CAMBRIDGE
International Education

# Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

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**COMPUTER SCIENCE** **9618/31**

Paper 3 Advanced Theory **May/June 2026**

**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. Do **not** use correction fluid or tape.
- 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/TC) 363144/5


[Turn over

1 **(a)** A record data type is a type of composite user-defined data type.

Identify **two** other types of composite user-defined data types.

1 .....

2 .....

[2]

**(b)** **(i)** A pointer data type is a non-composite user-defined data type.

State the purpose of a pointer user-defined data type.

.....

..... [1]

**(ii)** Write the pseudocode statement to declare a pointer data type called `Word` to be used with `STRING` data.

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..... [2]



 

**2** **(a)** Random file organisation can be used with a database management system.

State **one** other example of where random file organisation could be used.

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..... [1]

**(b)** Describe how records are organised in random files.

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..... [2]

**(c)** Outline the process that would be used to find a record in a random file.

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..... [3]

**3** Numbers are stored in a computer system 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)** Calculate the normalised binary floating-point representation of –10.8125 in this system.

Show your working.

| mantissa | | | | | | | | | | exponent | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |

working .....

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[3]

**(b)** Calculate the denary value of the given normalised binary floating-point number.

Show your working.

| mantissa | | | | | | | | | | exponent | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |

working .....

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denary value .....

[3]

**4** Draw **one** line to connect each TCP/IP layer to its **most appropriate** description.

| TCP/IP layer | description |
|---|---|
| Application | ensures packets arrive in sequence without errors |
| Transport | provides remote access to files on a host server to access and manage files stored in a remote location |
| Internet | interconnects nodes or hosts in a network, encapsulates IP packets into frames and ensures correct protocols are followed |
| Link | identifies the intended network and host |
| | contains all the programs that exchange data and includes protocols: HTTP, FTP and POP3 |

[4]

**5** A virtual machine may be used to emulate computer hardware using software.

Outline **two** benefits and **two** limitations of using a virtual machine.

benefit 1 .....

.....

benefit 2 .....

.....

limitation 1 .....

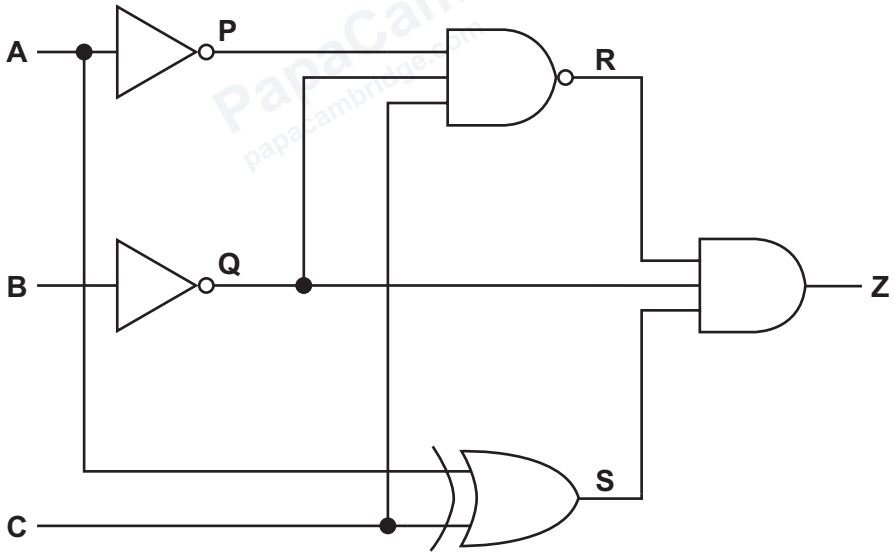
.....

limitation 2 .....

.....

