Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8982694890

COMPUTER SCIENCE **9618/32**

Paper 3 Advanced Theory **May/June 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.

[Turn over

1 Numbers are stored in a computer using floating point representation with:

- 10 bits for the mantissa
- 6 bits for the exponent
- two's complement form for both the mantissa and exponent.

(a) Write the normalised floating-point representation of the following binary number using this system:

0101010.111

Show your working.

Working .....

.....

.....

.....

.....

Mantissa **Exponent**

[2]

(b) Describe the reason why the normalised form of the following binary number cannot be represented accurately using this system.

0101011.111001

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..... [3]

2 **(a)** Describe how records are organised and accessed in a sequential file.

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..... [3]

(b) A hashing algorithm is used to calculate storage locations for records in a random access file. The algorithm calculates hash values using the function modulus 5.

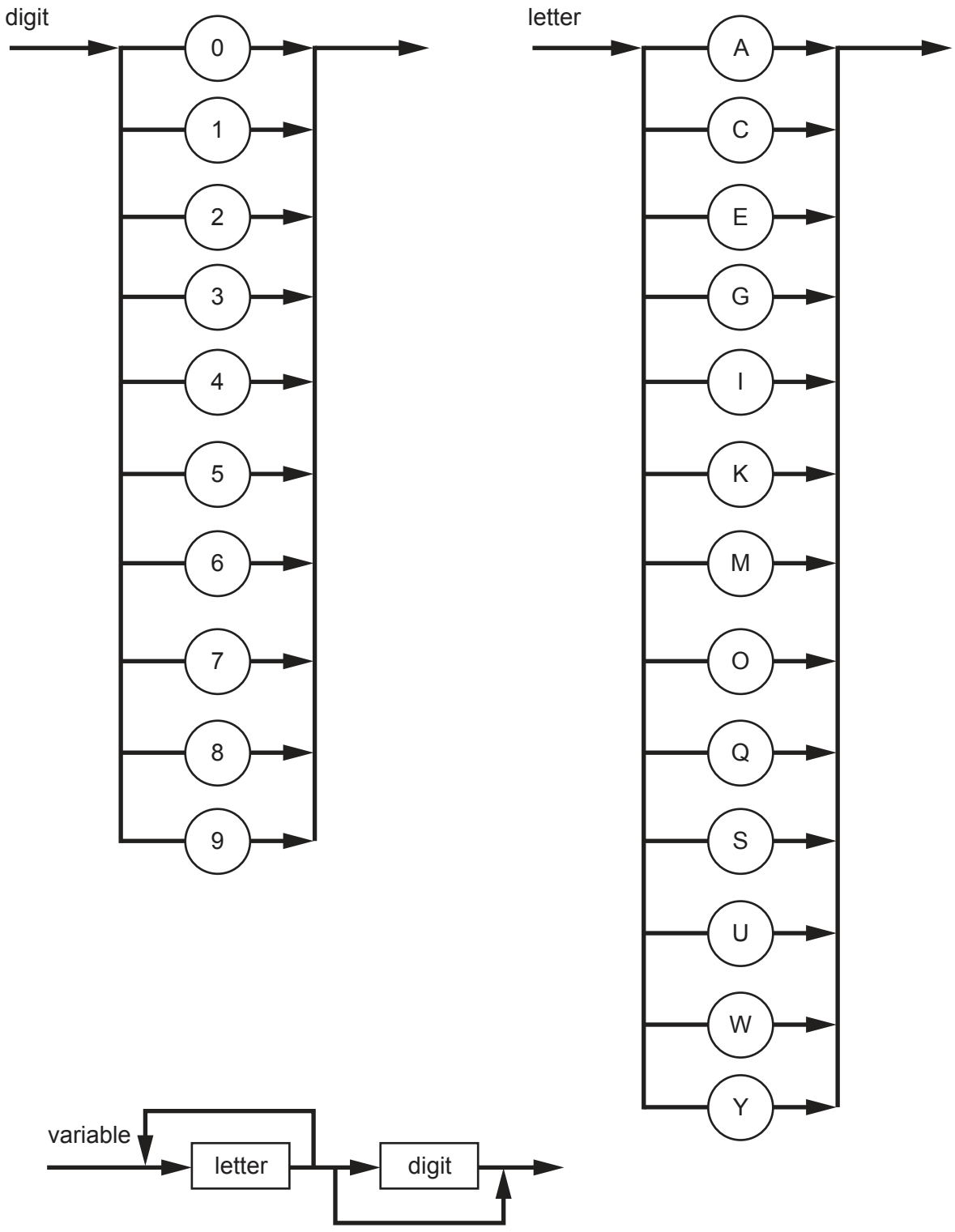
The function modulus gives the remainder after integer division.
For example, 3003 modulus 5 = 3, so the record key 3003 gives a hash value of 3.

