

AS LEVEL 9618

Computer Science

Paper 1 Topical

WITH MARK SCHEME

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Preface

CAIE A Level Computer Science (9608) as a subject helps students come up with current and emerging computing technologies along with applying their learning to develop computer based problems using programming.

This book being need of the hour serves students in dual ways.

It contains a collection of questions arranged chapter-wise so that students have a full opportunity to test their understanding of each chapter and at the end of each section I have provided the solutions to each of those questions.

I hope this book serves its purpose and helps students succeed.

Acknowledgment

The completion of this undertaking could not have been possible without the participation and assistance of so many people whose names may not all be enumerated. Their contributions are sincerely appreciated and gratefully acknowledged.

However, the group would like to express their deep appreciation and indebtedness particularly to the following:

Mr. Taj Din - my grandfather, my mother, my brother Husnain and sisters for their endless support, kind and understanding spirit during my phase of hard work.

To all relatives, friends and others who in one way or another shared their support, either morally, financially and physically, thank you.

Above all, to the Great Almighty, the author of knowledge and wisdom, for His countless love and utmost kindness.

I Thank You All..

Ali Akram

TOPIC 1: INFORMATION REPRESENTATION

1 9608/01/SP/15/Q5

Here are the contents of three memory locations with addresses shown in denary.

Address	Memory contents
150	0100 0111
151	1100 1101
152	1001 1100

(a) (i) What is the binary value for address 150?

..... [1]

(ii) What is the hexadecimal value for the contents of address 152?

..... [1]

(b) The numbers in location 151 and 152 are the height and width (in pixels) of a bitmap graphic currently in main memory. What are the dimensions of the bitmap in denary?

Height:pixels

Width:pixels [2]

(c) A bitmap graphic can be saved in a number of different image resolutions.

(i) How many bits are required to store each pixel for a black and white bitmap?

..... [1]

(ii) For a 256-colour bitmap, each pixel requires a byte of memory. Explain this statement.

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

(iii) In addition to the pixel data values and its dimensions, what other information is stored in the bitmap file?

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

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(iv) Bitmaps may use compression techniques to reduce the file size.

Explain the difference between 'lossless' and 'lossy' techniques for achieving this compression.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

2 9608/12/M/J/15/Q1

(i) Convert the following binary number into hexadecimal.

1 0 1 1 1 0 0 0

..... [1]

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

9 7

..... [1]

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

114

--	--	--	--	--	--	--	--

- 93

--	--	--	--	--	--	--	--

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3 9608/12/M/J/15/Q2

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

(i) Give the definition of the term sampling.

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

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

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

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

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

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

Benefit

.....

Drawback

.....[2]

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

1

.....

2

.....[2]

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5 9608/11/O/N/15/Q8

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

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

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

[6]

- (b) (i) A black and white image is 512 pixels by 256 pixels.
 Calculate the file size of this image in kilobytes (KB) (1 KB = 1024 bytes).
 Show your working.

.....

 [2]

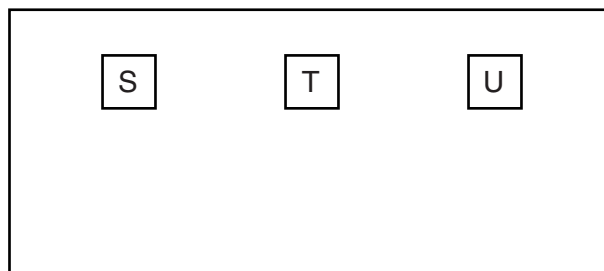
- (ii) Give a reason why it is important to estimate the file size of an image.

.....

 [1]

6 9608/12/O/N/15/Q3

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



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

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

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

.....
 [1]

- (ii) Convert the denary number 40 into binary.

.....
 [1]

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

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

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

.....[1]

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

Explain your answer.

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

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

(i) Describe how lossless compression techniques work.

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

(ii) Describe how lossy compression techniques work.

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

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7 9608/12/O/N/15/Q4

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

Explain the terms sampling resolution and sampling rate.

Sampling resolution
.....
.....
.....

Sampling rate
.....
.....
.....[4]

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

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

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

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

(ii) A particular track is four minutes long.

