Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1612799207

COMPUTER SCIENCE **9618/31**

Paper 3 Advanced Theory **October/November 2023**

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.

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1 Real numbers are stored in a computer using floating-point representation with:

- 12 bits for the mantissa
- 4 bits for the exponent
- two's complement form for both the mantissa and exponent.

(a) Write the normalised floating-point representation of +65.25 in this system.

Show your working.

Mantissa												Exponent			

Working .....

.....

.....

.....

.....

..... [3]

(b) Explain the problem that will occur in storing the normalised floating-point representation of +65.20 in this system.

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..... [2]

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2 **(a)** Draw **one** line to connect **each** protocol to its most appropriate use.

Protocol	Use
HTTP	to provide peer-to-peer file sharing
BitTorrent	when retrieving email messages from a mail server over a TCP/IP connection
SMTP	when transmitting hypertext documents
IMAP	to map MAC addresses onto IP addresses
	when sending email messages towards the intended destination

[4]

(b) Outline the purpose of the **Link layer** in the TCP / IP protocol suite.

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.....

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..... [2]

3 Describe what is meant by **enumerated** and **pointer** data types.

Enumerated .....

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.....

.....

Pointer .....

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.....

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[4]

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4 **(a)** Describe sequential and random methods of file organisation.

Sequential file organisation .....

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.....

.....

.....

Random file organisation .....

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[4]

(b) Outline the process of sequential access for serial and sequential files.

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..... [2]

5 Describe the features of SISD and MIMD computer architectures.

SISD .....

.....

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MIMD .....

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[4]

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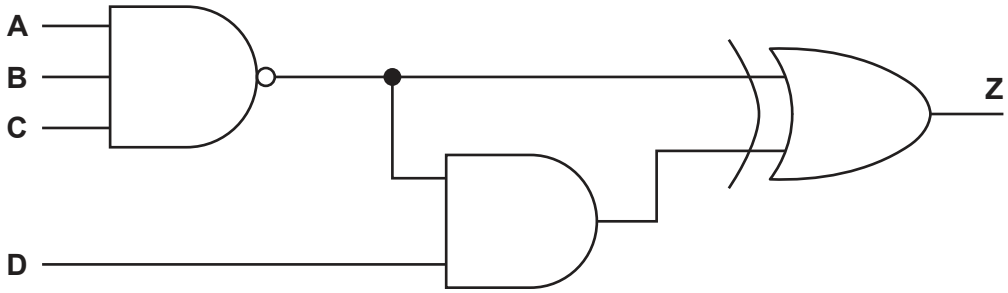
6 This diagram represents a logic circuit.



(a) Complete the truth table for the given logic circuit.

A	B	C	D	Working space	Z
0	0	0	0		
0	0	0	1		
0	0	1	0		
0	0	1	1		
0	1	0	0		
0	1	0	1		
0	1	1	0		
0	1	1	1		
1	0	0	0		
1	0	0	1		
1	0	1	0		
1	0	1	1		
1	1	0	0		
1	1	0	1		
1	1	1	0		
1	1	1	1		

[3]

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(b) Simplify the given Boolean expression using Boolean algebra.
Show your working.

$$Y = \overline{A}.\overline{B}.\overline{C}.\overline{D} + \overline{A}.\overline{B}.C.\overline{D} + \overline{A}.B.\overline{C}.\overline{D} + \overline{A}.B.C.\overline{D}$$

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..... [3]

7 **(a)** A student buys a new computer.

State **one** benefit to the student of a user interface **and** give an example.

Benefit .....

.....

.....

Example .....

.....
[2]

(b) Two of the process states are the running state and the ready state.

Identify **one other** process state.

..... [1]

(c) Outline conditions under which a process could change from the running state to the ready state.

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..... [2]

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8 **(a)** A pseudocode algorithm finds a customer account record in a random file and outputs it. The records are stored using the user-defined data type `TAccount`.

```
TYPE TAccount
    DECLARE AccountNumber : INTEGER
    DECLARE LastName : STRING
    DECLARE FirstName : STRING
    DECLARE Address : STRING
    DECLARE ContactNumber : STRING
ENDTYPE
```

Complete the file handling pseudocode.

The function `Hash()` takes the customer account number as a parameter, calculates and returns the hash value.

```
DECLARE Customer : TAccount
DECLARE Location : INTEGER
DECLARE AccountFile : STRING

..... ← "AccountRecords.dat"

..... AccountFile .....
OUTPUT "Please enter an account number"
INPUT Customer.AccountNumber

Location ← Hash(.....)

SEEK .....,Location

..... AccountFile, .....
OUTPUT Customer              // output customer record
CLOSEFILE AccountFile
```

[5]

(b) Define the term **exception handling**.

