Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMPUTER SCIENCE **9618/32**

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.

[Turn over

1 Data types can be defined using pseudocode.

The composite record data type, `Departure`, is used to represent flights from Cambridge Airport and is defined in pseudocode as:

```
TYPE Departure
    DECLARE FlightNumber : STRING
    DECLARE Destination : STRING
    DECLARE FlightDate : DATE
    DECLARE Gate : STRING
    DECLARE Airline : STRING
ENDTYPE
```

A variable, `Flight1`, is declared in pseudocode as:

```
    DECLARE Flight1 : Departure
```

(a) Write **pseudocode** to store the following details to `Flight1`:

Field	Data
FlightNumber	SB2789
Destination	Dublin
FlightDate	30/07/2025
Gate	N03
Airline	Cambridge Airways

....

....

....

....

....

.... [3]

(b) The data type for `Gate` is changed to an enumerated data type, `GateID`.

(i) Write a **pseudocode** statement to declare `GateID` to hold the identity codes for the airport gates:

N01, N02, N03, W01, W02, W03, W04

....

.... [2]

(ii) Write the new **pseudocode** statement required to replace the declaration of `Gate` in `Departure`.

.... [1]

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

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

(a) Calculate the normalised binary floating-point representation of +124.4375 in this system.
Show your working.

Mantissa	**Exponent**
☐☐☐☐☐☐☐☐☐☐☐☐	☐☐☐☐

Working ....

....

....

....

....

....

[3]

(b) Calculate the denary value of the following normalised binary floating-point number.
Show your working.

Mantissa	**Exponent**
1 0 1 0 0 0 1 0 1 0 1 1	0 1 1 0

Working ....

....

....

....

....

Denary value ....

[3]

3 **(a)** Identify **two** different layers of the TCP/IP protocol suite.

....

.... [1]

(b) Describe how the TCP/IP protocol suite is applied when a message is sent through the internet from one host to another. Do **not** describe the function of individual layers of the TCP/IP protocol suite.

....

....

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.... [4]

4 Circuit switching may be used as a method of data transmission.

State **two** benefits and **two** drawbacks of circuit switching.

Benefit 1 ....

....

Benefit 2 ....

....

Drawback 1 ....

....

Drawback 2 ....

....

[4]

5 The management and scheduling of processes are tasks carried out by an operating system.

(a) Identify **three** process states.

1 ....

2 ....

3 ....

[3]

(b) Describe the function of the shortest job first scheduling routine **and** give a benefit of this routine.

Function ....

....

....

....

....

....

Benefit ....

....

[4]

6 (a) Describe the structure of a graph as used in an Artificial Intelligence (AI) system.

....

....

....

.... [2]

(b) Explain how supervised learning and unsupervised learning differ from each other.
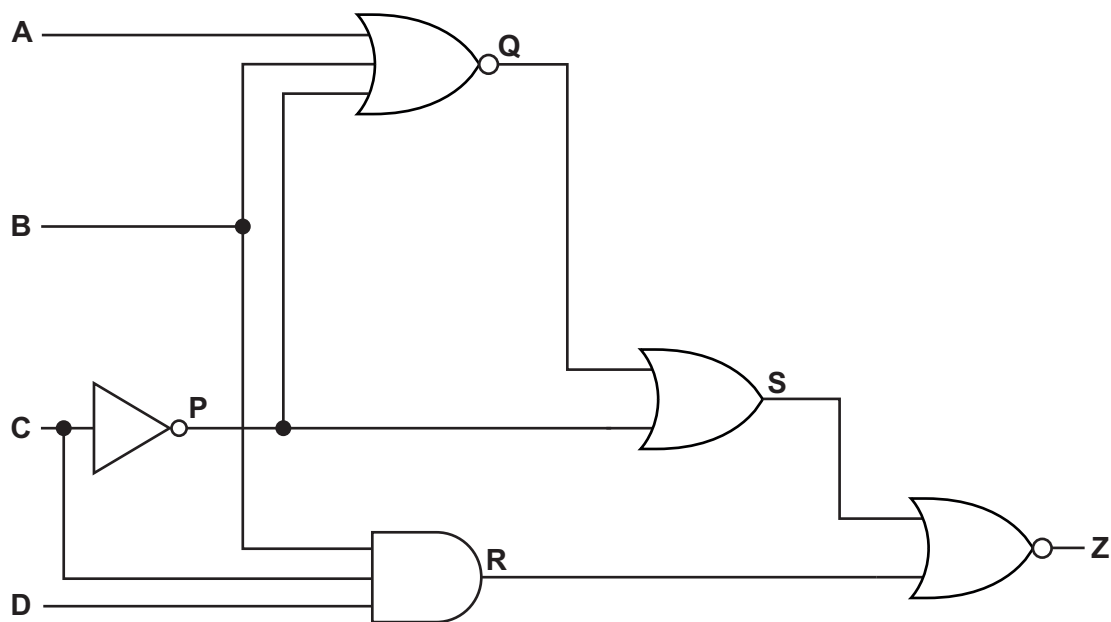
....

