



CANDIDATE  
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## 9618/32

October/November 2023

**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 **16** pages. Any blank pages are indicated.

1 (a) Real numbers are stored in a computer 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.

Write the normalised floating-point representation of  $-96.75$  in this system.

Show your working.

**Mantissa**

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

**Exponent**

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

Working .....

.....

.....

.....

.....

.....

[3]

(b) Explain why a binary representation is sometimes only an approximation to the real number it represents.

.....

.....

.....

.....

.....

..... [3]

- 2 Describe what is meant by **composite** and **non-composite** data types.

Composite .....

.....

.....

.....

Non-composite .....

.....

.....

.....

[4]

- 3 The location of a record in a random file is determined using a hashing algorithm.

A collision may occur during the process of adding a record.

- (a) Outline what is meant by the term **collision** in this context.

.....

.....

.....

..... [2]

- (b) Explain how a collision can be dealt with when writing records to a random file.

.....

.....

.....

.....

.....

..... [3]

- 4 Complete the following paragraph about a **protocol suite**, using words from the given list.

Some words are **not** used.

|                     |                          |                |             |               |
|---------------------|--------------------------|----------------|-------------|---------------|
| <b>BitTorrent</b>   | <b>circuit switching</b> | <b>layered</b> | <b>link</b> | <b>list</b>   |
| <b>peer-to-peer</b> | <b>queue</b>             | <b>stack</b>   | <b>star</b> | <b>TCP/IP</b> |

The protocols in a ..... determine the interconnectivity rules for a ..... network model such as the ..... model.

[3]

- 5 (a) Outline the reasons why an operating system may need to use virtual memory.

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

- (b) Explain the circumstances in which disk thrashing could occur.

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

- 6 (a) The Reverse Polish Notation (RPN) expression:

$$a \ b \ * \ 2 \ / \ c \ d \ / \ *$$

is to be evaluated where  $a = 20$ ,  $b = 3$ ,  $c = 10$  and  $d = 5$ .

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

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

[4]

- (b) Explain how an expression stored in RPN can be evaluated.

.....

.....

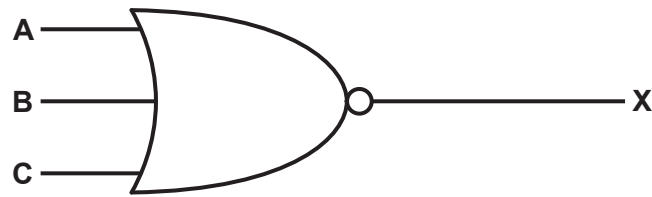
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.....

..... [3]

- 7 (a) This logic circuit represents the Boolean expression:  $X = \overline{A + B + C}$



Complete this truth table for the given logic circuit.

| A | B | C | X |
|---|---|---|---|
| 0 | 0 | 0 |   |
| 0 | 0 | 1 |   |
| 0 | 1 | 0 |   |
| 0 | 1 | 1 |   |
| 1 | 0 | 0 |   |
| 1 | 0 | 1 |   |
| 1 | 1 | 0 |   |
| 1 | 1 | 1 |   |

[1]

- (b) Apply De Morgan's laws to the expression:  $X = \overline{A + B + C}$

$X =$  ..... [1]

- (c) Simplify the following expression using Boolean algebra.

Show all the stages in your simplification.

$$T = X.Y.Z + X.\bar{Y}.Z + \bar{X}$$

.....

.....

.....

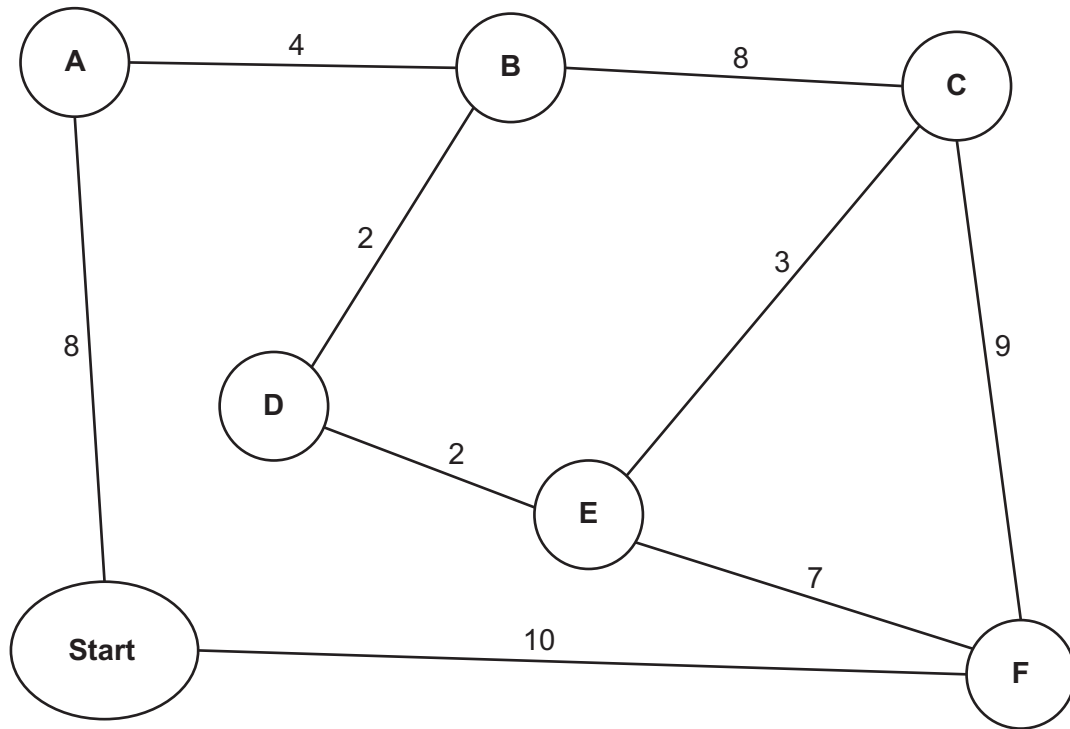
.....

