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Cambridge Assessment International Education

# Cambridge International AS & A Level

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**COMPUTER SCIENCE** **9618/33**

Paper 3 Advanced Theory **May/June 2024**

**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 **12** pages. Any blank pages are indicated.


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[Turn over

**1** Real numbers are stored in a computer system using 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 denary value of the given normalised floating-point number.

Show your working.

| Mantissa | | | | | | | | | | Exponent | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |

Working .....

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Answer .....

[3]

**(b)** Calculate the normalised floating-point representation of –102.75 in this system.

Show your working.

| Mantissa | | | | | | | | | | Exponent | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |

Working .....

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[3]

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**2** The TCP/IP protocol suite has four layers:

Transport, Application, Link, Internet

**(a)** Complete the diagram to show the correct order for these layers.



[2]

**(b)** Describe the function of the Transport layer.

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**(c)** Outline **one** protocol that is associated with the Application layer.

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**3** **(a)** Explain what is meant by **non-composite** and **composite** data types.

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**(b)** Write **pseudocode** statements to declare the record data type `FootballClub` to hold data about football clubs in a league, to include:

- name of team
- date team joined the league
- main telephone number
- name of the manager
- number of members
- current position in the league.

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**4** **(a)** Describe the sequential method of file **access**.

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**(b)** Explain how the sequential method of file access is applied to files with serial organisation and to files with sequential organisation.

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**5** **(a)** Write this Reverse Polish Notation (RPN) in infix form:

```
5 2 + 9 3 - / 3 *
```

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..... [3]

**(b)** Write this infix expression in RPN:

```
((7 + 3) - (2 * 8)) / 6
```

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..... [2]

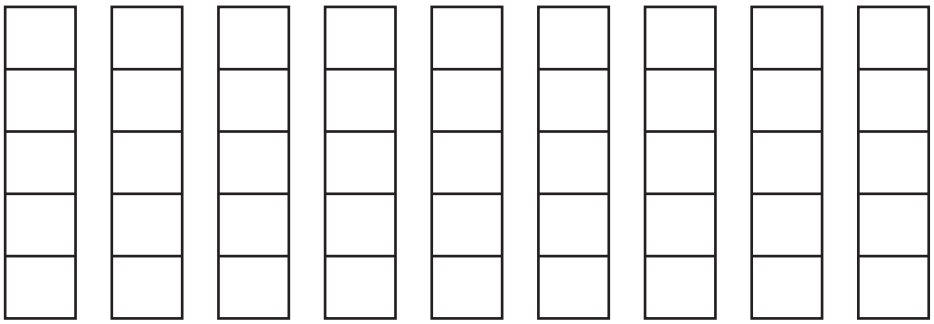
**(c)** Evaluate this RPN expression:

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

when

`a = 17, b = 5, c = 7, d = 3` and `e = 10`

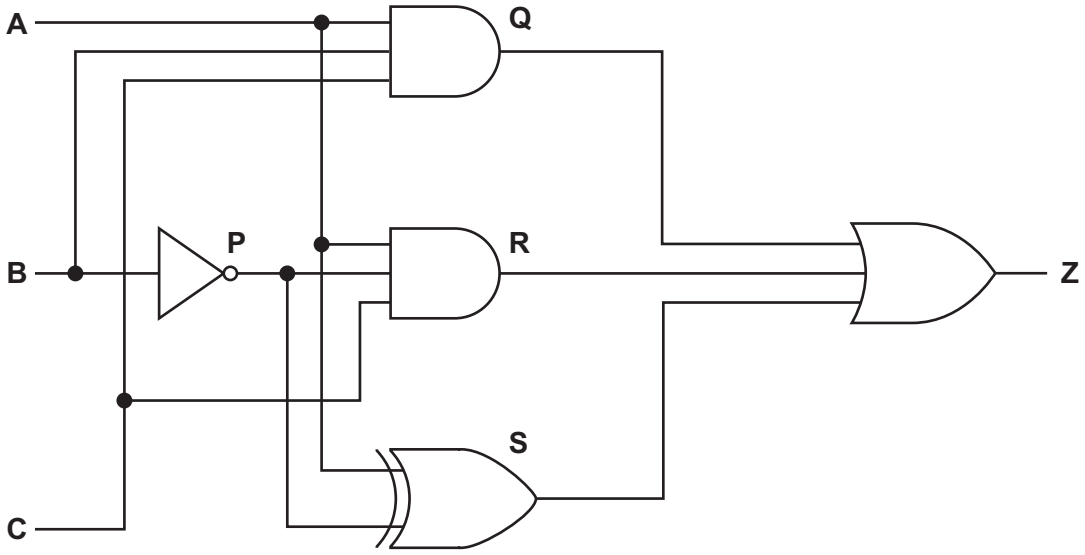
Show the changing contents of the stack as the RPN expression is evaluated.



