Cambridge Assessment International Education

# Cambridge International AS & A Level

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*4602197819*

**COMPUTER SCIENCE** **9618/31**

Paper 3 Advanced Theory **May/June 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 **16** pages. Any blank pages are indicated.


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**1** Data types can be defined using pseudocode.

The data type, `LibraryRecord`, is defined in pseudocode as:

```
TYPE LibraryRecord
   DECLARE Title : STRING
   DECLARE Fiction : BOOLEAN
   DECLARE Author : STRING
   DECLARE NumberOfCopies : INTEGER
ENDTYPE
```

A variable, `LibraryBook`, is declared in pseudocode as:

```
DECLARE LibraryBook : LibraryRecord
```

**(a)** Write **pseudocode** statements to assign:

- `A Level Computer Science` to `Title` of `LibraryBook`
- `FALSE` to `Fiction` of `LibraryBook`.

.....

.....

.....

..... [2]

**(b)** The type definition for `LibraryRecord` is changed.

**(i)** The value for `NumberOfCopies` must be between `1` and `10` inclusive.

Write the updated line of **pseudocode** from the type definition of `LibraryRecord` to implement the change.

.....

..... [1]

**(ii)** Every copy of every book is now uniquely identified by an accession number, `AccessionNumber`, as it is added to the library. Each library record will include one or more accession numbers. Each accession number is an integer.

Write the extra line of **pseudocode** needed in the type definition of `LibraryRecord`.

.....

.....

.....

..... [2]

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**(c)** A record is a user-defined composite data type.

Explain what is meant by a **user-defined composite data type**.
Include an example of **another** user-defined composite data type in your answer.

.....

.....

.....

.....

.....

.....

[3]

**2** A declarative language is used to represent the following facts about cats.

```
01  type(leopard, wild).
02  type(lion, wild).
03  type(cheetah, wild).
04  type(savannah, hybrid).
05  type(persian, domestic).
06
07  hair(leopard, medium).
08  hair(lion, short).
09  hair(cheetah, medium).
10  hair(savannah, medium).
11  hair(persian, long).
12
13  spots(leopard, yes).
14  spots(lion, no).
15  spots(cheetah, yes).
16  spots(savannah, yes).
17  spots(persian, no).
```

These clauses have the following meaning:

| Clause | Meaning |
|---|---|
| 01 | A leopard is a type of wild cat. |
| 08 | A lion has short hair. |
| 16 | A savannah has spots. |

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**(a)** More facts are to be included. A **caracal** is a wild cat with short hair.

Write the additional clauses to record these facts.

```
18 .....
19 .....
```
[2]

**(b)** Using the variable `Cat`, the goal:

```
hair(Cat, medium)
```

returns

```
Cat = leopard, cheetah, savannah
```

Write the result returned by the goal:

```
hair(Cat, long)
```

`Cat =` ..... [1]

**(c)** **(i)** Write the goal, using the variable `Pet`, to find all the domestic cats.

.....

..... [1]

**(ii)** Write the goal, using the variable `WildSpotty`, to find all the wild cats with spots.

.....

.....

.....

..... [2]

**3** Data can be sent over networks using either circuit switching or packet switching.

Describe both methods of data transmission. Include a different advantage and disadvantage for each method.

Circuit switching .....

.....

.....

.....

.....

Advantage .....

.....

Disadvantage .....

.....

Packet switching .....

.....

.....

.....

.....

Advantage .....

.....

Disadvantage .....

.....

[8]

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

**(a)** Describe what is meant by **RISC** and **CISC processors**.

RISC .....

.....

.....

.....

CISC .....

.....

.....

.....

[4]

**(b)** Identify **two** differences between RISC and CISC processors.

1 .....

.....

.....

2 .....

.....

.....

[2]

**5** Part of a program's calculations uses the integer variables `j`, `k`, `m`, `n` and `p`.

```
j = 3
k = 2
m = 10
n = (j + k)/(j - k)
p = m * (m - j * k)
```

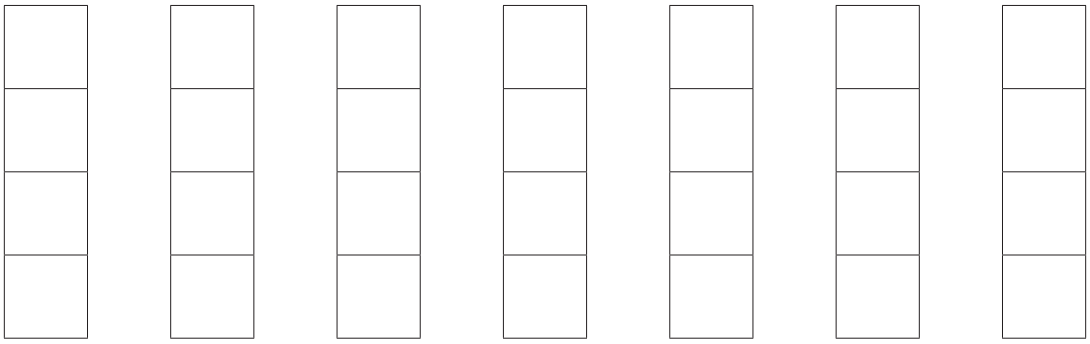
**(a)** Write the Reverse Polish Notation (RPN) for the expression:

```
(j + k)/(j - k)
```