[4]

**6** **(a)** The diagram shows a logic circuit.




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

| | | | working space | | | | |
|---|---|---|---|---|---|---|---|
| **A** | **B** | **C** | **P** | **Q** | **R** | **S** | **Z** |
| 0 | 0 | 0 | | | | | |
| 0 | 0 | 1 | | | | | |
| 0 | 1 | 0 | | | | | |
| 0 | 1 | 1 | | | | | |
| 1 | 0 | 0 | | | | | |
| 1 | 0 | 1 | | | | | |
| 1 | 1 | 0 | | | | | |
| 1 | 1 | 1 | | | | | |

[3]



**(b)** Describe **one** benefit of using a Karnaugh map (K-map) for solving logic problems.

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..... [1]

**(c)** The Karnaugh map (K-map) represents a logic circuit with four inputs.

| CD \ AB | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| **00** | 0 | 0 | 1 | 0 |
| **01** | 0 | 1 | 1 | 0 |
| **11** | 1 | 1 | 1 | 1 |
| **10** | 0 | 0 | 1 | 0 |

**(i)** Draw loop(s) around appropriate group(s) in the K-map to produce an optimal sum-of-products. [3]

**(ii)** Write the Boolean expression from your answer to **6(c)(i)** as a simplified sum-of-products. Do **not** carry out any further simplification.

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..... [2]

**7** **(a)** Write this infix expression in Reverse Polish Notation (RPN).

```
21 * (15 - 3 + 8) / 7
```

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.....

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..... [2]

**(b)** Write this RPN expression in infix form.

```
c d + a b - a c - * /
```

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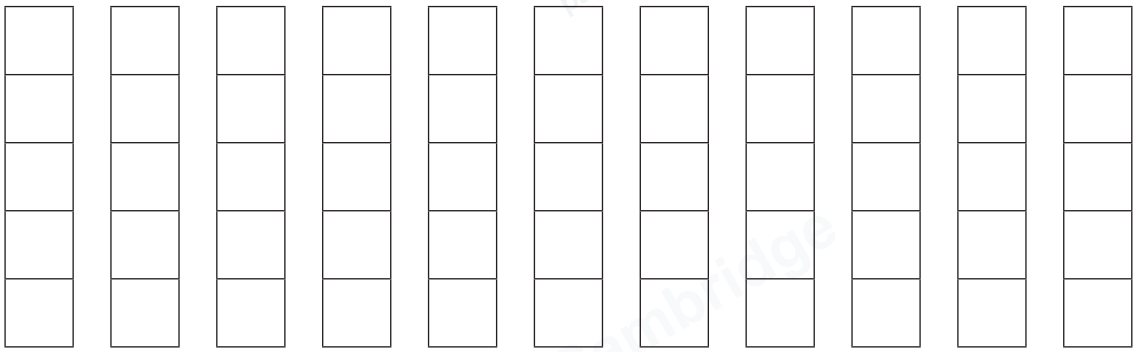
..... [3]

**(c)** The RPN expression

```
15  9 - 24  3 / * 18  6 + /
```

is to be evaluated.

Show the changing contents of the stack as the RPN expression is evaluated.



[4]



8 **(a)** Define the following asymmetric key encryption terms:

**(i)** cipher text

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..... [1]

**(ii)** public key.

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..... [1]

**(b)** Outline the process that would allow an individual to use asymmetric key encryption to send a private message to an organisation.

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..... [4]

9 **(a)** Explain how supervised learning and unsupervised learning are trained.

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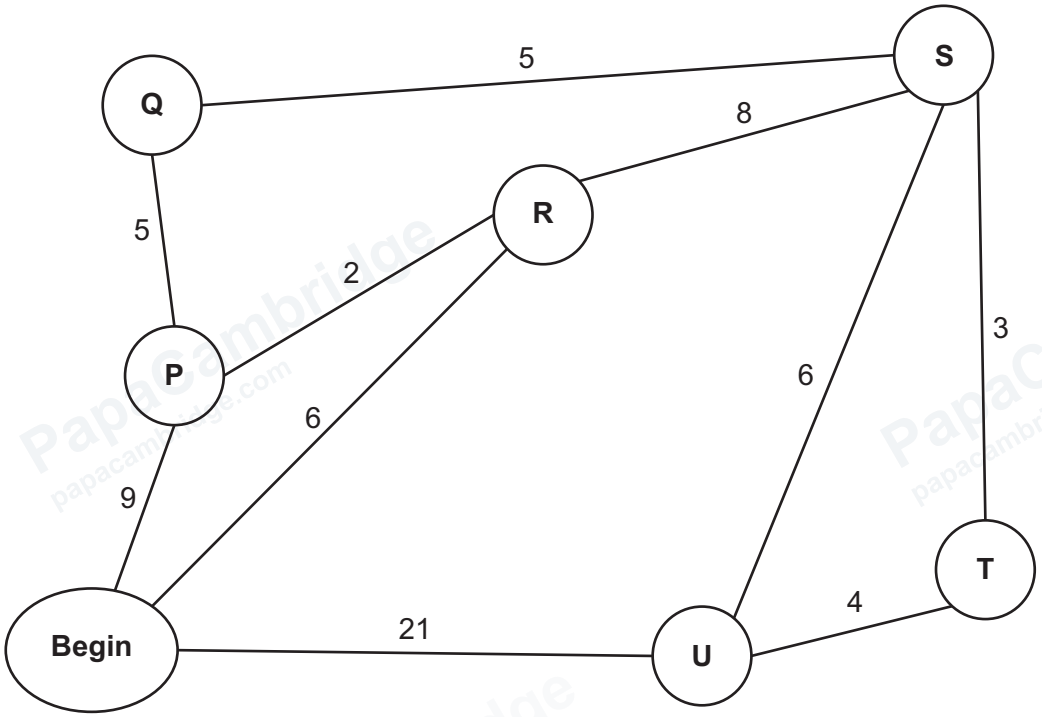
..... [4]



