![Cambridge Assessment International Education]

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMPUTER SCIENCE **9618/12**

Paper 1 Theory Fundamentals **May/June 2022**

1 hour 30 minutes

You must answer on the question paper.
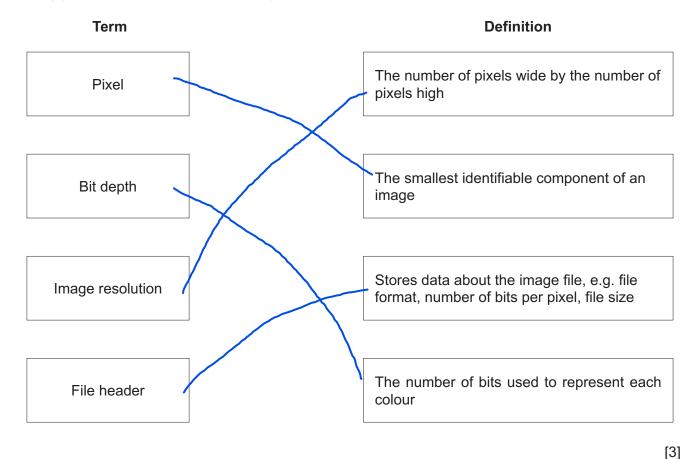
No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use an HB pencil for any diagrams, graphs or rough working.
- Calculators must **not** be used in this paper.

INFORMATION

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].
- No marks will be awarded for using brand names of software packages or hardware.

This document has **16** pages. Any blank pages are indicated.

1 **(a)** Draw **one** line from each image representation term to its correct definition.

Term | | **Definition**

| Pixel | | The number of pixels wide by the number of pixels high |

| Bit depth | | The smallest identifiable component of an image |

| Image resolution | | Stores data about the image file, e.g. file format, number of bits per pixel, file size |

| File header | | The number of bits used to represent each colour |

[3]

(b) The following section of a bitmap image is 10 pixels wide and 5 pixels high. In this example, each colour is represented by a letter, e.g. B is blue.

B	B	B	B	B	B	B	B	B	B
Y	Y	P	Y	Y	Y	P	Y	Y	Y
R	R	M	R	P	K	T	T	R	R
B	O	P	Y	Y	Y	P	G	P	P
R	O	R	P	P	P	R	R	R	R

The complete image can have up to 256 colours.

(i) Identify the smallest number of bits that can be used to represent each colour in the complete bitmap image.

8

.... [1]

(ii) Calculate an estimate for the file size of the section of the bitmap image shown, giving your answer in bytes. Use your answer from **part (b)(i)**.

Show your working.

Working 10 * 5 * 8 (bits) / 8 ....

....

....

....

Answer ....50................... bytes

[2]

(c) Describe how changing the colour depth of an image affects its file size.

Increasing the colour depth results in increased file size // Decreasing the ....

....

....

.... [2]

(d) The first row of pixels in the image from **part (b)** is shown:

B	B	B	B	B	B	B	B	B	B

Explain how this row of pixels can be compressed using lossless compression.

Use run-length encoding // RLE ....

Record the colour Blue, and the number of times it occurs 10 ....

....

.... [2]

2 A car has several features.

(a) One feature is a lane detection system. This system monitors the lines on either side of the lane. If the car gets too close to one line, the system automatically moves the car away from the line.

Explain why the lane detection system is an example of an embedded system.

The lane detection system is built into / integrated into the car

The lane detection system is not easily changed/updated by the car owner

The lane detection system only performs one task

.... [2]

(b) Two other features:

- record the number of miles travelled in the current journey, from when the engine is turned on to when it is turned off
- record the total number of miles the car has travelled since it was built.

Identify the data that will be stored in the primary **and** secondary storage of the car for these **two** features.

Primary Number of miles travelled in the current journey, from when the engine is turned on to when it is turned off

Secondary Total number of miles the car has travelled since it was built

.... [2]

(c) The car has a resistive touchscreen for the user to select options.

Tick (✓) **one** box in each row to show whether each statement about a resistive touchscreen is true or false.

