Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMPUTER SCIENCE **9618/13**

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.

[Turn over

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1 A digital audio message needs to be recorded.

(a) Tick (✓) **one** box in each row to identify the effect of each action on the accuracy of the recording.

Action	Accuracy increases	Accuracy decreases	Accuracy does not change
Change the sampling rate from 40 kHz to 60 kHz.			
Change the duration of the recording from 20 minutes to 40 minutes.			
Change the sampling resolution from 24 bits to 16 bits.			

[2]

(b) The audio message is recorded with a sampling rate of 50 kHz and a sampling resolution of 16 bits.

The recording is 20 minutes in length.

Calculate the file size of the recording.

Give your answer in megabytes **and** show your working.

Working .....

.....

.....

.....

Answer ..... megabytes

[2]

(c) A computer uses a buffer when playing the audio message.

Explain the purpose of a buffer in a computer system using **one other** example.

.....

.....

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.....

.....

..... [3]

2 The relational database ASTRONOMY is used to store data about telescopes, the companies that own the telescopes and the photographs taken by the telescopes.

The database has these three tables:

```
COMPANY(TelephoneNumber, CompanyID, CompanyName)

PHOTOGRAPH(PhotoID, TelescopeID, DateTaken, TimeTaken, Elevation)

TELESCOPE(TelescopeID, CompanyID, SerialNumber)
```

(a) Complete the following table by writing the correct answer for each item.

Item	Answer
a suitable field for the primary key in COMPANY	
a candidate key in TELESCOPE	
the degree of relationship between TELESCOPE and PHOTOGRAPH	

[3]

(b) A Database Management System (DBMS) has several features.

Identify the feature that describes the relationship between data and its structure.

..... [1]

(c) Complete the SQL script to return the total number of telescopes owned by the company whose ID begins with HW.

```
SELECT ..... (.....)

FROM TELESCOPE

WHERE ..... LIKE .....;
```

[4]

(d) Write the SQL script to add **one** field to the table PHOTOGRAPH to store the resolution of the photograph, e.g. 1920 × 1068.

.....

.....

.....

..... [2]

(e) The photographs are stored as bitmap images.

Complete the statements about bitmap images by writing the missing words.

The ..... of a bitmap image is the number of bits that are used to store each pixel.

Metadata about the image is stored in the ..... of the file.

[2]

(f) Describe the purpose of a query processor in a DBMS.

.....

.....

.....

..... [2]

3 Draw **one** line from each Operating System (OS) management task to its most appropriate description.

OS Management task	Description
hardware management	dynamically allocates memory to processes
security management	marks unallocated file storage for availability
memory management	installs programs for devices connected to external ports
process management	validates user and process authenticity
	allows processes to transfer data to and from each other

[4]

4 **(a)** A Central Processing Unit (CPU) contains several special purpose registers and other components.

(i) State the roles of the following registers.

Memory Address Register (MAR) .....

.....

.....

Memory Data Register (MDR) .....

.....

.....

[2]

(ii) State when interrupts are detected during the Fetch-Execute (F-E) cycle.

.....

..... [1]

(b) A computer system contains a system clock.

Describe the purpose of the system clock.

.....

.....

.....

..... [2]

(c) Upgrading secondary storage to solid state typically improves the performance of computer systems.

Identify **one other** upgrade to the hardware **and** explain why it improves the performance of a computer system.

Upgrade .....

Explanation .....