[4]

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




**(a)** 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)** Write the Boolean expression that corresponds to the logic circuit as a sum-of-products.

**Z =** .....

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**(c)** **(i)** Complete the Karnaugh map (K-map) for the Boolean expression:

$\overline{A}.\overline{B}.\overline{C} + \overline{A}.\overline{B}.C + A.\overline{B}.\overline{C} + A.\overline{B}.C + A.B.\overline{C} + A.B.C$

| A \ BC | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | | | | |
| 1 | | | | |

[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 expression from your answer to part **(c)(ii)** as a simplified sum-of-products.

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**7** **(a)** Describe what is meant by a digital certificate.

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**(b)** Explain the role of a digital certificate in creating a digital signature.

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**8** A **declarative** programming language is used to represent the features that are available and the features that are unavailable on different body styles of a car.

```
01 feature(sunroof).
02 feature(automatic_tailgate).
03 feature(heated_seats).
04 feature(extra_seats).
05 feature(reversing_camera).
06 feature(dashboard_camera).
07 feature(air_conditioning).
08 feature(heated_windscreen).
09 feature(satnav).
10 bodystyle(saloon).
11 bodystyle(hatchback).
12 bodystyle(estate).
13 bodystyle(minivan).
14 bodystyle(convertible).
15 available(sunroof, hatchback).
16 available(sunroof, minivan).
17 available(reversing_camera, hatchback).
18 available(extra_seats, minivan).
19 available(reversing_camera, saloon).
20 unavailable(sunroof, convertible).
21 unavailable(automatic_tailgate, saloon).
22 unavailable(extra_seats, hatchback).
```

These clauses have the meanings:

| Clause | Meaning |
|---|---|
| 01 | Sunroof is a feature. |
| 10 | Saloon is a body style. |
| 15 | Sunroof is available on a hatchback. |
| 20 | Sunroof is unavailable on a convertible. |

**(a)** Sliding doors is a feature that is available on a minivan but unavailable on a hatchback.

Write additional clauses to represent this information.

23 .....

24 .....

25 .....

[3]

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

```
available(Options, saloon)
```

returns

```
Options = reversing_camera
```

Write the result returned by the goal:

```
available(Options, hatchback)
```

`Options =` ..... [1]

**(c)** `F` may be available for `B` if `F` is a feature and `B` is a body style and `F` is **not** unavailable for that body style.

Write this as a rule:

```
may_choose_option(F, B)
```

`IF` .....

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**9** Explain what is meant by **Deep Learning** in relation to Artificial Intelligence (AI).

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**10 (a)** State a condition that must be true for an array to be searchable for a binary search.

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**(b)** Complete the given pseudocode to find an item in a 1D array `Names` of type `STRING` using a binary search.

```
DECLARE Names : ARRAY[1:100000] OF STRING
DECLARE TopOfList : INTEGER
DECLARE EndOfList : INTEGER
DECLARE CurrentItem : INTEGER
DECLARE ToFind : STRING
DECLARE Found : BOOLEAN
DECLARE NotInList : BOOLEAN
TopOfList ← 1
EndOfList ← 100000

OUTPUT "Which name do you wish to find? "
INPUT ToFind

.....

NotInList ← FALSE

WHILE ..... AND .....
   CurrentItem ← (TopOfList + EndOfList) DIV 2

   IF ..... THEN
      Found ← TRUE
   ELSE
      IF TopOfList >= EndOfList THEN

         .....
      ELSE
         IF ToFind > Names[CurrentItem] THEN

            .....
         ELSE
            EndOfList ← CurrentItem - 1
         ENDIF
      ENDIF
   ENDIF
ENDWHILE
IF Found = TRUE THEN
   OUTPUT "Item found at position ", CurrentItem, " in array"
ELSE
   OUTPUT "Item not in array"
ENDIF
```

[5]

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**(c)** Describe the performance of a binary search in relation to the number of data items in the array being searched. Refer to Big O notation in your answer.

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..... [2]

**11** Reduced Instruction Set Computers (RISC) and Complex Instruction Set Computers (CISC) are two types of processor.

**(a)** State **two** features of RISC processors.

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**(b)** Outline the process of interrupt handling as it could be applied to RISC or CISC processors.

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**(c)** Explain how pipelining affects interrupt handling for RISC processors.

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