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

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

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

Explain how the music quality is apparently retained.

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

8 9608/12/M/J/16/Q2

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

55

--	--	--	--	--	--	--	--

[1]

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

10000011

.....[1]

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

-102

--	--	--	--	--	--	--	--

[2]

- (d) Convert the following hexadecimal number into denary.

4E

.....[1]

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9 9608/12/M/J/16/Q4

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

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

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

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

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

Lossy / Lossless

Justification:
.....
.....
.....[3]

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

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

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

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

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(iii) The following diagrams show:

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

Colour symbol	Colour code (denary)
B	153
W	255

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	B	B	B	B	B	B	B	B	B	B	W	W	W	B	B	B
1	B	B	B	B	B	B	B	B	B	W	W	W	W	W	W	B
2	B	B	B	B	B	B	W	W	W	W	W	W	W	W	W	W
...	⋮															
95																

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

Row 1:

Row 2:

Row 3:[2]

10 9608/13/M/J/16/Q2

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

01001101

.....[1]

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

82

.....[1]

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

11001011

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

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

198

.....[2]

11 9608/11/O/N/16/Q3

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

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

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

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

(iii) Convert the denary number 46 into hexadecimal.

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

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

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

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

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

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

12 9608/11/O/N/16/Q7(b)

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

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

1
.....
2
.....
3
.....
4
.....[4]

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13 9608/12/O/N/16/Q4

Hexadecimal, Binary Coded Decimal (BCD) and binary values are shown below.
 Draw a line to link each value to its correct denary value.

Hexadecimal, BCD, binary

Denary

Hexadecimal:
 3A

93

BCD representation:
 0100 1001

-65

Binary integer:
 01011101

58

Two's complement
 binary integer:
 11000001

-63

73

49

-93

14 9608/11/M/J/17/Q3

(a) A computer has a microphone and captures a voice recording using sound recording software. Before making a recording, the user can select the sampling rate.

Define the term **sampling rate**. Explain how the sampling rate will influence the accuracy of the digitised sound.

Sampling rate

Explanation

[2]

(b) The computer also has bitmap software.

(i) Define the terms **pixel** and **screen resolution**.

Pixel

Screen resolution

[2]

(ii) A picture has been drawn and is saved as a monochrome bitmap image.

State how many pixels are stored in one byte.

.....[1]

(iii) A second picture has width 2048 pixels and height 512 pixels. It is saved as a 256-colour image. Calculate the file size in kilobytes.

Show your working.

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

(iv) The actual bitmap file size will be larger than your calculated value.

State another data item that the bitmap file stores in addition to the pixel data.

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

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15 9608/12/M/J/17/Q3

(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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16 9608/11/O/N/17/Q1

(a) Each of the following bytes represents an integer in two's complement form.

State the denary value.

(i) 0111 0111 Denary [1]

(ii) 1000 1000 Denary [1]

(iii) Express the following integer in two's complement form.

-17

--	--	--	--	--	--	--	--

[1]

(iv) State in denary, the range of integer values that it is possible to represent in two's complement integers using a single byte.

Lowest value

Highest value [1]

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

653

.....[1]

(ii) A 3-digit BCD representation has been incorrectly copied. It is shown as:

0	1	0	0	1	1	1	0	0	0	1	0
---	---	---	---	---	---	---	---	---	---	---	---

State how you can recognise that this is not a valid BCD representation.

.....
[1]

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

.....

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17 9608/11/M/J/18/Q2

A logo is designed as a bitmap image.

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

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

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



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

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

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

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

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

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(c) The finished logo is 500 pixels by 1000 pixels and uses 35 different colours.

Estimate the file size for the logo. Give your answer in kilobytes. Show your working.

Working

.....

.....

.....

.....

.....

Answer [4]

(d) The logo is redesigned as a vector graphic.

State **two** benefits of a vector graphic compared to a bitmap image. Give a reason for each benefit.

Benefit 1

.....

Reason 1

.....

Benefit 2

.....

Reason 2

.....

[4]

18 9608/11/M/J/18/Q8(c)

X is a register. The current contents of X are:

1	0	0	0	0	1	1	1
---	---	---	---	---	---	---	---

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

Convert the value in X into denary.

