Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5566946399 4

COMPUTER SCIENCE **9618/32**

Paper 3 Advanced Theory **October/November 2023**

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

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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.

.....

.....

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..... [3]

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

Composite .....

.....

.....

.....

Non-composite .....

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.....

.....

[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.

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.....

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..... [2]

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

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..... [3]

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

Some words are **not** used.

BitTorrent	**circuit switching**	**layered**	**link**	**list**
peer-to-peer	**queue**	**stack**	**star**	**TCP/IP**

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.

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..... [2]

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

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.....

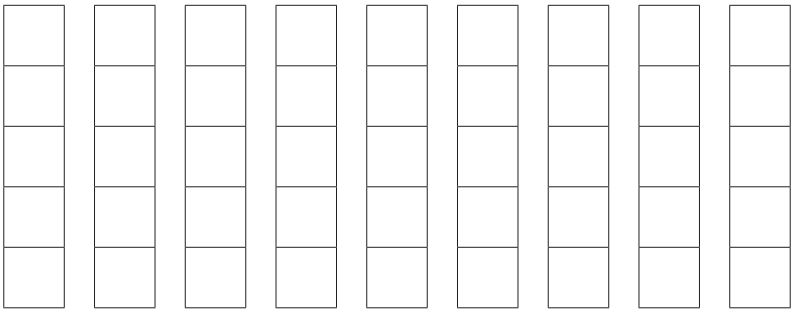
..... [3]

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.

.....

.....

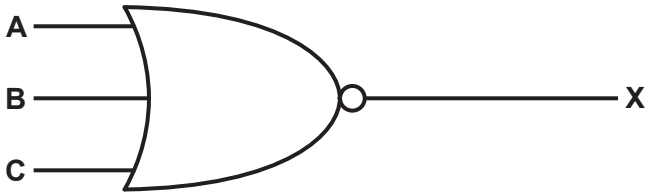
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..... [3]

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



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: $\mathbf{X = \overline{A + B + C}}$

X = ... [1]

(c) Simplify the following expression using Boolean algebra.

Show all the stages in your simplification.

$\mathbf{T = X.Y.Z + X.\overline{Y}.Z + \overline{X}}$

.....

.....

.....

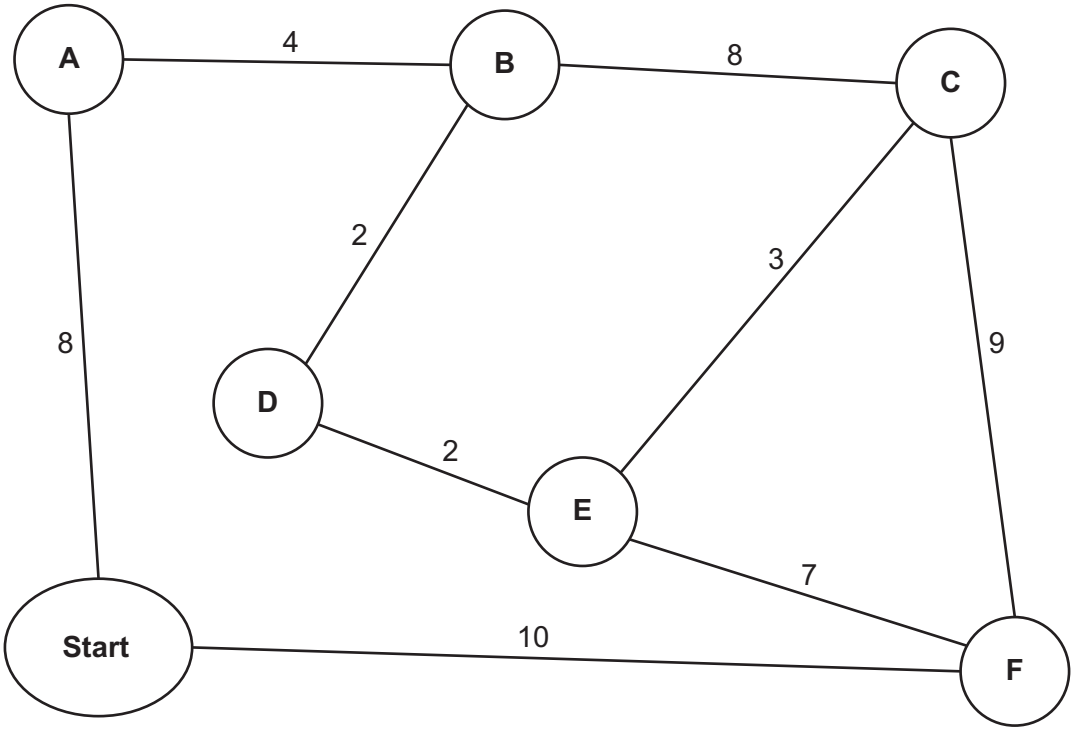
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..... [3]

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.

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..... [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
```

[7]

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