Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

9809761197

COMPUTER SCIENCE **9618/12**

Paper 1 Theory Fundamentals **October/November 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 **20** pages. Any blank pages are indicated.

1 **(a)** Draw **one** line from each utility software to its most appropriate purpose.

Utility software	**Purpose**
	to reorganise files so they are contiguous
virus checker	to scan for malicious program code
disk formatter	to decrease the file size
backup	to initialise a disk
disk repair	to create copies of files in case the original is lost
defragmentation	to check for and fix inconsistencies on a disk

[5]

(b) Compilers and interpreters translate programs written in a high-level language into a low-level language.

(i) State **two** drawbacks of using a compiler compared to an interpreter during program development.

1 ....

....

....

2 ....

....

....

[2]

(ii) Explain why high-level language programs might be partially compiled and partially interpreted.

....

....

....

.... [2]

2 **(a)** **(i)** Convert the two's complement binary integer into denary.

10010110

Answer .... [1]

(ii) Convert the unsigned binary integer into hexadecimal.

10010110

Answer .... [1]

(iii) Convert the unsigned binary integer into Binary Coded Decimal (BCD). Show your working.

10010101

Working ....

....

....

Answer ....

[2]

(b) Perform the following binary addition.

	1	0	0	0	1	1	0	0
+	0	1	0	0	0	1	1	0

[1]

3 **(a)** A greenhouse has an automatic window.

The window (**X**) operates according to the following criteria:

Parameter	Description of parameter	Binary value	Condition
T	Temperature	1	Too high
		0	Acceptable
W	Wind speed	1	Too high
		0	Acceptable
R	Rain	1	Detected
		0	Not detected
M	Manual override	1	On
		0	Off

The window opens (**X** = 1) if:

- the temperature is too high **and** the wind speed is acceptable
- **and**
- rain is not detected, **or** the manual override is off.

Draw a logic circuit to represent the operation of the window.

[3]

(b) Complete the truth table for the logic expression:

X = NOT (**A** OR **B** OR **C**) AND (**B** NOR **C**)

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

[2]

(c) Embedded systems contain Read Only Memory (ROM) and Random Access Memory (RAM).

Explain the reasons why ROM is used in an embedded system.

....

....

....

....

....

.... [2]

4 **(a)** State the difference between **data verification** and **data validation**.

....

....

.... [1]

(b) A checksum can be used to detect errors during data transmission.

Describe how a checksum is used.

....

....

....

....

....

.... [3]

(c) One validation method is a presence check.

Describe **two other** validation methods that can be used to validate non-numeric data.

1 ....

....

2 ....

....

[2]

5 A relational database, `GARDEN`, has the following tables:

`OWNER(OwnerID, FirstName, TelephoneNo, TreeID, TreePosition)`

`TREE(TreeID, ScientificName, MaxHeight, FastGrowing)`

(a) The database is **not** in Third Normal Form (3NF).

Explain how the database can be normalised to 3NF.

....

....

....

....

....

.... [3]

(b) Write the Structured Query Language (SQL) script to add a new record in the table `TREE` to store the following data:

Attribute	Value
TreeID	LOW_1276
ScientificName	Salix_Alba
MaxHeight	30.00
FastGrowing	TRUE

....

....

....

.... [3]

(c) State what is meant by a **candidate key** in a relational database.

....

.... [1]

(d) **(i)** Describe, using an example, what is meant by a **data dictionary**.

....

....

....

.... [2]

(ii) Describe what is meant by a **logical schema**.

....

....

....

.... [2]

6 **(a)** A student uses a networked laptop computer to send an email to a colleague.

(i) Explain how a digital signature ensures the email is authentic.

....

....

....

.... [2]

(ii) Describe how a firewall protects the data on the computer.

....

....

....

....

....

.... [3]

(b) The student records a sound file.

(i) Explain the effect of increasing the sampling rate on the accuracy of the sound recording.

....

....

....

.... [2]

(ii) Explain the effect of decreasing the sampling resolution on the file size of the sound recording.

....

....

....

.... [2]

7 The following table shows part of the instruction set for a processor. The processor has one general purpose register, the Accumulator (ACC), and an Index Register (IX).

Instruction		Explanation
Opcode	**Operand**	
`LDM`	`#n`	Immediate addressing. Load the number n to ACC
`LDD`	`<address>`	Direct addressing. Load the contents of the location at the given address to ACC
`LDX`	`<address>`	Indexed addressing. Form the address from <address> + the contents of the index register. Copy the contents of this calculated address to ACC
`LDR`	`#n`	Immediate addressing. Load the number n to IX
`STO`	`<address>`	Store the contents of ACC at the given address
`ADD`	`<address>`	Add the contents of the given address to the ACC
`ADD`	`#n`	Add the denary number n to the ACC
`INC`	`<register>`	Add 1 to the contents of the register (ACC or IX)
`JMP`	`<address>`	Jump to the given address
`CMP`	`<address>`	Compare the contents of ACC with the contents of <address>
`CMI`	`<address>`	Indirect addressing. The address to be used is at the given address. Compare the contents of ACC with the contents of this second address
`JPE`	`<address>`	Following a compare instruction, jump to <address> if the compare was True
`JPN`	`<address>`	Following a compare instruction, jump to <address> if the compare was False
`END`		Return control to the operating system
<address> can be an absolute or symbolic address # denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001101		

(a) Trace the program currently in memory using the trace table, stopping when line `90` is executed for a second time.