.....[1]

(ii) The current contents of register X represent a Binary Coded Decimal.

Convert the value in X into denary.

.....[1]

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

Convert the value in X into denary.

.....[1]

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19 9608/12/M/J/18/Q4

(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]

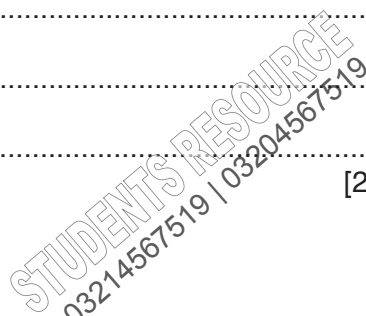
(iii) The current contents of the Accumulator represent a two's complement binary integer.
Convert the value in the Accumulator into denary.
.....[1]

(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]



20 9608/12/M/J/18/Q5

A student has recorded a sound track for a short film.

(a) Explain how an analogue sound wave is sampled to convert it into digital format.

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

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

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

(c) The original sound was sampled at 44.1 kHz. The sample rate is changed to 22.05 kHz.

Explain the effects of this change on the sound file.

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

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(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]

21 9608/13/M/J/18/Q3(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).

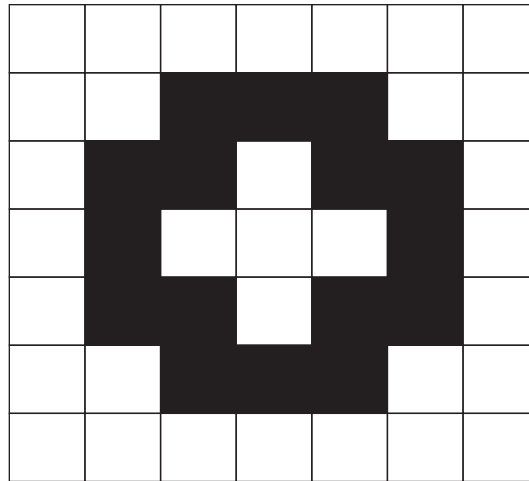
.....

.....[1]

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22 9608/13/M/J/18/Q6

A black and white bitmap image is shown.



(a) State the **minimum** number of bits needed to represent each pixel in this image.
[1]

(b) Run-length encoding (RLE) is used to store the image with the following colour codes.

Colour	Code
Black	1A
White	3B

Show how run-length encoding is used to store the image.

.....

[3]

(c) An image has 30 different colours.
 State the **minimum** number of bits needed to represent each pixel in the 30-colour image.
[1]

(d) When the image is saved, a header is added to the file.

State the purpose of the **file header**. Give **two** examples of the file header contents.

Purpose

.....

Example 1

.....

Example 2

.....

[3]

(e) Graphics software is used to edit a digital photograph.

Give **three** features of graphics software that can be used to edit the photograph.

Describe the effect each has on the photograph.

Feature 1

Effect

.....

.....

Feature 2

Effect

.....

.....

Feature 3

Effect

.....

.....

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23 9608/11/O/N/18/Q1

A student is creating a short video and needs to record music to play in the background.

(a) The student uses a microphone to capture the music.

Explain how the microphone captures the music.

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

(b) An analogue-to-digital converter uses sampling to encode the sound.

Explain how different sampling resolutions affect the sound file and the sound it represents.

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

(c) The student needs to edit the sound file.

Describe **two** features of sound editing software that can be used to edit the sound file.

Feature 1

.....
.....
.....

Feature 2

.....
.....
.....

[4]

24 9608/12/O/N/18/Q1

A company is designing a website.

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

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

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

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

..... [1]

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

Working

.....

.....

.....

File size [3]

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

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

Working

.....

.....

.....

Estimated file size [4]

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

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

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

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

.....

.....

.....

Reason 2

.....

.....

.....

[4]

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25 9608/13/O/N/18/Q1

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

.....

Estimated file size

[4]

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- (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)**.

.....

.....

.....

.....

.....

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..... [3]

26 9608/11/M/J/19/Q6(d)

A sound track is recorded for the video.

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

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..... [3]

STUDENTS RESOURCE
03214567519 | 03204567519