Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMPUTER SCIENCE **9618/31**

Paper 3 Advanced Theory **May/June 2025**

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.

DC (DE/CT) 342251/3

[Turn over

1 A programmer is writing a program to manage bookings for a small taxi company. The programmer requires some user-defined data types.

(a) Write a **pseudocode** statement to declare the enumerated data type, `Vehicle`, to hold the identity code of each of the company's taxis:

M100, M230, T101, T102, T120, T150

.....

..... [2]

(b) Write **pseudocode** statements to declare the composite data type, `Booking`, to hold data about taxi bookings. The data required includes:

- booking number (any combination of letters and numbers)
- destination
- client name
- client telephone number
- date of departure
- address for pick-up
- the identity code of the taxi used.

Use the most appropriate data type in each case, including the enumerated data type from part **(a)**.

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..... [4]

2 Numbers are stored in a computer using binary floating-point representation with:

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

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

0.00000011010111

Mantissa										Exponent					

[2]

(b) Calculate the normalised binary floating-point representation of –25.3125 in this system. Show your working.

Mantissa										Exponent					

Working .....

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[4]

3 **(a)** The Application Layer and Transport Layer are two layers of the TCP/IP protocol suite.

Describe the purpose of the Application Layer **and** the purpose of the Transport Layer.

Purpose of Application Layer .....

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Purpose of Transport Layer .....

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[5]

(b) Describe packet switching as a method of transmitting messages across the internet.

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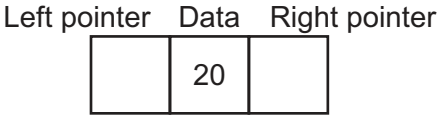
..... [4]

4 **(a)** A linked list of nodes is used to store an ordered list of integers. Each node consists of the data, a left pointer and a right pointer, for example:

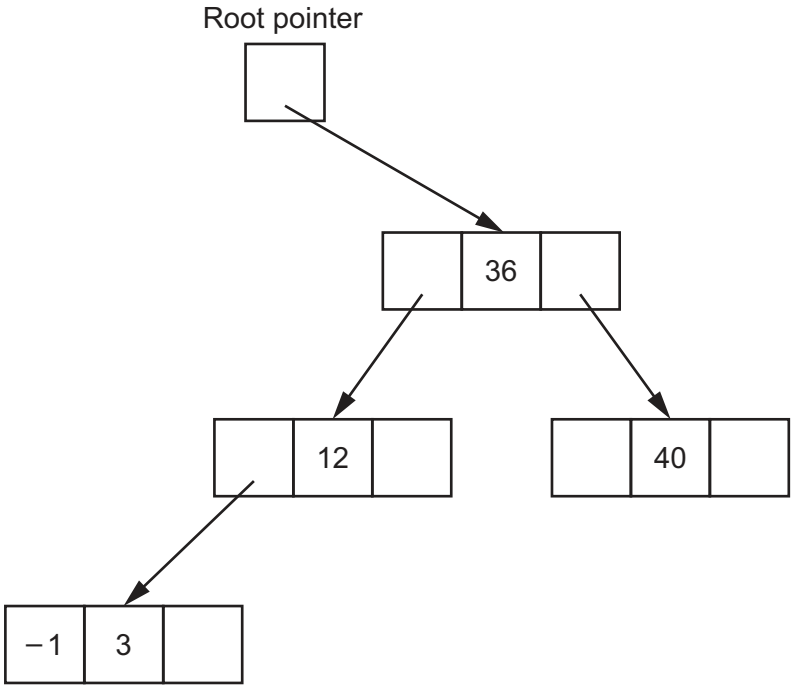


The linked list will be organised as a binary tree.

−1 is used to represent a null pointer.

Complete the binary tree, including null pointers, to show how the data will be organised after the following integers have been added:

6, 15, 41, 66



[4]

(b) Describe what is meant by recursion.

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..... [2]

(c) A binary tree is a suitable Abstract Data Type (ADT) that a designer can implement using recursive algorithms.

Identify **one other** ADT that a designer can implement using recursive algorithms.

..... [1]

5 This truth table represents a logic circuit.

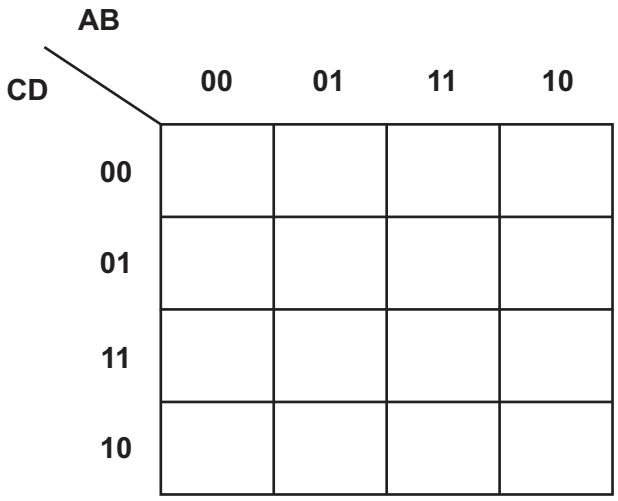
INPUT				OUTPUT
A	**B**	**C**	**D**	**Z**
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

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

Z = ...

