



Cambridge International AS & A Level

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COMPUTER SCIENCE

9618/31

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.



2

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

0	1	0	0	1	1	1	1	0	0
---	---	---	---	---	---	---	---	---	---

Exponent

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

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Exponent

--	--	--	--	--	--

Working

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[3]

3

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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..... [2]

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

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..... [2]

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

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..... [3]

(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]

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

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..... [2]

(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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..... [3]

5

- 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 /

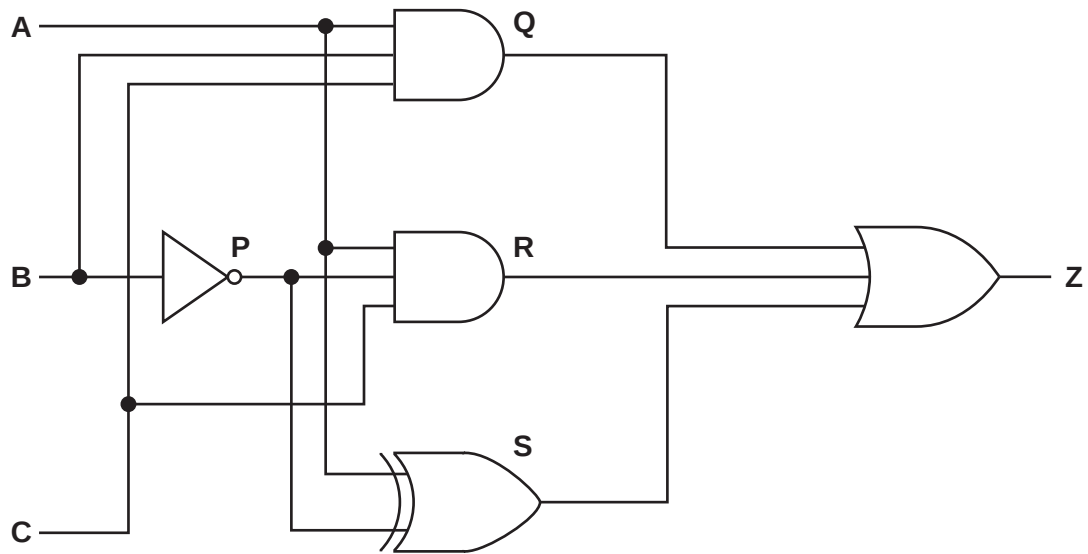
when

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]

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 =
.....
.....
..... [2]

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

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

		BC			
		00	01	11	10
A	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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..... [1]

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

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..... [3]

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

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..... [2]

- 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]

(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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..... [4]

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

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..... [3]

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

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 [1]

- (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]

11

- (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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..... [3]

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