Cambridge Assessment International Education

# Cambridge International AS & A Level

CANDIDATE NAME

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**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.

DC (WW/FC) 342253/2


[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 |

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..... [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 .....

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Denary value .....

[3]

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

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..... [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 .....

.....

.....

.....

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.....

Benefit .....

.....

[4]

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

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..... [2]

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

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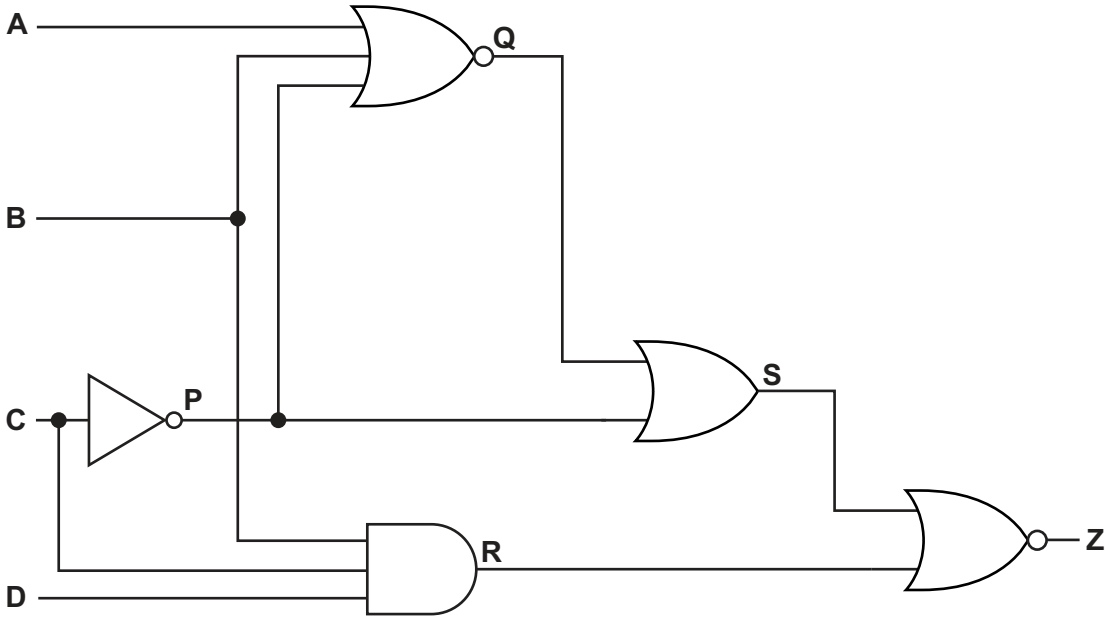
..... [4]

**7** The diagram shows a logic circuit.




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

| | | | | Working space | | | | |
|---|---|---|---|---|---|---|---|---|
| **A** | **B** | **C** | **D** | **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.

$$(\overline{\mathbf{A} + \mathbf{B}}) \,.\, (\overline{\mathbf{A} \,.\, \mathbf{B}} + \overline{\mathbf{B} \,.\, \mathbf{C}})$$

Working .....

.....

.....

.....

.....

.....

Simplified expression .....

.....

[4]