..... [2]

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



[2]

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

(iii) Write the Boolean logic expression from your answer to part **(b)(ii)** as the simplified sum-of-products.

Z = ...

..... [2]

6 Describe the process of executing a program using an interpreter.

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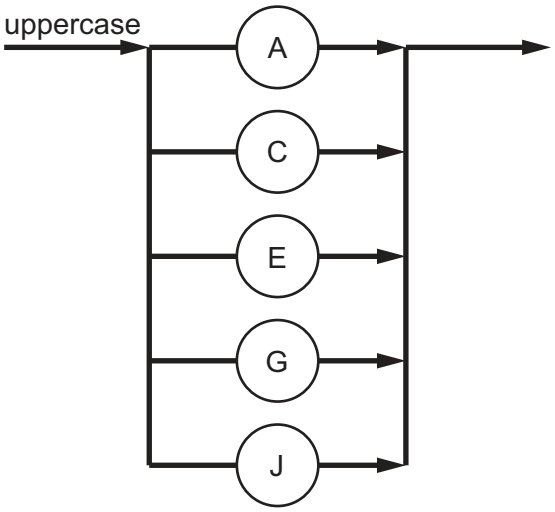
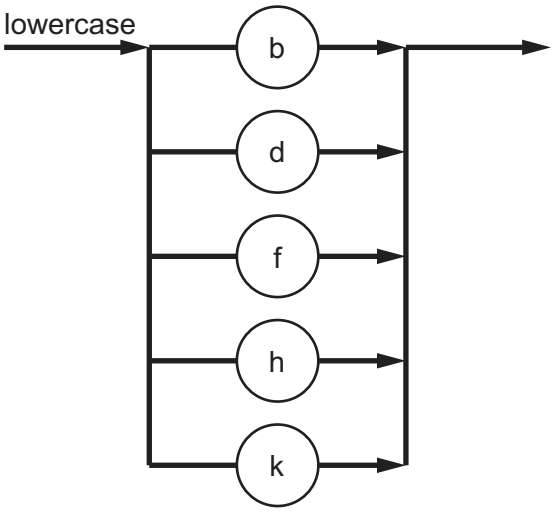
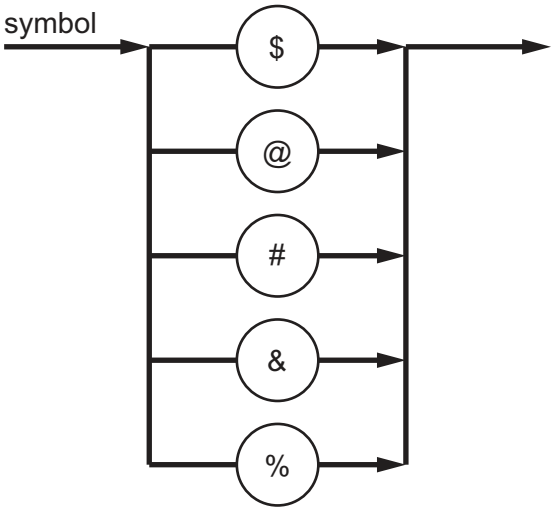
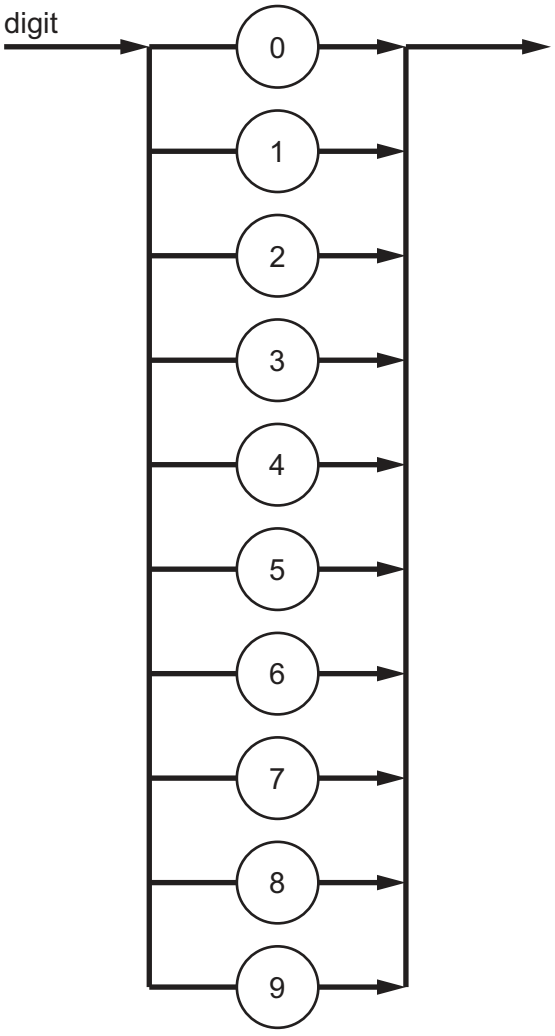
..... [4]

