Cambridge Assessment International Education

# Cambridge International AS & A Level

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CANDIDATE NAME | | | | | | | | | |
| CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | | |

*7666363074*

**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 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |

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.

| Mantissa | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |

| Exponent | | | | | | | |
|---|---|---|---|---|---|---|---|
| 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]

**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 |
|---|---|
| `PetName` | String |
| `AnimalType` | String |
| `PetAge` | Integer |
| `PetGender` | Char |
| `OwnerName` | 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 | converting a sequence of characters into a sequence of tokens |
| Syntax analysis | using parsing algorithms to interpret the meaning of a sequence of tokens |
| Code generation | converting an intermediate representation of source code into an executable form |
| Optimisation | minimising a program's execution time and memory requirement |
| | directly executing instructions written in a scripting language |

[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]

**(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.

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

| CD \ AB | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 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** 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.

.....

.....

.....

..... [2]

**BLANK PAGE**