



Cambridge International AS & A Level

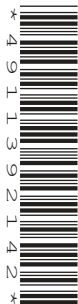
CANDIDATE
NAME

CENTRE
NUMBER

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COMPUTER SCIENCE

9618/31

Paper 3 Advanced Theory

October/November 2022

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 Real numbers are stored in a computer system using floating-point representation with:

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

(a) Write the normalised floating-point representation of +202 in this system.

Show your working.

Mantissa

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

Exponent

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

Working

.....

.....

.....

.....

.....

[3]

(b) Write the normalised floating-point representation of -202 in this system.

Show your working.

Mantissa

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

Exponent

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

Working

.....

.....

.....

.....

.....

[3]

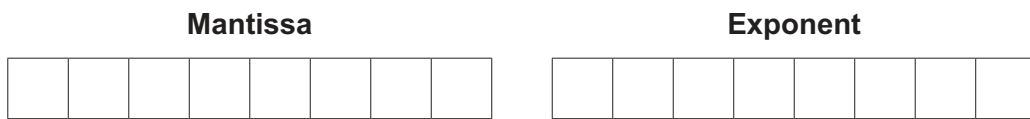
(c) A binary number is stored in the computer system.



(i) State why the number is **not** normalised.

.....
..... [1]

(ii) Write the normalised floating-point representation of the number.



[2]

2 Outline the functions of the Transport and Internet layers of the TCP/IP protocol suite.

Transport layer

.....

.....

.....

Internet layer

.....

.....

.....

[5]

- 3 (a) State what is meant by the term **enumerated data type**.

.....
 [1]

- (b) State what is meant by the term **pointer data type**.

.....
 [1]

- (c) The months of the year are: January, February, March, April, May, June, July, August, September, October, November and December.

Write the **pseudocode** statement to define the data type `Quarter1`, to hold the names of the first three months of a year.

.....

 [2]

- (d) The composite data type `Pet` is used to store data about the various pets of a group of students. It uses these fields:

Field name	Data type
<code>PetName</code>	String
<code>AnimalType</code>	String
<code>PetAge</code>	Integer
<code>PetGender</code>	Char
<code>OwnerName</code>	String

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

.....
 [1]

- (ii) Write **pseudocode** to store the details of the following pet, in the variable you set up in part (d)(i).

PetName	AnimalType	PetAge	PetGender	OwnerName
Tibbles	Cat	8	M	Jasmine Smith

.....

.....

.....

.....

.....

.....

..... [3]

- 4 Draw **one** line to connect each stage of compilation to its **most appropriate** description.

Stage of compilation

Description

Lexical analysis

Syntax analysis

Code generation

Optimisation

minimising a program's execution time and memory requirement

converting an intermediate representation of source code into an executable form

converting a sequence of characters into a sequence of tokens

directly executing instructions written in a scripting language

using parsing algorithms to interpret the meaning of a sequence of tokens

[4]

5 (a) Write the infix expression in Reverse Polish Notation (RPN).

$$a * b + b - d + 15$$

.....
..... [1]

(b) (i) Write the RPN expression in infix form.

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

.....
..... [1]

(ii) Evaluate your infix expression from **part (b)(i)** when $a = 5$, $b = 10$, $c = 27$ and $d = 12$.

.....
..... [1]

6 A message is encrypted using a private key and sent to an individual using asymmetric encryption.

(a) State what is meant by a **private key**.

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

(b) Describe the process of asymmetric encryption.

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

8 Virtual memory, paging and segmentation are used in memory management.

(a) Explain what is meant by **virtual memory**.

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

(b) State **one** difference between paging and segmentation in the way memory is divided.

.....
..... [1]

9 Deep learning is used in Artificial Intelligence (AI).

(a) Describe what is meant by **deep learning**.

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

(b) Outline the reasons for using deep learning.

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

10 Reduced Instruction Set Computers (RISC) and Complex Instruction Set Computers (CISC) are two types of processor.

(a) Tick (✓) **one** box in each row to show if the statement applies to RISC or CISC processors.

Statement	RISC	CISC
uses a smaller instruction set		
uses single-cycle instructions and limited addressing modes		
uses fewer general-purpose registers		
uses both hardwired and micro-coded control unit		
uses a system where cache is split between data and instructions		

[2]

(b) Describe the process of pipelining during the fetch-execute cycle in RISC processors.

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.....

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.....

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.....

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..... [4]

11 (a) Define these Object-Oriented Programming (OOP) terms:

Instance

.....

Inheritance

.....

Polymorphism

.....

[3]

(b) In OOP, a class contains attributes and methods.

Complete the pseudocode for the class `Car` to enable objects to be created. The class needs to include:

- string attributes to store the make, model, body type and fuel type
- an integer attribute to store the number of cars of that type built.

The attributes must be available only through the methods of the class.

```

CLASS .....

    PRIVATE Make : STRING

    PRIVATE .....

    .....

    .....

    PUBLIC PROCEDURE New(CarMake : STRING, .....,
                        ..... )

        Make ← .....

        Model ← .....

        BodyType ← CarBodyType

        Fuel ← ""

        NumberBuilt ← 0

    ENDPROCEDURE

    GetFuel()

    GetNumberBuilt()

    .....
    
```

[5]

12 (a) The array Names [0:99] is in alphabetical order.

Complete this pseudocode binary search algorithm.

Lower ← 0

```

.....
Mid ← 0
Exit ← FALSE
OUTPUT "Enter the name to be found "
INPUT Target
REPEAT
..... THEN
    OUTPUT Target, " does not exist"
    Exit ← TRUE
ENDIF
Mid ← Lower + (Upper - Lower + 1) DIV 2
IF Names[Mid] < Target THEN
    Lower ← .....
ENDIF
IF Names[Mid] > Target THEN
.....
ENDIF
..... THEN
    OUTPUT Target, " was found at location ", Mid
    Exit ← TRUE
ENDIF
.....

```

[6]

(b) Big O notation is used to classify efficiency of algorithms.

The Big O notation for time complexity in a binary search is O(log n).

(i) State the Big O notation for time complexity of a linear search.

..... [1]

(ii) Describe the meaning of O(log n) as it applies to a binary search algorithm.

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

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