Address	Instruction
75	`LDR #0`
76	`LDX 110`
77	`CMI 102`
78	`JPE 91`
79	`CMP 103`
80	`JPN 84`
81	`ADD 101`
82	`STO 101`
83	`JMP 86`
84	`INC ACC`
85	`STO 101`
86	`LDD 100`
87	`INC ACC`
88	`STO 100`
89	`INC IX`
90	`JMP 76`
91	`END`
…	
100	`0`
101	`0`
102	`112`
103	`4`
…	
110	`1`
111	`4`
112	`0`

Instruction address	ACC	IX	Memory address						
			100	101	102	103	110	111	112
			0	0	112	4	1	4	0

[5]

(b) The following table shows another part of the instruction set for the processor.

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	Bn	Bitwise XOR operation of the contents of ACC with the binary number n
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>
LSL	#n	Bits in ACC are shifted logically n places to the left. Zeros are introduced on the right-hand end
LSR	#n	Bits in ACC are shifted logically n places to the right. Zeros are introduced on the left-hand end
<address> can be an absolute or symbolic address # denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001101		

The contents of memory addresses 50 and 51 are shown:

Memory address	Data value
50	01001101
51	10001111

(i) The current contents of the ACC are:

0	1	0	1	0	0	1	1

Show the contents of the ACC after the execution of the following instruction.

```
XOR B00011111
```

....

....

[1]

(ii) The current contents of the ACC are:

0	1	0	1	0	0	1	1

Show the contents of the ACC after the execution of the following instruction.

`AND 50`

....

....

[1]

(iii) The current contents of the ACC are:

0	1	0	1	0	0	1	1

Show the contents of the ACC after the execution of the following instruction.

`LSL #3`

....

....

[1]

(iv) The current contents of the ACC are:

0	1	0	1	0	0	1	1

Show the contents of the ACC after the execution of the following instruction.

`OR 51`

....

....

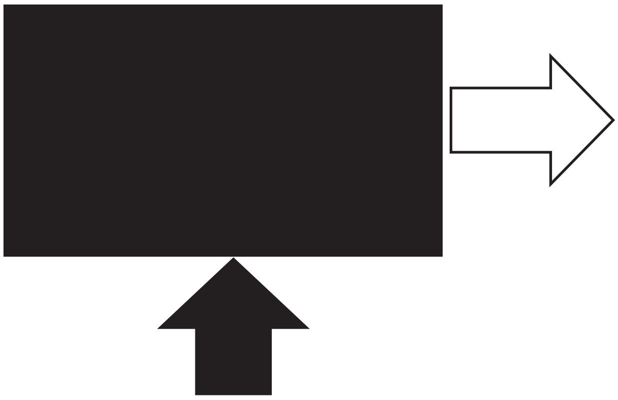
[1]

(c) Write the register transfer notation for each of the stages in the fetch-execute cycle described in the table.

Description	Register transfer notation
Copy the address of the next instruction into the Memory Address Register.	
Increment the Program Counter.	
Copy the contents of the Memory Data Register into the Current Instruction Register.	

[3]

8 The following bitmap image has a resolution of 4096 × 4096 pixels and a colour depth of 24 bits per pixel.



The image is displayed on a monitor that has a screen resolution of 1920 × 1080 pixels.

(a) Tick (✓) **one** box in each row to identify the effect of each action on the image file size.

Action	Increases the file size	Decreases the file size	No change to the file size
Change the colour depth of the image file to 16 bits per pixel.			
Change the screen resolution to 1366 × 768 pixels.			
Change the colour of the rectangle from black to red.			

[2]

(b) State **two** benefits of creating a vector graphic instead of a bitmap image.

1 ....

....

2 ....

....

[2]

(c) A second bitmap image is stored using a colour depth of 8 bits per pixel.

The file is compressed using run-length encoding (RLE).

(i) The table shows the compressed and uncompressed values for parts of the image file.

Each colour of the pixel in the image is represented by a hexadecimal value.

Complete the table. The first row has been completed for you.

Uncompressed image	RLE compressed image
EA F1 F1 F2 F2 F2 EA	1EA 2F1 3F2 1EA
	2AB 2FF 11D 167
32 32 80 81 81	

[2]

(ii) RLE is an example of lossless compression.

Explain why lossless compression is more appropriate than lossy compression for a text file.

....

....

....

....

.... [2]

9 One use of Artificial Intelligence (AI) is for facial recognition software.

Describe the social impact of using facial recognition software to identify individuals in an airport.

....

....

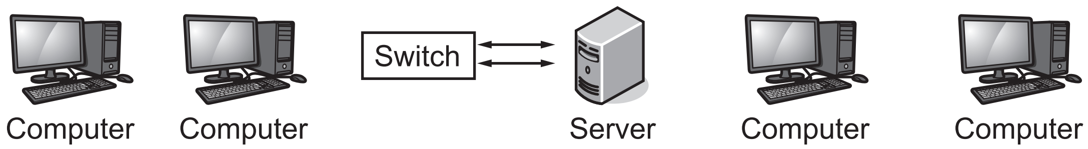
....

.... [2]

10 A Local Area Network (LAN) consists of four computers, one server and a switch.

The LAN uses a star topology.

(a) Complete the following diagram to show how the hardware is connected.



[1]

(b) A router is attached to one of the devices on the LAN shown in **part (a)** to connect the LAN to the internet.

(i) Identify the device. Give a reason for your choice.

Device ....

Reason ....

....

.... [2]

(ii) Describe the role **and** function of the router in the network.

....

....

....

....

....

.... [3]

BLANK PAGE

BLANK PAGE

BLANK PAGE