Cambridge Assessment International Education

# Cambridge International AS & A Level

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|---|---|---|---|---|---|---|---|---|---|
| CANDIDATE NAME | | | | | | | | | |
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*T612799207*

**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.

**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 .....

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..... [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]

**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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..... [2]

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

Enumerated .....

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Pointer .....

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[4]

**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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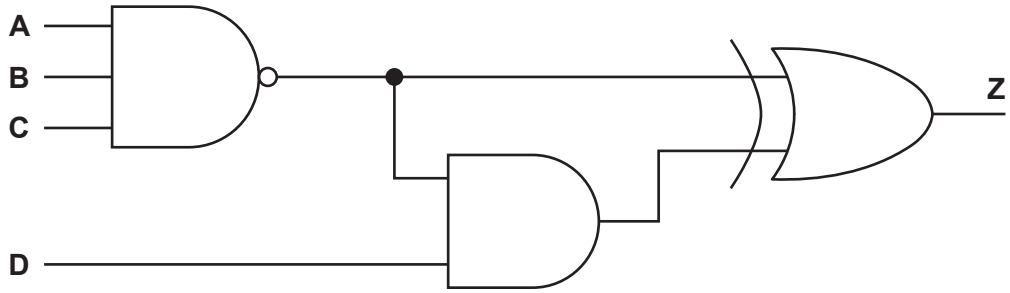
**6** This diagram represents a logic circuit.




**(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]

**(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]

**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**.

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..... [1]

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

.....

..... [2]

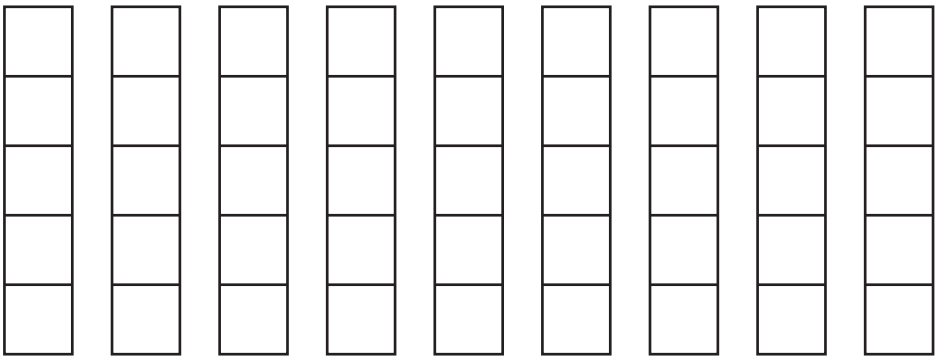
**9** **(a)** **(i)** Write the infix expression for this Reverse Polish Notation (RPN) expression:

```
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]

**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.

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..... [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]

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

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..... [2]

**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. |

**(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 .....

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.....

..... [4]

**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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