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....

.... [4]

7 The diagram shows a logic circuit.

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

A	B	C	D	Working space				
				P	Q	R	S	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) Write the Boolean logic expression that corresponds to the given logic circuit as the sum-of-products.

Z = ...

.... [1]

(c) Use Boolean algebra including De Morgan's laws to simplify the following expression. Show all working.

$$\overline{(\overline{A + B})} \cdot (\overline{\overline{A \cdot B}} + \overline{\overline{B \cdot C}})$$

Working ....

....

....

....

....

....

Simplified expression ....

....
[4]

8 Explain what is meant by **lexical analysis** during program compilation.

....

....

....

....

....

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....

.... [4]

9 Several syntax diagrams are shown.
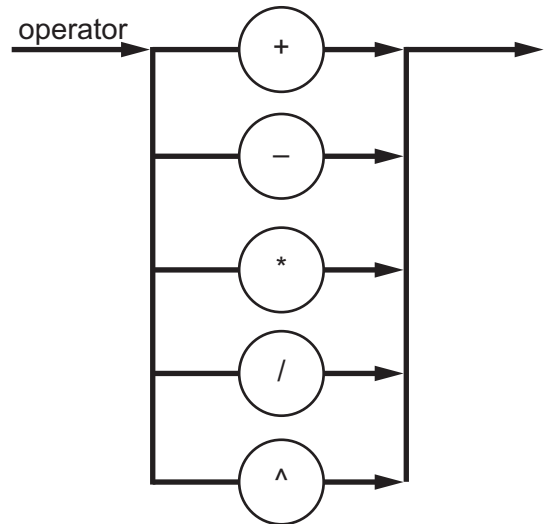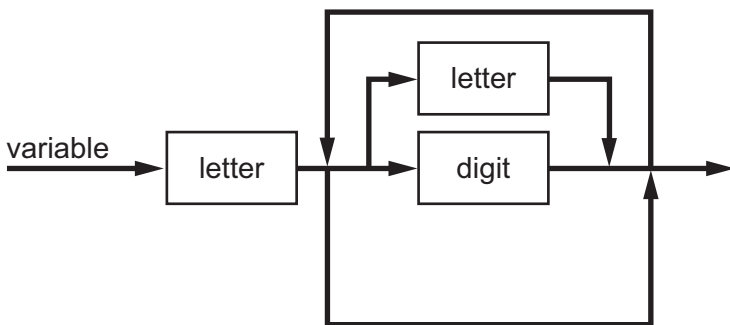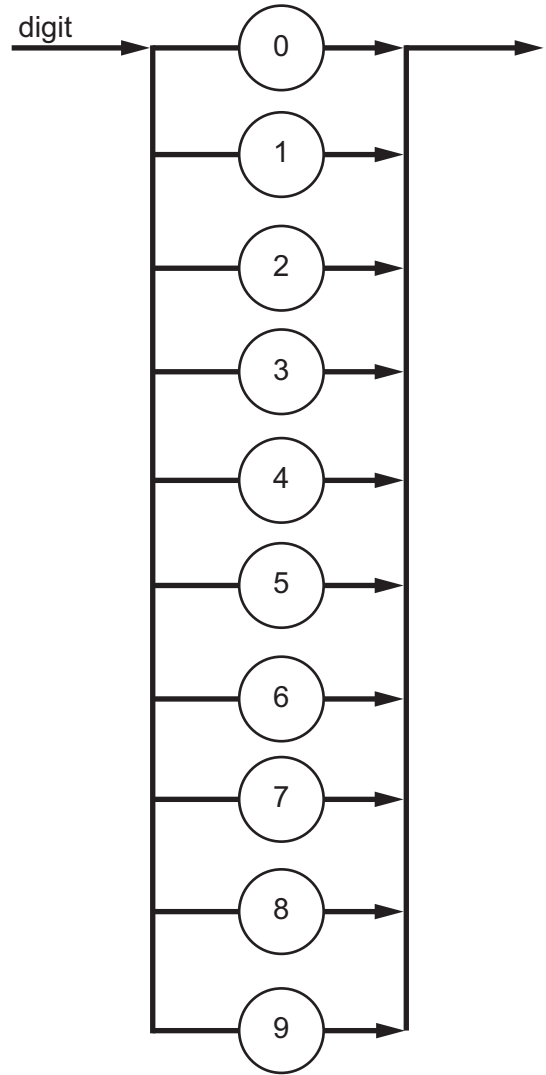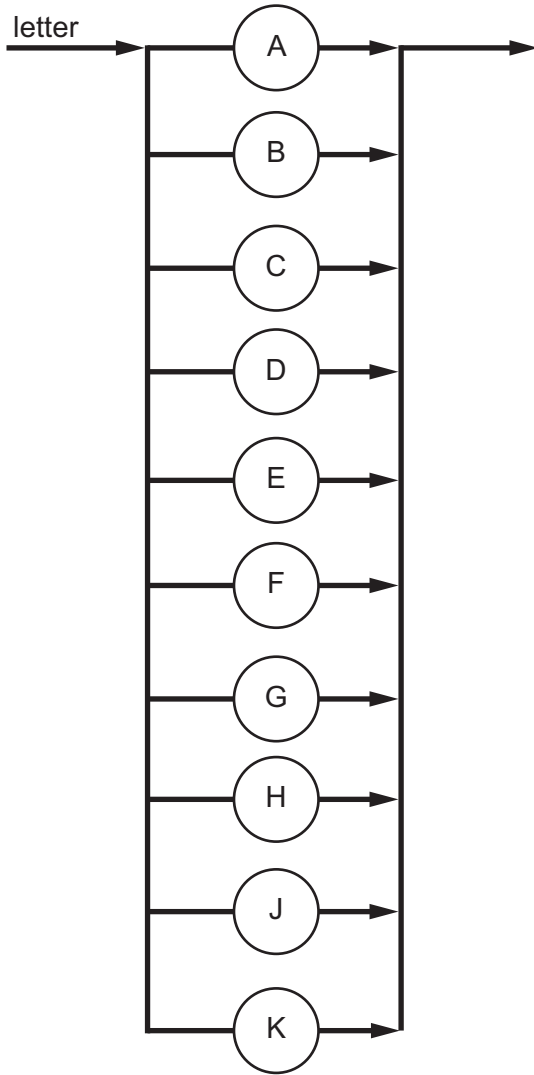
(a) State why `9K` is **not** a valid variable for the given syntax diagrams.

....

.... [1]

(b) Complete the Backus-Naur Form (BNF) for `<operator>`.

`<operator> ::=` ....

.... [1]

(c) An expression is defined as follows:

- A variable is assigned to a variable followed by an operator followed by another variable.
- The operator and final variable stage can be repeated as many times as necessary.

Complete the syntax diagram for an expression.
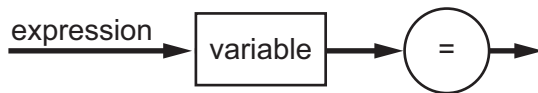
[3]

(d) A character can be a letter or a digit.

An additional constraint has been applied to the definition of variable. It must comply with the given syntax diagram, but it will only pass validation if it has at least **four** characters.

State **one** example of a valid variable.

....

.... [1]

10 Identify the **two** main protocols that form Transport Layer Security (TLS) **and** state the purpose of each.

Protocol 1 ....

Purpose ....

....

Protocol 2 ....

Purpose ....

....

[4]

11 (a) A linked list of nodes is used to store an ordered list of strings. Each node consists of the data, a left pointer and a right pointer.

Left pointer   Data   Right pointer

	Pp	
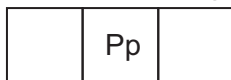
The linked list will be organised as a binary tree.