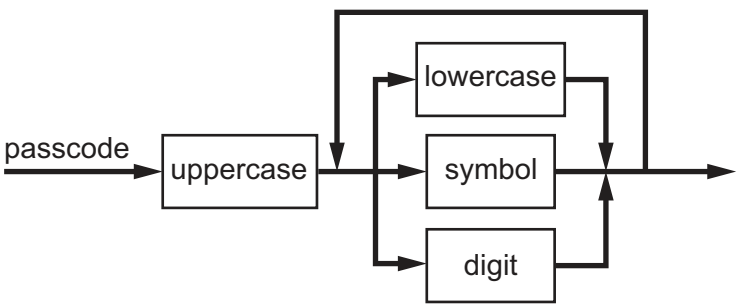
7 Several syntax diagrams are shown.











(a) State why each **passcode** is invalid for the given syntax diagrams.

`#Jd7`

Reason .....

.....

`C%6A`

Reason .....

.....

[2]

(b) Complete the Backus-Naur Form (BNF) for `<uppercase>` and `<passcode>`.

`<uppercase> ::=` .....

.....

`<passcode> ::=` .....

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[4]

8 **(a)** Describe what is meant by **multi-tasking** and how it benefits process management.

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..... [2]

(b) Explain the function of the shortest remaining time scheduling routine **and** give a benefit of this routine.

Function .....

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Benefit .....

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[4]

9 Secure Socket Layer (SSL) and Transport Layer Security (TLS) are two protocols.

(a) State **two** functions of SSL/TLS.

1 .....

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2 .....

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[2]

(b) Give **two** examples of situations where the use of SSL/TLS would be appropriate.

1 .....

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2 .....

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[2]

10 **(a)** Describe the purpose of a graph when used in an Artificial Intelligence (AI) system.

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..... [2]

(b) Explain the use of artificial neural networks in Deep Learning.

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..... [4]

11 (a) A medical centre uses objects of the class `Appointment` to record treatments given and medication prescribed during each doctor's appointment. Some of the attributes required in the class are listed in the table.

Attribute	Data type	Description
`DateSeen`	`DATE`	date of treatment
`Treatments`	`STRING`	treatments given
`Medications`	`STRING`	medications prescribed

Patients are identified by a unique 8-digit number, beginning with the patient's year of birth, for example, 20108989.
Doctors are identified by their name, for example, A N Other.

Complete the class diagram for `Appointment`, to include:

- attribute and data type for the identification of the patient
- attribute and data type for the identification of the doctor
- methods to assign date seen, treatments given and medications prescribed
- method to return the date seen and the attributes for the patient and the doctor.

[5]

(b) (i) Identify the object-oriented programming (OOP) feature whose function includes restricting external access to the data.

..... [1]

(ii) Describe what is meant by the OOP feature **inheritance**.

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..... [2]

12 The pseudocode algorithm checks whether a location in a stock file `StockList.dat` is empty or not. The location is given by the user. If the location is empty, a suitable message is displayed, otherwise the item stored at that location is displayed.

Complete this file-handling pseudocode algorithm.

```
DECLARE Location : INTEGER
DECLARE Item : STRING
DECLARE Continue : BOOLEAN
DECLARE Answer : CHAR
Continue ← TRUE

OPENFILE .....
WHILE Continue
   OUTPUT "Enter a location between 1 and 500: "
   INPUT Location

   .....

   GETRECORD .....
   IF Item = "" THEN
      OUTPUT "This record is missing."
   ELSE
      OUTPUT "The item in stock is ", .....
   ENDIF
   OUTPUT "Another location (Y or N)?"
   INPUT Answer
   IF Answer <> 'Y' THEN
      Continue ← FALSE
   ENDIF
ENDWHILE

.....
OUTPUT "End of program"
```

[5]

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