Statement	True	False
The screen always has five different layers		Correct
A processor determines the horizontal and vertical coordinates of the point of contact	Correct	
The touchscreen will work if any object touches the screen	Correct	

[1]

3 The table shows part of the instruction set for a processor. The processor has one general purpose register, the Accumulator (ACC).

Instruction		Explanation
Opcode	**Operand**	
AND	#n	Bitwise AND operation of the contents of ACC with the operand
AND	<address>	Bitwise AND operation of the contents of ACC with the contents of <address>
XOR	#n	Bitwise XOR operation of the contents of ACC with the operand
XOR	<address>	Bitwise XOR operation of the contents of ACC with the contents of <address>
OR	#n	Bitwise OR operation of the contents of ACC with the operand
OR	<address>	Bitwise OR operation of the contents of ACC with the contents of <address>
<address> can be an absolute or a symbolic address # denotes a denary number, e.g. #123		

(a) The ACC currently contains the following positive binary integer:

0	1	1	0	0	1	0	1

Write the bit manipulation instruction that would change the binary integer in ACC to:

1	1	1	1	1	1	1	1

Opcode ....OR.......................... Operand ....#255..........................

[2]

(b) The ACC currently contains the following positive binary integer:

0	1	1	0	0	1	0	1

Write the bit manipulation instruction that would change the binary integer in ACC to:

1	0	0	1	1	0	1	0

Opcode ....XOR.......................... Operand ....#255..........................

[2]

(c) Convert the following positive binary integer into hexadecimal.

$$0\ 1\ 1\ 1\ 1\ 1\ 1\ 0$$

7E

.... [1]

(d) A **three-place logical shift** to the **left** is performed on the following positive binary integer.

Show the result of this logical shift.

$$0\ 1\ 1\ 1\ 1\ 1\ 1\ 0$$

11110000

.... [1]

(e) Convert the denary numbers 127 and 12 to 8-bit binary and then perform the subtraction 12 − 127 in binary.

Show your working.

127 in binary ....

12 in binary ....

12 − 127 in binary ....

....

....

....

....

[3]

4 A school stores personal data about its staff and students on its computer system.

(a) Explain why the school needs to keep both its data **and** its computer system secure from unauthorised access.

Data .....Data needs protecting from someone amending / deleting or taking it....

....

Computer system .....Computer system need protecting to stop people for example,

installing malware or damaging the system...

[2]

(b) Complete the table by identifying **two** security threats to the data on a computer.

Describe each threat.

Give a different prevention method for each threat.

Threat	Description	Prevention method
.... Virus	Malicious software that replicates itself and can corrupt data	Anti-virus / Firewall / Anti-malware
.... Hacker	Unauthorised access to the computer with malicious intent	Biometrics / Strong Password

[6]

(c) Data is encrypted when it is transmitted within the school network, or externally such as over the internet.

Describe what is meant by encryption **and** explain why it is used.

.....Data is turned into cipher text // Data is encoded...

.....Used so that it cannot be understood if intercepted without the decryption key....

....

.... [2]

 [Turn over

5 A database, `FILMS`, stores information about films and actors.

Part of the database is shown:

```
ACTOR(ActorID, FirstName, LastName, DateOfBirth)
FILM_FACT(FilmID, FilmTitle, ReleaseDate, Category)
FILM_ACTOR(ActorID, FilmID)
```

(a) Complete the entity-relationship (E-R) diagram.

[2]

(b) A composite primary key consists of two or more attributes that together form the primary key.

Explain why the table `FILM_ACTOR` has a composite primary key.

Neither key uniquely identifies each tuple by itself

One actor cannot appear in the same film twice so together they are unique

....

.... [2]

(c) Complete the SQL script to return the IDs of all the actors in the film with the title Cinderella.

SELECT FILM_ACTOR.ActorID / ActorID

FROM FILM_ACTOR

INNER JOIN FILM_FACT

ON FILM_FACT.FilmID = FILM_ACTOR.FilmID

WHERE FILM_FACT.FilmTitle = "Cinderella";

[4]

(d) Write an SQL script to count the number of films that were released in January 2022.