Complete the table to show the remaining hash values.

Record key	Hash value
3003	3
1029	
7630	

[2]

3 Several syntax diagrams are shown.



(a) State whether each variable is valid or invalid **and** give a reason for your choice in each case.

`9SW` .....

Reason .....

.....

`UWY` .....

Reason .....

.....

[2]

(b) `<word>` contains one or more letters.

Complete the Backus-Naur Form (BNF) for `<word>` **and** use this to complete the BNF for `<variable>`.

`<word> ::=` .....

.....

`<variable> ::=` .....

.....

[3]

(c) Vehicle registrations must begin with two letters and be followed by one, two or three digits.

Valid letters and digits are shown in the syntax diagrams on page 4.

(i) State an example of a valid vehicle registration.

.....

..... [1]

(ii) Draw a syntax diagram for a vehicle registration.

[3]

4 Draw **one** line from each Object-Oriented Programming (OOP) term to its **most appropriate** description.

OOP term	Description
Encapsulation	methods used to return the value of a property
Getters	the process of putting data and methods together as a single unit
Polymorphism	methods used to update the value of a property
Setters	allows methods to be redefined for derived classes
	enables the defining of a new class that inherits from a parent class

[4]

5 **(a)** Encryption is used to scramble data to make it meaningless if intercepted.

Describe the purpose of quantum cryptography.

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..... [2]

(b) Explain the differences between symmetric and asymmetric cryptography when encrypting and decrypting data.

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..... [3]

6 **(a)** Write **pseudocode** statements to declare the composite data type, `TAppointments`, to hold data about patients for a dental clinic. It will include for each patient:

- name (first name and last name)
- date of birth
- telephone number
- date of last appointment
- date of next appointment
- all treatments are complete (yes or no).

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..... [4]

(b) This pseudocode algorithm reads dental records stored in a random file using the user-defined data type `TAppointments` and prints the contents of the file, one record at a time.

Complete this file handling pseudocode:

```
DECLARE DentalRecord : ARRAY[1:250] OF TAppointments
DECLARE DentalFile : STRING
DECLARE Count : INTEGER
DentalFile ← "DentalFile.dat"
OUTPUT "The file ", DentalFile, " contains these records:"

OPENFILE .....

..... ← 1

REPEAT
   SEEK DentalFile, Count

   .....
   OUTPUT DentalRecord[Count]
   Count ← Count + 1

.....(DentalFile)

.....
```

[5]

7 **(a)** State **two** examples of where it would be appropriate to use packet switching.

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..... [2]

(b) Give **four** differences between circuit switching and packet switching.

1 .....

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2 .....

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3 .....

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4 .....

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[4]

8 **(a)** Describe the use of pipelining in Reduced Instruction Set Computers (RISC).

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..... [2]

(b) The processing of instructions is divided into five stages:

- instruction fetch (IF)
- instruction decode (ID)
- operand fetch (OF)
- instruction execute (IE)
- write back result (WB)

Each stage is carried out using a different register when pipelining is used.

Complete the table to show how a program consisting of **six** instructions would be completed using pipelining.

Clock cycles

Processor stages	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
IF												
ID												
OF												
IE												
WB												

[4]

9 This truth table represents a logic circuit.

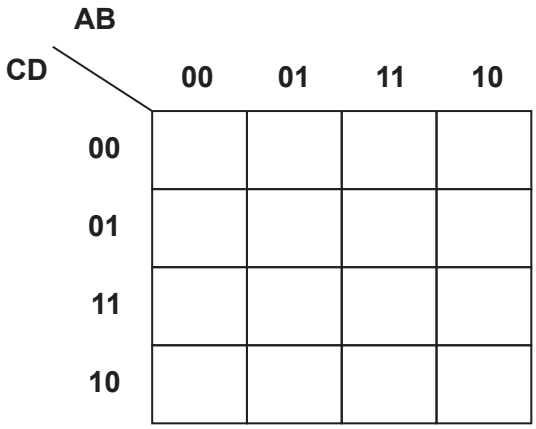
INPUT				OUTPUT
A	**B**	**C**	**D**	**Z**
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

(a) Write the Boolean logic expression that corresponds to the given truth table as the sum-of-products.

Z = ...

..... [3]

(b) Complete the Karnaugh map (K-map) for the given truth table.



[2]

(c) Draw loop(s) around appropriate group(s) in the K-map to produce an optimal sum-of-products. [2]

(d) Write the Boolean logic expression from your answer to **part (c)** as a simplified sum-of-products.

Z = ...

..... [2]

(e) Use Boolean algebra to give your answer to **part (d)** in its simplest form.