0 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 strings have been added:

Aa, Mm, Ss, Xx

Root pointer

Pp (node): left pointer → Gg node, right pointer → Rr node

Gg (node): right pointer → Kk node

Kk (node): left pointer = 0

Rr (node)
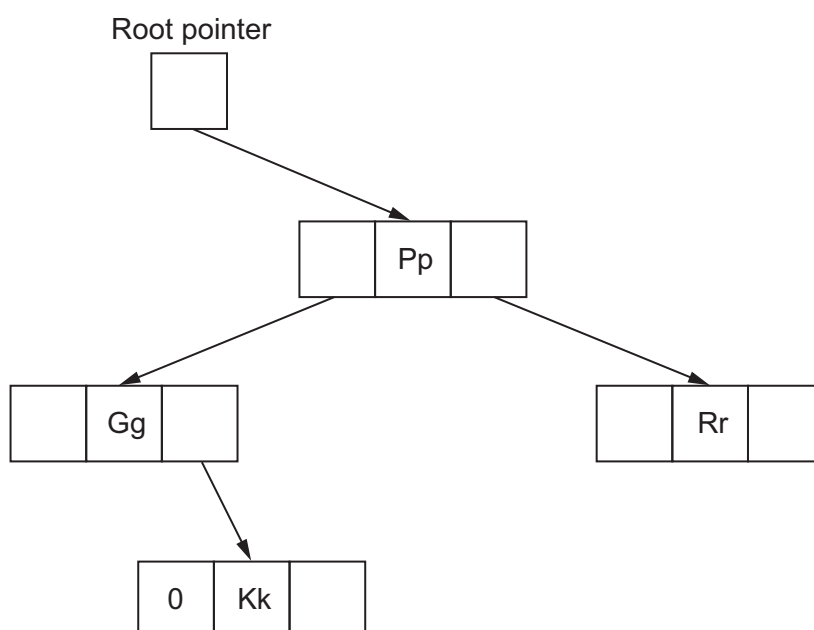
[4]

(b) A binary tree can be used to implement recursion.

Identify **one** feature of an algorithm that makes it beneficial to use recursion.
Give **one** example of an application that could use a recursive algorithm.

Feature ....

....

Example ....

[2]

12 (a) A medical clinic uses objects of the class `Patient` to assign a priority and a doctor to a patient. Some of the attributes required in the class are listed in the table.

Attribute	Data type	Description
PatientID	STRING	Unique identifier of the patient
Name	STRING	Patient's full name, surname first
DoctorID	STRING	ID of doctor administering treatment

Treatment is prioritised with a numeric scale of 1 to 5.

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

- attribute and data type for the date of birth
- attribute and data type for the priority
- methods to assign the patient ID, priority and doctor ID
- methods to return the patient ID, patient date of birth and the priority.

Patient
PatientID   : STRING
Name   : STRING
.... : ....
.... : ....
DoctorID   : STRING
....
SetName(FullName : STRING)
SetDateOfBirth(DOB : DATE)
....
....
....
GetName()
....
....
GetDoctorID()

[5]

(b) (i) Identify the object-oriented programming (OOP) term described as 'an occurrence of an object'.

.... [1]

(ii) Describe what is meant by the OOP term **polymorphism**.

....

....

....

.... [2]

13 The pseudocode algorithm below uses random file access to copy 50 records from a live file `CurrentResults.dat` to a stored file `StoredResults.dat` one record at a time. It uses the user-defined type `StudentResult`.

```
TYPE StudentResult
    DECLARE LastName : STRING
    DECLARE FirstName : STRING
    DECLARE ExamGrade : STRING
ENDTYPE
```

If any grades are missing in `CurrentResults.dat`, the text `"Missing grade"` is added to the `ExamGrade` field in `StoredResults.dat`

Complete this file handling pseudocode algorithm.

```
DECLARE Grade : StudentResult
DECLARE Position : INTEGER
```

....

```
OPENFILE "StoredResults.dat" FOR RANDOM
```

....

```
    SEEK "CurrentResults.dat", Position
    GETRECORD "CurrentResults.dat", Grade
    IF Grade.ExamGrade = "" THEN
```

....

```
    ENDIF
```

....

....

```
NEXT Position
CLOSEFILE "CurrentResults.dat"
CLOSEFILE "StoredResults.dat"
```

[5]

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