



# Cambridge International AS & A Level

CANDIDATE  
NAME

CENTRE  
NUMBER

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**COMPUTER SCIENCE**

**9618/33**

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																
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Working .....

.....

.....

.....

.....

.....

[3]

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

Mantissa	Exponent																
<table border="1" style="width: 100%; height: 20px; border-collapse: collapse;"> <tr> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> </tr> </table>									<table border="1" style="width: 100%; height: 20px; border-collapse: collapse;"> <tr> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> <td style="width: 12.5%;"></td> </tr> </table>								

Working .....

.....

.....

.....

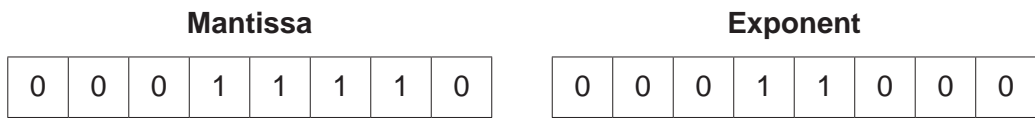
.....

.....

[3]



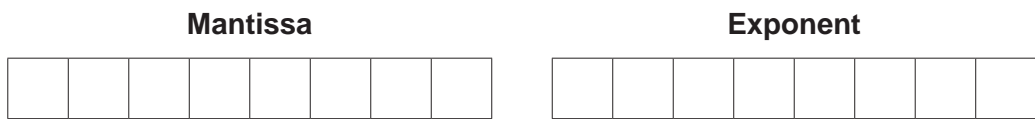
(c) A binary number is stored in the computer system.



(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

- 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]



(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.

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

		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 = .....



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]



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.

.....  
 .....  
 .....  
 .....



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