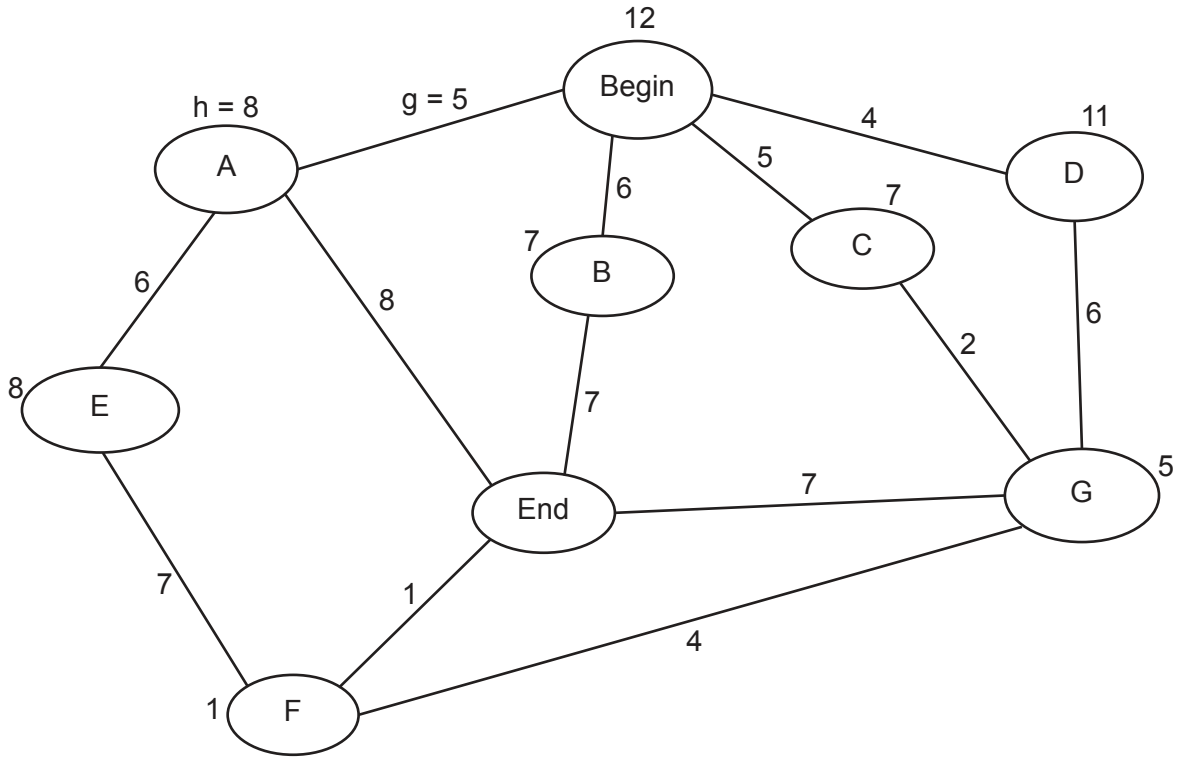
Z = ... [1]

10 **(a)** State **one** category of machine learning.

..... [1]

(b) Calculate the path that takes the shortest time to travel from the Begin node to the End node, using the A* algorithm.
Show your working in the table provided.

The first two rows have already been completed.



Start node	Destination node	Cost from start node (g)	Heuristic (h)	Total (f = g + h)
Begin	Begin	0	12	12
Begin	A	5	8	13

Final path	

[5]

11 (a) The pseudocode shown represents a queue Abstract Data Type (ADT) with procedures for initialisation and to add new items. It is incomplete.

```
CONSTANT MaxLength = 50
DECLARE FrontPointer : INTEGER
DECLARE RearPointer : INTEGER
DECLARE Length : INTEGER
DECLARE Queue : ARRAY[0 : MaxLength - 1] OF STRING

// initialisation of queue
PROCEDURE Initialise
   FrontPointer ← -1

   .....

   ..... ← 0
ENDPROCEDURE

// adding a new item to the queue
PROCEDURE Enqueue(NewItem : STRING)

   IF ..... THEN

      RearPointer ← .....
      IF RearPointer > MaxLength - 1 THEN
         RearPointer ← 0
      ENDIF

      .....
      Length ← Length + 1
   ENDIF
ENDPROCEDURE
```

(i) Study the pseudocode and insert the identifiers to complete this table.

Identifier	Data type	Description
	STRING	An array to store the contents of the queue.
	INTEGER	Points to the last item of the queue.
	INTEGER	Indicates the number of items in the queue.
	INTEGER	Points to the first item of the queue.

[2]

(ii) Complete the given pseudocode. [5]

(b) Explain the reasons why a queue ADT works better than a stack ADT in organising print jobs.

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..... [3]

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