.....

..... [1]

(c) State **two** possible causes of an exception.

.....

..... [2]

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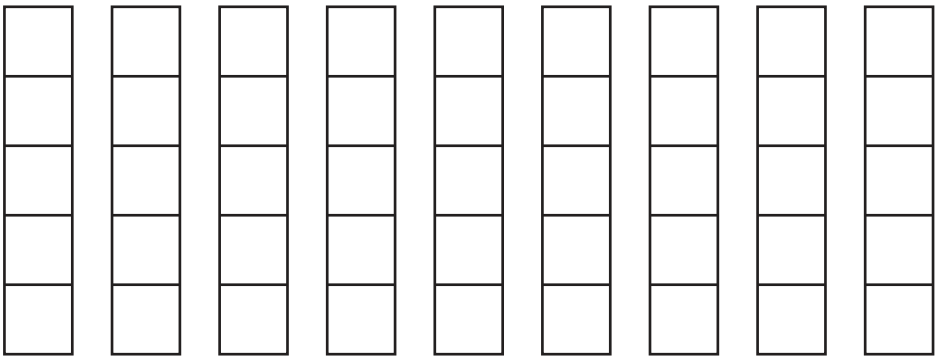
9 **(a)** **(i)** Write the infix expression for this Reverse Polish Notation (RPN) expression:

```
5 2 - 5 4 + * 9 /
```

.....

..... [2]

(ii) Show how the contents of the following stack will change as the RPN expression in part **(a)(i)** is evaluated.



[4]

(b) Explain how a stack can be used to evaluate RPN expressions.

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..... [3]

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10 A stack is to be set up using the information in the table.

Identifier	Data type	Description
`BasePointer`	`INTEGER`	points to the bottom of the stack
`TopPointer`	`INTEGER`	points to the top of the stack
`Stack`	`REAL`	1D array to implement the stack

A constant, with identifier `Capacity`, limits the size of the stack to 25 items.

(a) Write the **pseudocode** for the required declarations.

.....

.....

.....

.....

.....

..... [3]

(b) Complete the pseudocode function `Pop()` to pop an item from `Stack`.

```
// popping an item from the stack

FUNCTION Pop().....
   DECLARE Item : REAL
   Item ← 0

   ..... BasePointer THEN

      Item ← .....

      TopPointer ← .....
   ELSE
      OUTPUT "The stack is empty – error"
   ENDIF

   .....
ENDFUNCTION
```

[5]

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(c) Compare and contrast the queue and stack Abstract Data Types (ADT).

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..... [2]

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11 A **declarative** programming language is used to represent subjects that students can choose to study.

Students must choose two subjects.

```
01 subject(mathematics).
02 subject(physics).
03 subject(chemistry).
04 subject(computer_science).
05 subject(geography).
06 subject(history).
07 subject(english).
08 subject(biology).
09 student(tomaz).
10 student(josephine).
11 student(elspeth).
12 student(nico).
13 student(teresa).
14 student(pietre).
15 choice1(tomaz, mathematics).
16 choice1(teresa, chemistry).
17 choice1(pietre, mathematics).
18 choice1(nico, mathematics).
19 choice1(elspeth, chemistry).
20 choice2(tomaz, computer_science).
21 choice2(nico, geography).
```

These clauses have the meanings:

Clause	Meaning
01	Mathematics is a subject.
09	Tomaz is a student.
15	Tomaz has chosen mathematics as his first choice.
20	Tomaz has chosen computer science as his second choice.

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(a) Anthony is a student who would like to study history and geography.

Write additional clauses to represent this information.

22 .....

23 .....

24 .....

[3]

(b) Using the variable X, the goal:

```
choice1(X, chemistry)
```

returns

```
X = teresa, elspeth
```

Write the result returned by the goal:

```
choice1(X, mathematics)
```

X = ... [1]

(c) Students must choose two different subjects such that:

N may choose S, if N is a student and S is a subject and N has not chosen S as the first choice.

Write this as a rule.

```
may_choose_subject(N, S)
```

IF .....

.....

.....

..... [4]

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12 Artificial neural networks have played a significant role in the development of machine learning.

Explain what is meant by the term **artificial neural network**.

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..... [4]

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