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

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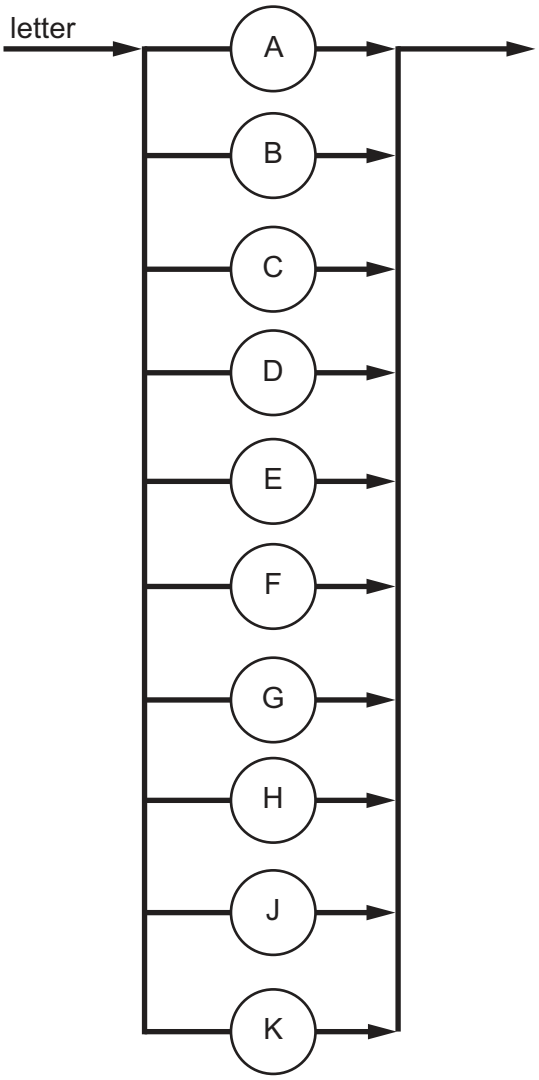
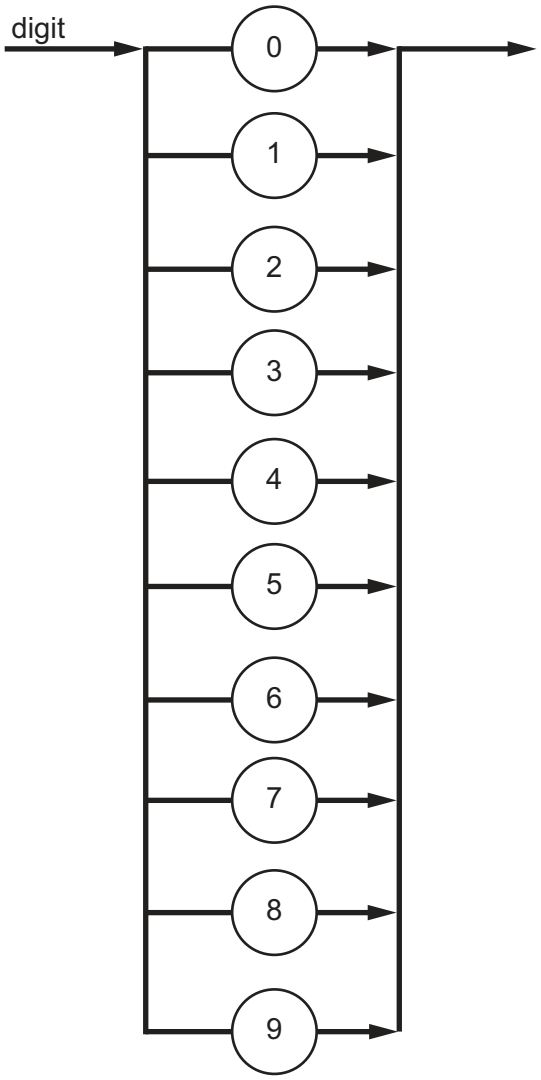
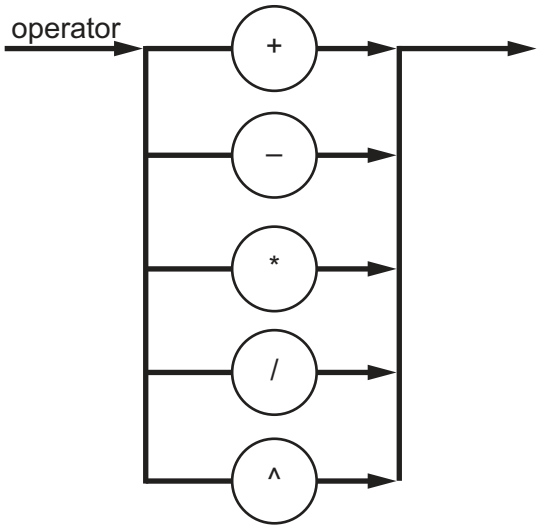
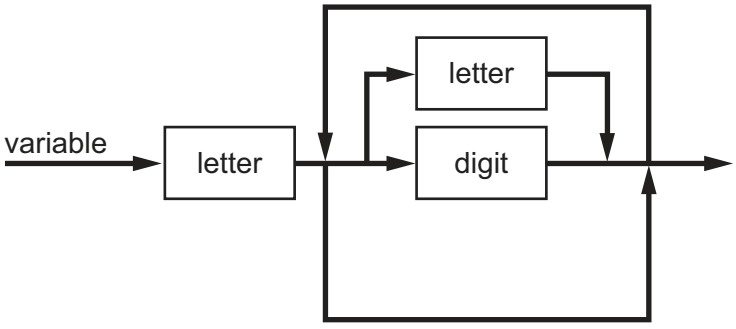
..... [4]

**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>`.

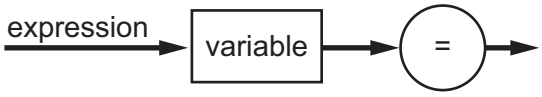
`<operator> ::=` .....

..... [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 .....

.....

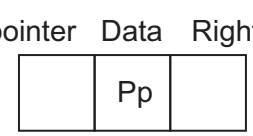
Protocol 2 .....

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.

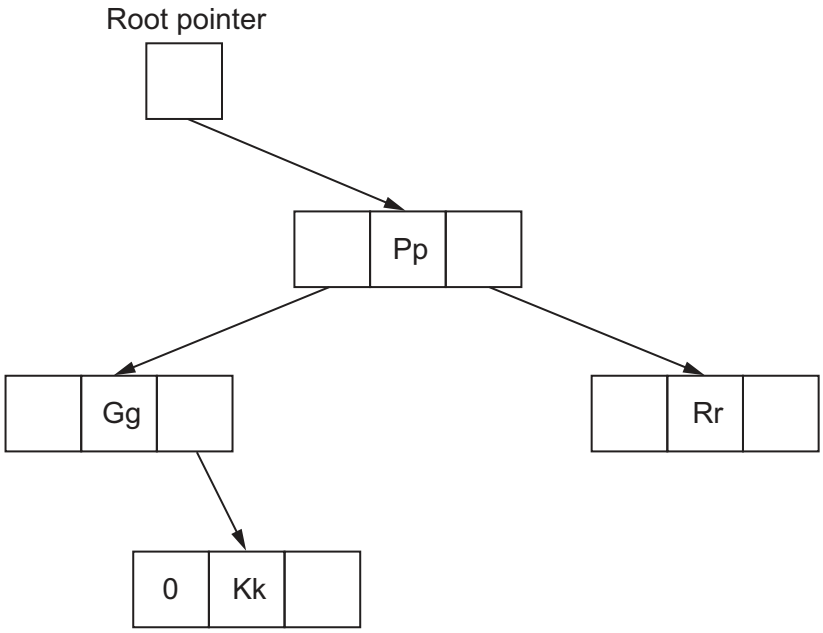



The linked list will be organised as a binary tree.

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




[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`<br>`Name : STRING`<br>..... : .....<br>..... : .....<br>`DoctorID : STRING` |
| .....<br>`SetName(FullName : STRING)`<br>`SetDateOfBirth(DOB : DATE)`<br>.....<br>.....<br>.....<br>`GetName()`<br>.....<br>.....<br>`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**.

.....

.....

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..... [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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