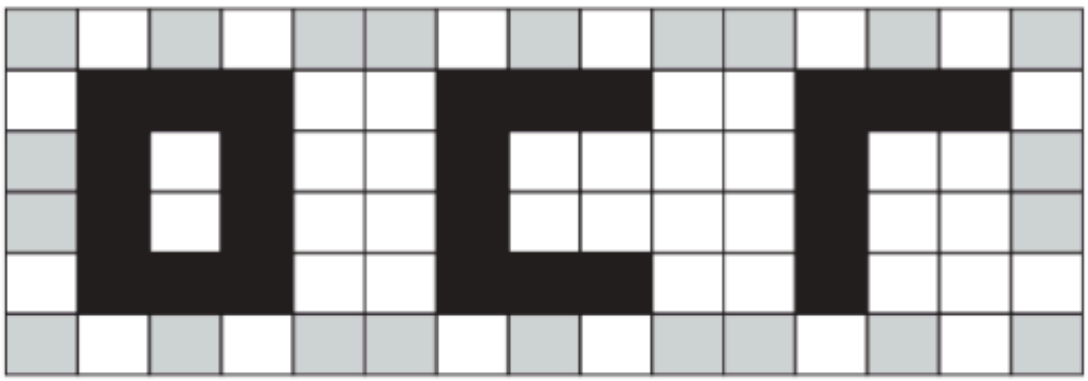
[2]

(e) Show the outcome of a right shift of three places on the binary value 0111 1000

.....

..... **[1]**

5 The following logo is stored as a bitmap image. Each box represents **one** pixel, with **three** different colours being used in the image.



(a) State what is meant by the term image resolution.

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..... **[1]**

(b) Calculate the fewest number of bits that could be used to store the logo as a bitmap image. You must show your working.

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..... **[4]**

Give **two** ways that the file size of the image could be reduced.

1 .....

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2 .....

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[2]

Metadata is sometimes stored alongside images.

(i) State what is meant by the term metadata.

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..... **[1]**

(ii) Give **one** example of metadata that could be stored alongside the logo.

.....

..... **[1]**

2019

Both computers have RAM and ROM.

(i) The table has **five** statements describing RAM and/or ROM.

Tick (✓) **one or more** boxes in each row to identify if that statement describes RAM and/or ROM.

	RAM	ROM
Stores data		
The memory is volatile		
Data will not be lost when the computer is turned off		
Data is read-only, cannot be changed		
Stores currently running data and instructions		

[5]

(ii) Give **one** difference between RAM and flash memory.

.....

..... **[1]**

Kerry has 5GB of files to transfer from her laptop at work to her new computer. She has been told to buy an external solid state device to do this.

(i) Give **one** example of a solid state device.

.....

..... **[1]**

(ii) Identify whether the device given in **part (c)(i)** is an example of primary or secondary memory.

.....

.....

(iii)* Kerry was originally going to use an optical storage device to transfer her files.

Discuss whether an optical or solid state device is the most appropriate media to transfer these files.

You may want to consider the following characteristics in your answer:

- portability
- robustness
- capacity
- cost

[8]

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(iv) The filesizes of Kerry's files are usually displayed in megabytes (MB) or gigabytes (GB).

Calculate how many MB are in 5GB. Show your working.

.....MB **[2]**

1 (a) A radio station records an interview with a computer scientist using a computer and audio recording software.

(i) Explain how sampling is used to store audio recordings.

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..... [2]

A second interview with the computer scientist is recorded. Before this interview, the sampling frequency in the audio software is increased.

(ii) Define what is meant by the term **sampling frequency**.

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..... [1]

(iii) Tick (✓) **two** boxes to show the effects of increasing the sampling frequency.

Data type of returned value	Tick (✓) **two** boxes
The file size of the digital recording will be smaller.	
The file size of the digital recording will be larger.	
The quality of playback of the digital recording will be better.	
The quality of playback of the digital recording will be worse.	

[2]

The radio station uses a digital camera to take a photograph of the computer scientist for their website. The photograph is stored as a bitmap image.

(i) Describe how bitmap images are represented in binary.

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..... **[3]**

5 (a) Convert the hexadecimal number **A3** to denary. Show your working.

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..... [2]

(b) Convert the binary number **1011011** to denary. Show your working.

.....

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..... [2]

(d) Add the following binary numbers.

```
  1 0 1 1 0 1 1 0
+     1 0 0 1 1 1
```

[2]

2018

William is creating a film for a school project using a digital video camera.

(a) The digital video camera has a secondary storage device.

(i) Explain why the digital video camera needs secondary storage.

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.....

.....

..... **[2]**

(ii) The digital video camera uses solid state storage.

Explain why solid state storage is the most appropriate type of storage for the digital video camera.