..... [2]

**(b)** **(i)** Show the changing contents of the stack as the value for `p` is calculated from its RPN expression:

```
m m j k * - *
```



[4]

**(ii)** Describe the main steps in the evaluation of this RPN expression using a stack.

.....

.....

.....

.....

.....

.....

.....

..... [4]

**(c)** State **two other** uses of a stack.

1 .....

.....

2 .....

.....

[2]

**6** A virtual machine is used to emulate a new computer system.

Describe **two** benefits and **one** limitation of using a virtual machine for this purpose.

Benefit 1 .....

.....

.....

.....

.....

Benefit 2 .....

.....

.....

.....

.....

Limitation .....

.....

.....

.....

.....

[6]

**7** A program is to be written using Object-Oriented Programming (OOP) for a shop that sells knitting yarn. There are three types of yarn: acrylic, wool or mix.

The following data are stored for each type.

- Name
- Colour
- Batch code
- Weight
- Number of balls of yarn in stock (can be edited)
- Type of yarn

The following statements apply to yarn.

- Acrylic can be soft or not soft.
- Wool can be lamb, merino or alpaca.
- Mix contains a percentage of acrylic.

Each type of yarn has a method that will display all the information about the yarn.

**(a)** Complete this class inheritance diagram to show the **properties**, **methods** and **inheritance**.

| **Yarn** |
|---|
| `Name: STRING`<br>`Colour: STRING`<br>`BatchCode: STRING`<br>`Weight: INTEGER`<br>`NumberBalls: INTEGER`<br>`Type: STRING` |
| `Constructor()`<br>`EditNumberBalls()`<br>`YarnInfo()` |

| **Acrylic** |
|---|
| ..... |
| `Constructor()`<br>..... |

| **Wool** |
|---|
| ..... |
| `Constructor()`<br>..... |

| **Mix** |
|---|
| `Percentage: INTEGER` |
| `Constructor()`<br>`YarnInfo()` |

[5]

**(b)** Describe what is meant by the terms **properties**, **methods** and **inheritance**.

Properties .....

.....

.....

.....

Methods .....

.....

.....

.....

Inheritance .....

.....

.....

.....

[6]

**8** A message is to be sent securely. Software uses a key to encrypt the message before it is sent.

**(a) (i)** Give **two** reasons for using key cryptography.

1 .....

.....

2 .....

.....

[2]

**(ii)** Give **two** methods of key cryptography that can be used.

1 .....

2 .....

[2]

**(b)** When there is a secure exchange of key(s), the message is sent.

The use of quantum cryptography is being considered for the secure exchange.

**(i)** State **two** possible benefits of using quantum cryptography.

1 .....

.....

.....

2 .....

.....

.....

[2]

**(ii)** State **two** possible drawbacks of using quantum cryptography.

1 .....

.....

.....

2 .....

.....

.....

[2]

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**9** The table shows assembly language instructions for a processor that has one general purpose register, the Accumulator (ACC).

| | Instruction | | Explanation |
|---|---|---|---|
| **Label** | **Opcode** | **Operand** | |
| | LDM | #n | Load the number n to ACC |
| | LDD | <address> | Load the contents of the given address to ACC |
| | LDI | <address> | The address to be used is at the given address<br>Load the contents of this second address to ACC |
| | ADD | <address> | Add the contents of the given address to the ACC |
| | STO | <address> | Store the contents of the ACC at the given address |
| <label>: | | <data> | Gives a symbolic address <label> to the memory location with the contents <data><br><label> can be used in place of <address> |
| # denotes a denary number, e.g. #123 | | | |

**(a)** The address `500` contains the value `100` and the address `100` contains the value `20`.

State the addressing mode and the contents of ACC after each instruction has been executed.

`LDM #500` Addressing mode .....

Contents of ACC .....

`LDD 500` Addressing mode .....

Contents of ACC .....

`LDI 500` Addressing mode .....

Contents of ACC .....

[3]

**(b)** Use only the given instruction set to write **assembly language** code to:

- use the constant `20` which needs to be stored
- add this constant to the value stored in the address contained in the variable `Y`
- store the result in variable `Z`.

| Label | Instruction | |
|---|---|---|
| | **Opcode** | **Operand** |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

[7]

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