SELECT COUNT(FilmID)
FROM FILM_FACT
WHERE ReleaseDate >= #01/01/2022# AND ReleaseDate <= #31/01/2022#;
// WHERE ReleaseDate BETWEEN #01/01/2022# AND #31/01/2022#;
// WHERE ReleaseDate = "January 2022";

[3]

(e) A Database Management System (DBMS) is used to create and manipulate the database.

Complete the descriptions of the features and tools found in a DBMS using the given terms. Not all terms will be used.

Boolean	**data dictionary**	**data redundancy**	**field names**
input	**interface**	**logical schema**	**normalisation**
operating system	**output**	**primary keys**	**query**
structure			

A DBMS provides data management. This includes the development of a
......data dictionary...... that stores information about the data stored, such as
......field names...... and ......primary keys...... .

The ......logical schema...... uses methods, such as an E-R diagram, to show the

structure of the database and its relationships.

The ......query...... processor allows a user to perform searches to find

specific data. The DBMS also provides a developer ......interface...... that

allows the user to create tables, forms and reports.

[6]

6 A programmer uses language translators when writing and testing a program.

(a) Describe the operation of a compiler.

Attempts to translate the whole source code

Creates a separate error report at the end of the translation process

If translation successful / no errors creates an executable file

.... [2]

(b) Describe the operation of an interpreter.

Reads each line then translates it and executes it

Stops when an error is encountered // displays errors where it finds them

.... [2]

(c) Explain how a programmer can make use of a typical Integrated Development Environment (IDE) when writing **and** testing a program.

Writing Enter code into an editor / Pretty printing to identify key terms / Context-sensitive prompts to help complete statements / Expand and collapse code blocks / Auto-complete to suggest what to type next / Auto-formatting to indent code blocks / Dynamic syntax checking

Testing Single stepping to run the code line by line / Breakpoints to stop the code at set points to check values / Report window to see how variables change

.... [4]

7 Complete the truth table for the following logic expression:

X = (**A** XOR **B**) AND NOT **C**

A	B	C	Working space	X
0	0	0		0
0	0	1		0
0	1	0		1
0	1	1		0
1	0	0		1
1	0	1		0
1	1	0		0
1	1	1		0

[2]

8 Describe **one** application of Artificial Intelligence (AI).

Police identifying wanted people

Uses image recognition
... to identify characteristics in an image

Natural language interfaces

Use speech recognition to identify words that are spoken
... and adapts to learn regional accents

[3]

Self-driving cars

Detects its position on the road and within the traffic
Follows a route // Collision avoidance // Self-parking etc.

Game playing

Models characters in a computer game
... to allow computer characters to react according to the player's movements

9 (a) The following incomplete table contains four network devices and their descriptions.

Complete the table by writing the missing devices and missing descriptions.

Device	Description
Router	Receives and sends data between two networks operating on the same protocol
Wireless Network Interface Card (WNIC)	Hardware component that allows a device to connect to a wireless network // Provides a MAC address to the device to identify it on the wireless network
Repeater	Restores the digital signal so it can be transmitted over greater distances
Wireless Access Point (WAP)	Hardware component that provides radio communication from the central device to nodes on the network (and vice versa)

[4]

(b) Describe **three** differences between fibre-optic cables and copper cables.

1 Fibre optic data is transmitted using light, copper cable through electrical signals / Fibre optic has higher bandwidth than copper cable /

2 Fibre optic has smaller risk of (noise) interference than copper cable / Fibre optic is much more difficult to hack into than copper cable /

3 Fibre optic is more prone to damage than copper cable / Fibre optic can be used over longer distances than copper cable before repeaters are needed

[3]

(c) Ethernet uses Carrier Sense Multiple Access/Collision Detection (CSMA/CD).

Describe CSMA/CD.

A workstation / node (wishing to transmit) listens to the communication
channel ... if channel is free data is sent
Because there is more than one computer connected to the same
transmission medium ... two workstations can start to transmit at the
same time, causing a collision
If a collision happens, the workstations send a (jamming) signal /
abort transmission ... and each waits a random amount of time before
attempting to resend
[4]

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