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..... **[4]**

(b) William transfers the videos to a computer for editing.

(i) The computer has 1GB of storage free.

Calculate the number of videos that could be stored on the computer if each video was 100MB in size.

Show your working.

.....

.....

..... **[2]**

The computer will only have 2GB of RAM, but Alicia says that virtual memory can be used instead of adding more RAM.

(i) Explain how virtual memory can compensate for the lack of RAM in Alicia's computer.

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.....

..... **[3]**

(ii) Explain why it would be beneficial for Alicia to get more RAM instead of relying on virtual memory.

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.....

..... **[2]**

(a) **(i)** Convert the denary number **132** into an 8 bit binary number.

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.....

..... **[2]**

(ii) Convert the binary number **10110101** to its hexadecimal equivalent.

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..... **[2]**

(iii) Show the effect of a binary shift right of two places on the binary number **00110100**.

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.....

..... **[1]**

(iv) Describe a shift that can be used to double the value of the binary number **00100100**.

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..... **[2]**

2016

Alex is producing images and sound effects for a website.
Part of a bitmap image is shown in Fig. 2:

W	W	R	R	R	B	B
W	W	R	Y	R	B	B
B	B	R	R	R	B	B
B	B	B	LG	B	DG	B
B	DG	DG	LG	DG	B	B
B	B	DG	LG	B	B	B
B	B	B	LG	B	B	B

Fig. 2

The letters represent a colour, as shown in Fig. 3:

Letter	Colour
W	White
B	Blue
R	Red
Y	Yellow
DG	Dark Green
LG	Light Green

Fig. 3

(a) Using the example in Fig. 2, explain how a bitmap image is stored on a computer.

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..... **[3]**

(b) Explain how reducing the number of colours in an image can reduce its file size.

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..... **[2]**

(c) The final image file may contain metadata. Describe, using an example, what is meant by metadata.

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..... **[2]**

(d) Alex needs to create an audio recording of himself playing his guitar.

(i) Explain how sampling is used to make the recording.

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.....

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.....

..... **[3]**

(ii) State the effects of increasing the sample rate of the recording.

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.....

..... **[2]**

(b) Quinn is considering upgrading the RAM.

(i) Describe **two** differences between RAM and ROM.

Difference 1 .....

.....

.....

Difference 2 .....

.....

..... **[4]**

(ii) Quinn has decided to upgrade the RAM on his computer. Explain why this would improve the computer's performance.

.....

.....

.....

..... **[2]**

8 **(a)** Convert the decimal number 191 into 8-bit binary.

..... **[1]**

(b) Perform the following binary addition

$$\begin{array}{r} 01101011 \\ +\ 01011011 \\ \hline \end{array}$$

[2]

GCST

2015

7 Dipesh is thinking of buying a tablet computer to replace his old desktop computer.

(a) Describe how the CPU and RAM work together to enable the tablet computer to operate.

.....

.....

.....

.....

.....

.....

..... **[3]**

GCST

2014

A computer has 1024 megabytes of RAM.

(a) How many gigabytes of RAM does the computer have?

.....

..... **[1]**

(b) State **two** items that will be stored in the RAM.

1 .....

.....

2 .....

..... **[2]**

(c) The computer sometimes uses virtual memory.

Describe what is meant by virtual memory **and** state why it is needed.

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.....

..... **[3]**

3 **(a)** Add the following two 8-bit binary numbers.

```
  1   0   0   1   1   0   1   1
  0   1   0   1   0   1   0   0
-------------------------------

-------------------------------
```

[2]

(b) An overflow error can occur when adding two 8-bit binary numbers.

Describe what is meant by an overflow error.

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.....

.....

..... **[2]**

(b) Types of secondary storage devices are magnetic, optical or solid state.

(i) State which type of storage is most suitable for storing the electronic books inside the e-book reader.

..... **[1]**

(ii) Explain **one** reason why this type of storage is the most suitable.

.....

.....

.....

..... **[2]**

(c) Apu gets a free e-book on a CD-ROM from a magazine.

(i) Give **two** reasons why a CD-ROM is suitable in this case.

1 .....

.....

2 .....

.....

[2]

(ii) State whether a CD-ROM is magnetic, optical or solid state storage.

..... **[1]**

9 **(a)** The number 62 could be a denary number or a hex number.

(i) If 62 is a hex number, calculate its value as a denary number.

You **must** show your working.

.....

.....

.....

..... **[2]**

(ii) If 62 is a denary number, calculate its value as a hex number.

You **must** show your working.

.....

.....

.....

..... **[2]**

8. 00001100 is shifted two places to the left.

(i) Show the result.

---**[1]**

(ii) Identify what arithmetic operation this shift is equivalent to.

---**[1]**

If you found this useful, drop a follow to help me out!

THANK YOU!

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