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COMPUTER SCIENCE**9618/31**

Paper 3 Advanced Theory

October/November 2025**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.

- 1 The composite record data type, *ClubMember*, is defined in pseudocode as:

```

TYPE ClubMember
  DECLARE Code : INTEGER
  DECLARE LastName : STRING
  DECLARE FirstName : STRING
  DECLARE Telephone : STRING
  DECLARE JoinDate : DATE
  DECLARE Fees : REAL
  DECLARE FeesPaid : BOOLEAN
ENDTYPE

```

- (a) (i) Write the **pseudocode** statement to set up a variable for one record of the composite data type, *ClubMember*.

.....
 [1]

- (ii) Write the **pseudocode** statements to assign the following values to the variable set up in part (a)(i):

- 984632 to Code
- TRUE to FeesPaid

.....

 [2]

- (b) An enumerated data type, *Activity*, is required, so that a new field, *Choice*, can be added to the composite data type, *ClubMember*, to allow members to choose an activity.

- (i) Write the **pseudocode** statement for the type declaration of *Activity* to hold the names of the available activities:

Badminton, Football, Golf, Snooker, Swimming, Tennis.

.....

 [2]

- (ii) Write the **new pseudocode** statement required to update the declaration of *Choice* in the definition of *ClubMember*.

.....
 [1]



2 Numbers are stored in a computer system using binary floating-point representation with:

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

(a) Write the normalised floating-point representation of the following positive binary number using this system.

0.00000001110101101

Mantissa

Exponent

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

--	--	--	--

[2]

(b) Calculate the normalised binary floating-point representation of -76.1875 in this system. Show your working.

Mantissa

Exponent

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

--	--	--	--

Working

.....

.....

.....

.....

.....

.....

.....

[4]



3 (a) Explain why protocols are essential for communication between computer systems.

.....

.....

.....

..... [2]

(b) POP3 is an email communication protocol.

Identify and describe **two** other communication protocols that are used when sending or receiving emails.

Protocol 1

Description

.....

.....

Protocol 2

Description

.....

.....

[4]

(c) Describe **two** ways in which packet switching ensures a complete message is received when passing messages across a network.

1

.....

.....

.....

2

.....

.....

.....

[4]



- 4 (a) A scheduling routine determines how processes are managed by the operating system.

Identify **two** scheduling routines.

- 1
2 [2]

- (b) Describe **two** ways in which the complexities of the computer hardware are hidden from the user.

- 1
.....
.....
.....
2
.....
.....
..... [4]

- 5 (a) Identify **two** items commonly found within a digital certificate.

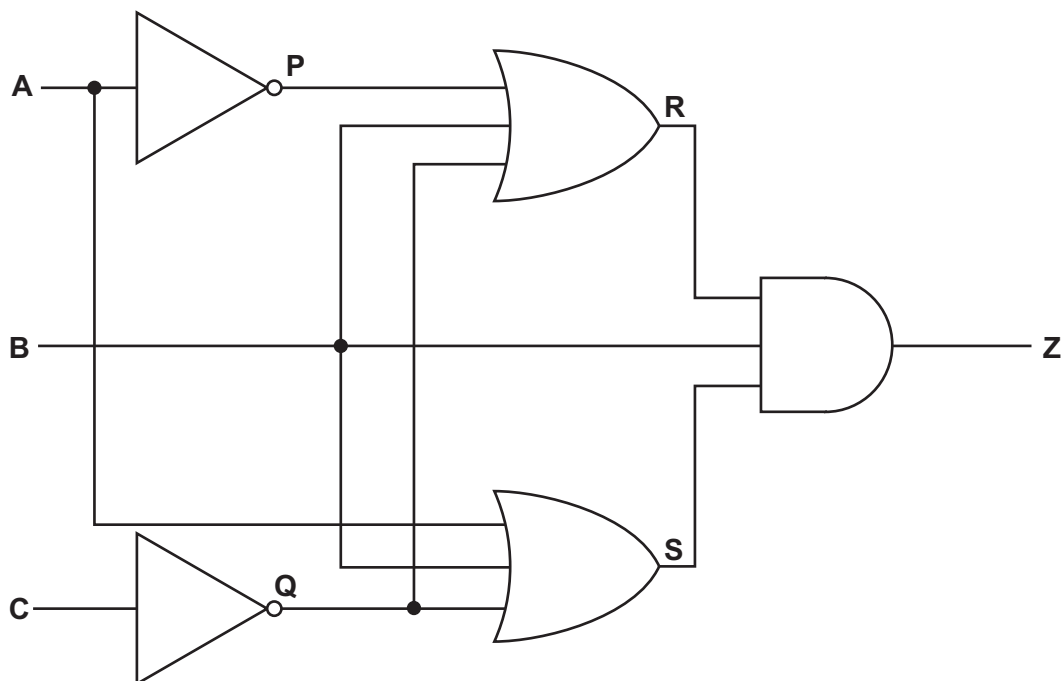
- 1
.....
2 [2]

