



CANDIDATE  
NAME

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## 9618/32

May/June 2024

**1 hour 30 minutes**

You must answer on the question paper.

No additional materials are needed.

- 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.

- 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.

- 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 |  |  |  |
|----------|--|--|--|--|--|--|--|--|--|--|--|----------|--|--|--|
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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

$$a = 6, b = 3, c = 7 \text{ and } d = 9$$

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

|  |  |  |  |  |  |  |  |  |
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[4]

- (c) Write this RPN expression in infix form:

$$b \ a \ c - + d \ b + * c /$$

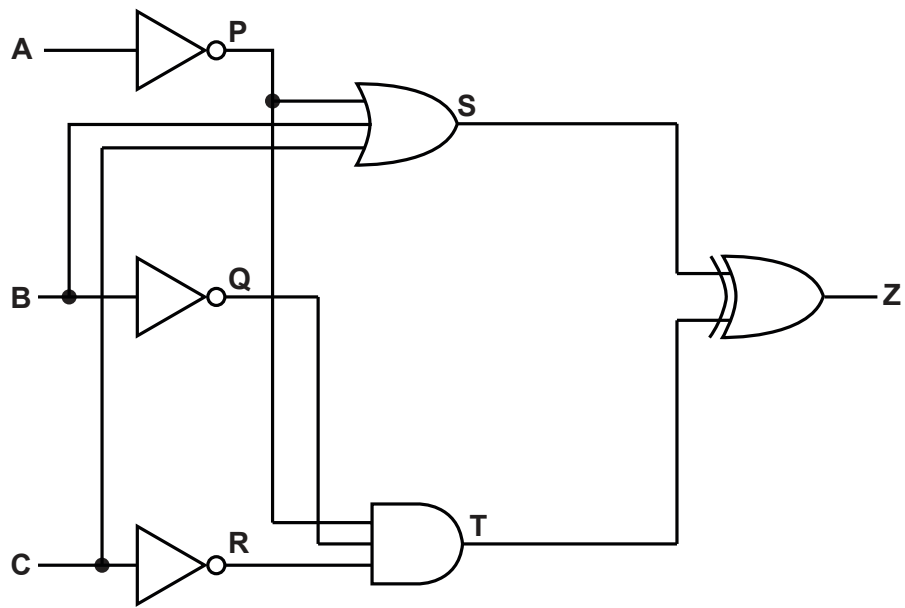
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..... [3]

6 The diagram shows a logic circuit.



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

|   |   |   | Working space |   |   |   |   |   |
|---|---|---|---------------|---|---|---|---|---|
| A | B | C | P             | Q | R | S | T | 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 this Boolean expression:

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

|   |   | 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) 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 .....

.....

.....

..... [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 .....

.....

.....

Benefit 2 .....

.....

.....

Limitation 1 .....

.....

.....

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 ..... [4]

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

..... [3]

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