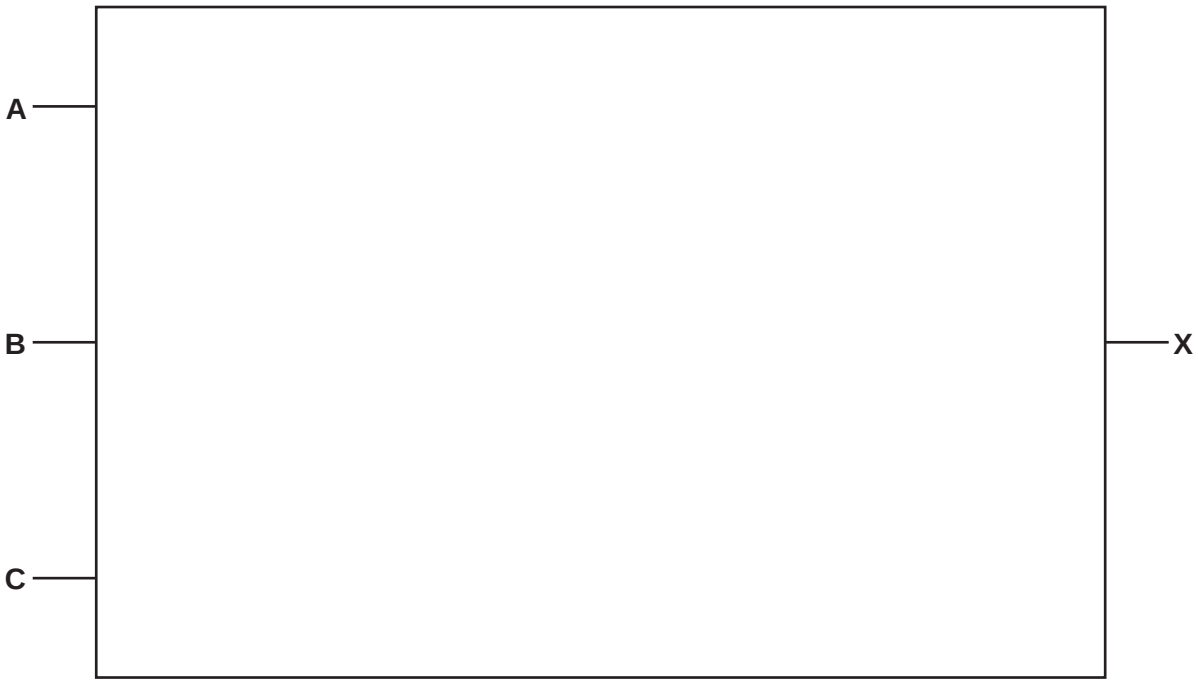
.....

.....

[2]

5 **(a)** Draw a logic circuit for the logic expression:

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



[3]

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

Y = (NOT **P** AND **Q**) OR (**Q** AND NOT **R**)

P	Q	R	Working space	Y
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]

Question 6 begins on page 10.

6 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
MOV	<register>	Moves the contents of the accumulator to the given register (IX)
STO	<address>	Store 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
SUB	#n	Subtract the denary number n from the ACC
INC	<register>	Add 1 to the contents of the register (ACC or IX)
JMP	<address>	Jump to the given address
CMP	#n	Compare the contents of ACC with number n
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
OUT		Output to the screen the character whose ASCII value is stored in ACC
END		Return control to the operating system
<address> can be an absolute or a symbolic address # denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001101		

(a) The current contents of main memory and selected values from the ASCII character set are given.

(i) Trace the program currently in memory using the trace table.

Address	Instruction
75	LDR #0
76	LDD 100
77	CMP #2
78	JPE 91
79	LDX 110
80	SUB #32
81	CMP #65
82	JPN 86
83	LDM #1
84	ADD 101
85	STO 101
86	LDM #1
87	ADD 100
88	STO 100
89	INC IX
90	JMP 76
91	LDD 101
92	ADD #48
93	OUT
94	END
…	
100	1
101	0
…	
110	97
111	98
112	97

ASCII value	Character
49	1
50	2
51	3
52	4
65	A
66	B
67	C
68	D

Instruction address	ACC	IX	Memory address					Output
			100	101	110	111	112	
			1	0	97	98	97	

[4]

(ii) Explain the purpose of **relative addressing** in an assembly language program.

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.....

.....

..... [2]

(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	Bn	Bitwise AND operation of the contents of ACC with the binary number n
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	Bn	Bitwise OR operation of the contents of ACC with the binary number n
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 a symbolic address # denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001101		

(i) The current contents of the ACC are:

0	0	1	1	0	1	1	0

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

```
AND B01001100
```

.....

.....

[1]

(ii) The current contents of the ACC are:

1	0	0	1	0	1	0	1

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

```
OR B01001111
```

.....

.....

[1]

(iii) The current contents of the ACC are:

1	0	0	1	1	1	0	1

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

```
LSR #2
```

.....

.....

