



Cambridge International AS & A Level

CANDIDATE
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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.

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.

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

[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
<input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>

Working

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

[3]

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

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

[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.

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

[3]

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

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

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

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

[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.

[4]

- 5 (a) Write this infix expression in Reverse Polish Notation (RPN):

$(7 - 2 + 8) / (9 - 5)$

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

[2]

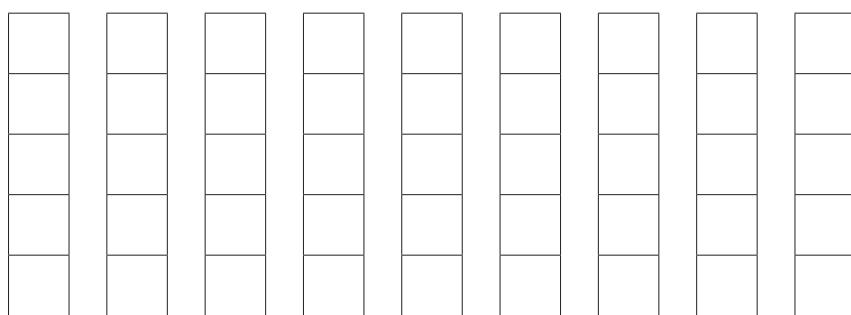
- (b) Evaluate this RPN expression:

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

when

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

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



[4]

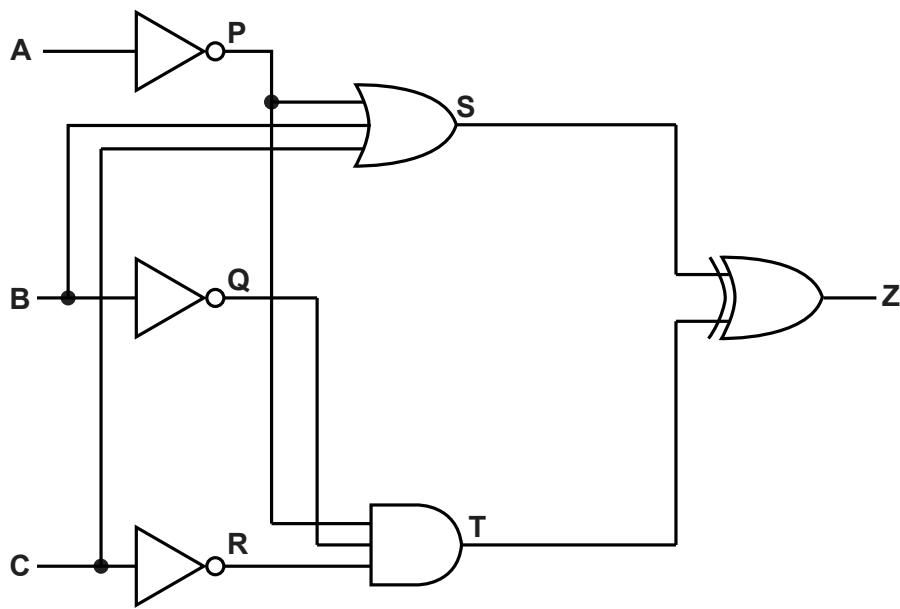
- (c) Write this RPN expression in infix form:

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

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

[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]

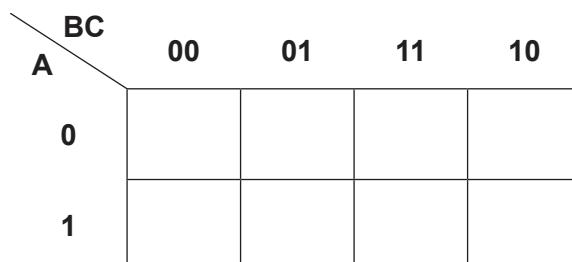
- (b) Write the Boolean expression that corresponds to the logic circuit as a sum-of-products.

$Z = \dots$

[2]

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

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



[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.

.....
.....

[1]

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

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

[2]

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

(i) Sequential files

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

[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.

[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.

[4]

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

Benefit 1

.....
.....

Benefit 2

.....
.....

Limitation 1

.....
.....

Limitation 2

.....
.....

[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.

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

[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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