



Cambridge International AS & A Level

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

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.

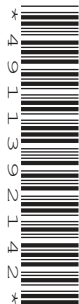
INSTRUCTIONS

- 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.



2

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]

3

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

Mantissa								Exponent							
0	0	0	1	1	1	1	0	0	0	0	1	1	0	0	0

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

.....
 [1]

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

Mantissa								Exponent							

[2]

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

Transport layer

.....

.....

.....

Internet layer

.....

.....

.....

[5]

4

- 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]

5

- (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]

6

- 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]

7

- (c) Explain how a digital signature is used to verify a message when it is received.

.....

.....

.....

.....

.....

.....

.....

..... [4]

- 7 (a) Complete the Karnaugh map (K-map) for the Boolean expression.

$$Z = \bar{A}.B.\bar{C}.\bar{D} + \bar{A}.B.\bar{C}.D + A.B.\bar{C}.\bar{D} + A.B.\bar{C}.D + A.\bar{B}.\bar{C}.\bar{D} + A.\bar{B}.\bar{C}.D$$

		AB			
		00	01	11	10
CD	00				
	01				
	11				
	10				

[2]

- (b) Draw loop(s) around appropriate group(s) in the K-map to produce an optimal sum-of-products. [2]
- (c) Write the Boolean expression from your answer to **part (b)** as a simplified sum-of-products. Use Boolean algebra to give your answer in its simplest form.

Simplified sum-of-products

Z =

Simplest form

Z =

[3]

8

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.

.....

.....

.....

.....

.....

.....

.....

..... [4]

10

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]

11

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]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.