[1]

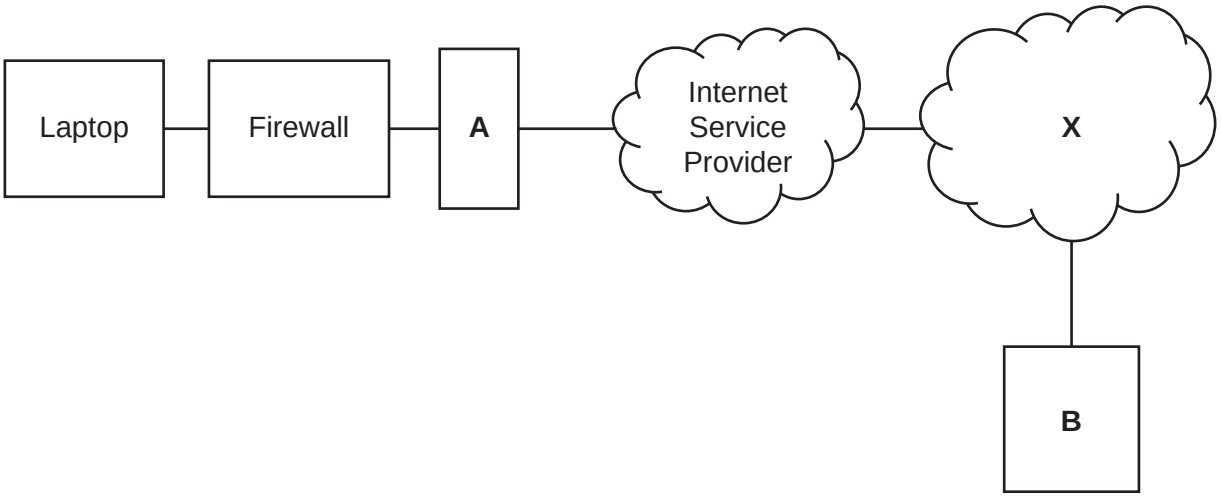
(c) One instruction group is data movement.

Give the name of **one other** instruction group.

.....

..... [1]

7 **(a)** The diagram shows the hardware and software used to retrieve files stored on the cloud.



Complete the following table by writing the answer for each row.

	Answer
The name of device **A** that allows the laptop to connect to the internet	
A type of cloud, **X**	
An example of an application, **B**, that can run on the cloud	

[3]

(b) Give **one** advantage and **two** disadvantages of transmitting data using satellites instead of copper cables.

Advantage 1 .....

.....

Disadvantage 1 .....

.....

Disadvantage 2 .....

.....

[3]

(c) Local Area Networks (LANs) can be made up of several subnetworks.

(i) Give **two** benefits of dividing a network into subnetworks by subnetting the LAN.

1 .....

.....

2 .....

.....

[2]

(ii) A subnet mask is used when subnetting a LAN.

Two devices on the LAN are located in different subnetworks.

The IP addresses and corresponding subnet masks are shown:

Device IP address	Subnet mask
`10.10.12.1`	`255.0.0.0`
`192.168.12.4`	`255.255.255.0`

Identify the following network ID and host ID.

The network ID for the device with the IP address `10.10.12.1`

.....

The host ID for the device with the IP address `192.168.12.4`

.....

[2]

8 **(a)** **(i)** Explain why some programs are distributed under an open source licence.

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..... [2]

(ii) Explain how a programmer benefits from distributing a program under a commercial licence.

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..... [2]

(b) A commercial program for a vehicle repair garage includes an Artificial Intelligence (AI) module that can diagnose faults and suggest repairs.

Describe **one** economic impact the AI module may have on the garage.

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..... [2]

9 **(a)** **(i)** Convert the unsigned binary value into hexadecimal.

10010011

Answer ..... [1]

(ii) Convert the unsigned binary value into denary.

10010011

Answer ..... [1]

(b) State **two** benefits of using Binary Coded Decimal (BCD) to represent values.

Benefit 1 .....

.....

Benefit 2 .....

.....

[2]

10 **(a)** Explain the importance of feedback in a control system.

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..... [3]

(b) **(i)** Identify **one** sensor that could be used in a car alarm system.

Justify your choice.

Sensor .....

Justification .....

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[2]

(ii) The car alarm is an example of an embedded system.

Describe the characteristics of an embedded system.

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..... [3]

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