**(b)** Calculate the best path between the Begin node and each of the nodes in the diagram using Dijkstra's algorithm.

Show your working and write your answers in the table provided.




working .....

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answers:

| P | Q | R | S | T | U |
|---|---|---|---|---|---|
| | | | | | |

[5]

**10 (a)** An insertion sort algorithm is used to sort the unique ID numbers of club members into ascending order. These unique ID numbers are kept in a 1D array `MemberID`. The corresponding names of the members are stored in a 1D array `Names`.

The arrays are declared as:

```
DECLARE MemberID : ARRAY[0:499] OF INTEGER
DECLARE Names : ARRAY[0:499] OF STRING
```

The following table defines the variables to be used in this algorithm.

| identifier | data type | description |
|---|---|---|
| `Count` | integer | main loop counter to iterate through the whole array |
| `Temp1` | integer | temporary holding location for current member ID |
| `Temp2` | string | temporary holding location for current member name |
| `Insert` | integer | counter to show current insertion position |

Write the pseudocode for an insertion sort to arrange the unique ID numbers into ascending order. Make sure that the data in both arrays is swapped as required so that data with the same index continues to apply to the same person.

Use the given identifiers. Assume all variables have been declared.

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..... [5]

 

**(b)** Describe the factors, other than changing the algorithm, that affect the time efficiency of the insertion sort algorithm.

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..... [3]

**(c)** State the Big O notation for the worst-case time complexity of the insertion sort.

..... [1]

**11** A declarative programming language is used to show which home cinema devices customers already have and which devices they want.

```
01 device(projector).
02 device(large_tv).
03 device(medium_tv).
04 device(bluray_player).
05 device(amplifier).
06 device(media_player).
07 device(main_speakers).
08 device(centre_speaker).
09 device(surround_speakers).
10 customer(petrov).
11 customer(margaret).
12 customer(steffan).
13 customer(susan).
14 customer(allan).
15 customer(sammy).
16 owns(projector, petrov).
17 owns(media_player, petrov).
18 owns(projector, susan).
19 owns(projector, sammy).
20 owns(media_player, allan).
21 owns(bluray_player, steffan).
22 wants(main_speakers, margaret).
23 wants(surround_speakers, susan).
24 wants(medium_tv, steffan).
```

These facts (clauses) have the meanings:

| fact | meaning |
|---|---|
| 01 | A projector is a device. |
| 10 | Petrov is a customer. |
| 16 | Petrov owns a projector. |
| 22 | Margaret wants main speakers. |

**(a)** Betty is a customer who owns a large TV and wants a Blu-ray player.

Write additional facts to represent this information.

25 .....

26 .....

27 .....

[3]

 

**(b)** Using the variable `Owner`, the goal:

```
owns(media_player, Owner)
```

returns

```
Owner = petrov, allan
```

Write the result of using the goal:

```
owns(projector, Owner)
```

`Owner =` ..... [1]

**(c)** `D` may be available for `A` to buy if `D` is a device and `A` is a customer and `A` does **not** own that device.

Write this as a rule:

```
may_buy_device(D, A)
```

`IF` .....

.....

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..... [4]

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