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 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.

[Turn over

1 (a) Describe the effect of changing the allocation of bits used for the mantissa and for the exponent in a floating-point number with a fixed total number of bits.

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.... [2]

(b) Real numbers are stored in a computer, using floating-point representation with:

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

Calculate the normalised floating-point representation of +54.8125 in this system.

Show your working.

Mantissa   **Exponent**

| | | | | | | | | | | | | | | | | |

Working ....

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.... [3]

2 (a) Outline why protocols are essential for communication between computers.

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.... [2]

(b) State the names of **two** different protocols associated with the sending and receiving of emails between computers.

Sending ....

Receiving ....
[2]

(c) Explain the meaning of the phrase:

BitTorrent protocol provides peer-to-peer file sharing.

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.... [3]

3 (a) Explain what is meant by the term **non-composite data type** and give an example of a non-composite data type.

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Example ....
[3]

(b) Write **pseudocode** statements to declare the set data type `EvenNumbers` to hold this set of even numbers between 2 and 12:

2, 4, 6, 8, 10, 12

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.... [4]

4 Sheila has a customer called Fred. Fred wants to send Sheila a confidential document as part of a transaction.

Explain how Fred uses asymmetric encryption to send his document securely.

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.... [4]

5 (a) Write this infix expression in Reverse Polish Notation (RPN):
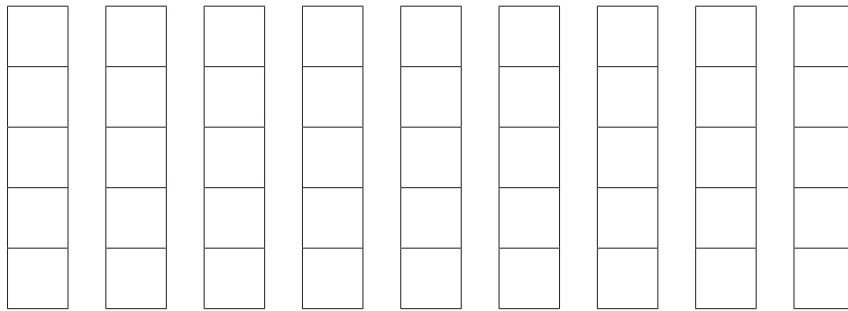
`(7 - 2 + 8) / (9 - 5)`

....

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.... [2]

(b) Evaluate this RPN expression:

`a d + a b + c - *`

when

`a = 6, b = 3, c = 7` and `d = 9`

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

[4]

(c) Write this RPN expression in infix form:

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

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....

.... [3]

6 The diagram shows a logic circuit.
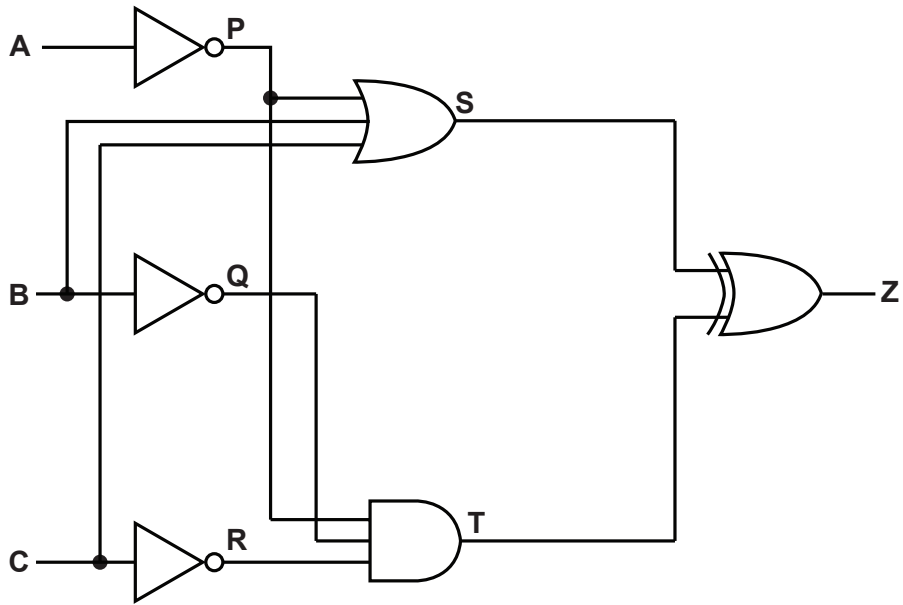
(a) Complete the truth table for the given logic circuit.
Show your working.

A	B	C	Working space					Z
			P	Q	R	S	T	
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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.... [2]

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

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

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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.... [1]

7 (a) Outline what is meant by **direct access** as a method of file access.

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.... [2]

(b) Explain how direct access is used to locate a specific record in sequential files and random files.

(i) Sequential files ....

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.... [2]

(ii) Random files ....

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.... [2]

8 (a) Complete the pseudocode to find an item in a 1D array `Widgets` of type `STRING`, using a **linear** search.

```
DECLARE Widgets : ARRAY[1:50000] OF STRING
DECLARE TopOfList : INTEGER
DECLARE EndOfList : INTEGER
DECLARE Count : INTEGER
DECLARE ToFind : STRING
DECLARE Found : BOOLEAN
DECLARE NotInList : BOOLEAN
TopOfList ← 1
EndOfList ← 50000
OUTPUT "Enter the name of the item you wish to find "
INPUT ToFind

.............................................................................................................

NotInList ← FALSE
Count ← TopOfList

WHILE ........................................... AND ...........................................

    IF ..................................................................................... THEN
        Found ← TRUE
    ENDIF
    Count ← Count + 1

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

[4]

(b) Compare the methods used by the linear and binary search algorithms to find an item in an array. Refer to Big O notation in your answer.

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.... [4]

9 (a) Outline **two** benefits and **two** limitations of a virtual machine.

Benefit 1 ....

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Benefit 2 ....

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Limitation 1 ....

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Limitation 2 ....

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[4]

(b) Explain the roles of the host operating system and the guest operating system as used in a computer system running a virtual machine.

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.... [3]

10 A **declarative** programming language is used to allow clients to choose daily activities at the beach.

```
01  activity(paddleboarding).
02  activity(sailing).
03  activity(rowing).
04  activity(kayaking).
05  activity(jetskiing).
06  client(stevie).
07  client(antonio).
08  client(henry).
09  client(eliza).
10  client(rebeka).
11  client(danny).
12  client(erik).
13  client(simone).
14  client(petra).
15  client(frankie).
16  choice(petra, rowing).
17  choice(frankie, sailing).
18  choice(erik, sailing).
19  choice(eliza, rowing).
20  choice(stevie, jetskiing).
21  choice(henry, sailing).
22  done(henry, jetskiing).
23  done(rebeka, jetskiing).
24  done(antonio, kayaking).
```

These clauses have the meanings:

Clause	Meaning
01	Paddle boarding is an activity.
06	Stevie is a client.
16	Petra has chosen rowing.
22	Henry has already done jet skiing.

(a) Jane is a client who would like to choose the activity surfing and she has already done sailing.

Write additional clauses to represent this information.

25 ....

26 ....

27 ....

28 ....

[4]

(b) Using the variable `List`, the goal:

    choice(List, rowing)

returns

    List = petra, eliza

Write the result returned by the goal:

    choice(List, sailing)

`List` = ... [1]

(c) `C` is a client who would like to choose `A` if `A` is an activity and `C` has **not** already done `A`.

Write this as a rule:

`may_choose_activity(C, A)`

`IF` ....

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.... [4]

11 Explain what is meant by **Reinforcement Learning** in relation to Artificial Intelligence.

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.... [3]