- (b) Explain why a digital certificate is required to validate a digital signature.

-
.....
.....
.....
..... [3]



6 (a) The diagram shows a logic circuit.



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

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

		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 **b(ii)** as a simplified sum-of-products. Do **not** carry out any further simplification.

..... [2]

7 (a) Identify **one** Artificial Intelligence (AI) algorithm to find the shortest distance between two points on a graph.

..... [1]

(b) Describe Deep Learning.

..... [5]



8 (a) Outline the purpose of lexical analysis during the compilation of a program.

.....

.....

.....

..... [2]

(b) Write the Reverse Polish Notation (RPN) for the given infix expression:

$$(2 - 6) * (13 + 7) / 5$$

.....

.....

.....

..... [2]

(c) The RPN expression:

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

is to be evaluated, where:

$$a = 6, \ b = 12, \ c = 15 \ \text{and} \ d = 5.$$

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

[4]





- 9 (a) A stack has been implemented using pseudocode to store a maximum of 100 string items using the global variables in the following table:

Identifier	Data type	Description	Initialisation value
Base	INTEGER	pointer for the bottom of the stack	0
Top	INTEGER	pointer for the top of the stack	-1
StackArray	STRING	1D array to implement the stack	[0:99]
Max	INTEGER	maximum number of items in the stack	100

The value of `Top` is incremented each time a data item is added to the stack and decremented every time a data item is removed.

- (i) Complete the **pseudocode** for the function to remove a data item from the stack.

```

FUNCTION Pop() .....
    DECLARE DataItem : STRING
    DataItem ← ""

    IF ..... THEN

        DataItem ← .....

        Top ← .....
    ELSE
        DataItem ← "You cannot remove data; the stack is empty"
    ENDIF

    .....
ENDFUNCTION
    
```

[5]

- (ii) Write the **pseudocode** to output the data item removed from the stack with an appropriate message.

.....
 [1]





(b) A stack is used to implement recursion.

State the **three** essential features of recursion.

- 1
-
- 2
-
- 3
-

[3]

10 Explain what is meant by **exception handling**.
Include an example of a possible cause of an exception in your answer.

Explanation

.....

.....

.....

Example

[3]



- 11 The table shows assembly language instructions for a processor that has one register, the Accumulator (ACC).

Label	Instruction		Explanation
	Opcode	Operand	
	LDM	#n	Load the number n to ACC
	LDD	<address>	Load the contents of the location at the given address to the ACC
	LDI	<address>	The address to be used is at the given address. Load the contents of this second address to the ACC
	ADD	<address>	Add the contents of the given address to the ACC
	SUB	<address>	Subtract the contents of the given address from the ACC
	STO	<address>	Store the contents of the ACC at the given address
<label>:		<data>	Gives a symbolic address <label> to the memory location with contents <data>
# denotes a denary number, e.g. #123 <label> can be used in place of <address>			

- (a) Write **assembly language** code, using **only** the given instruction set to:

- store the denary value 100 as a named constant
- subtract the constant from the value contained in address 632
- store the result in variable `Answer`.

Show the initialisation of the constant and `Answer` in the table provided.

.....

.....

.....

.....

.....

.....

Label	Contents

[6]

- (b) The address 632 contains the value 45.

State the value of `Answer` after the code described in part (a) has executed.

..... [1]





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