.....

..... [3]

- 8 Calculate the shortest distance between the **Start** and each of the destinations in the diagram using Dijkstra's algorithm.

Show your working **and** write your answers in the table provided.



Working .....

.....

.....

.....

.....

.....

Answers:

| A | B | C | D | E | F |
|---|---|---|---|---|---|
|   |   |   |   |   |   |

[5]

- 9 (a) A stack Abstract Data Type (ADT) is to be implemented using pseudocode, with procedures to initialise it and to push new items onto the stack.

A 1D array `Stack` stores the contents of the stack.

- (i) Study the pseudocode in **part (a)(ii)** and complete the table of identifiers by writing the missing data types and descriptions.

| Identifier  | Data type | Description |
|-------------|-----------|-------------|
| BasePointer |           |             |
| TopPointer  |           |             |
| Stack       | REAL      |             |

[2]

- (ii) Complete the pseudocode.

```

CONSTANT MaxSize = 40
DECLARE BasePointer : INTEGER
DECLARE TopPointer : INTEGER
DECLARE Stack : ARRAY[1:40] OF REAL

// initialisation of stack
PROCEDURE Initialise()

    ..... ← 1

    ..... ← 0

ENDPROCEDURE

// push an item onto the stack
PROCEDURE Push(NewItem : REAL)

    ..... MaxSize THEN

    .....

    Stack[TopPointer] ← .....

ENDIF

ENDPROCEDURE

```

[5]

(b) Justify the use of a linked list instead of an array to implement a stack.

.....

.....

.....

..... [2]

(c) Explain how a compiler makes use of a stack when translating recursive programming code.

.....

.....

.....

.....

.....

.....

.....

..... [4]

10 Describe the features of the SIMD and MISD computer architectures.

SIMD .....

.....

.....

.....

MISD .....

.....

.....

..... [4]

- 11** A **declarative** programming language is used to represent some facts about people and their hobbies.

```

01 hobby(music) .
02 hobby(caving) .
03 hobby(climbing) .
04 hobby(camping) .
05 hobby(baking) .
06 hobby(travelling) .
07 person(toby) .
08 person(natasha) .
09 person(fatima) .
10 person(joseph) .
11 person(elijah) .
12 person(nina) .
13 enjoys(natasha, travelling) .
14 enjoys(toby, climbing) .
15 enjoys(nina, climbing) .
16 enjoys(elijah, camping) .
17 enjoys(fatima, baking) .
18 enjoys(joseph, camping) .
19 dislikes(toby, caving) .

```

These clauses have the meanings:

| Clause | Meaning                   |
|--------|---------------------------|
| 01     | Music is a hobby          |
| 07     | Toby is a person          |
| 13     | Natasha enjoys travelling |
| 19     | Toby dislikes caving      |

- (a)** Carlos is a person who enjoys the hobby of cycling but does not like music.

Write additional clauses to represent this information.

```

20 .....
21 .....
22 .....
23 .....

```

[4]

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

```
enjoys(P, camping)
```

returns

```
P = elijah, joseph
```

Write the result returned by the goal:

```
enjoys(P, climbing)
```

`P = .....` [1]

(c) N is a person who might enjoy H if H is a hobby and N does not dislike H.

Write this as a rule.

```
might_enjoy(N, H)
```

IF .....  
 .....  
 .....  
 ..... [4]

12 (a) Describe, with an example, what is meant by an **exception**.

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

- (b) A pseudocode algorithm searches for a customer record in a random file `AccountRecord.dat`. A user inputs the name of the customer.

The records are stored using the user-defined data type `TAccount`.

```
TYPE TAccount
    DECLARE AccountNumber : INTEGER
    DECLARE Name : STRING
    DECLARE Address : STRING
    DECLARE Telephone : STRING
ENDTYPE
```

If the record is found, it is output, otherwise an error message is displayed.

Complete the file handling pseudocode.

```
DECLARE Customer : TAccount
DECLARE Location : INTEGER
DECLARE MaxSize : INTEGER
DECLARE FoundFlag : BOOLEAN
DECLARE SearchCustomer : STRING
MaxSize ← 1000

OPENFILE .....
Location ← 1

..... ← FALSE
OUTPUT "Enter the customer's name"

.....

..... AND Location <= MaxSize

..... "AccountRecord.dat", .....
GETRECORD "AccountRecord.dat", Customer
IF SearchCustomer = Customer.Name THEN
    OUTPUT "Customer found: "
    OUTPUT Customer           // output customer record
    FoundFlag ← TRUE
ENDIF
Location ← Location + 1
ENDWHILE
IF NOT FoundFlag THEN

    OUTPUT "....."
ENDIF
```







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