



Cambridge International AS & A Level

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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.

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]

(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.

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.....

[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.

(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.

.....

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..... [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

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.....

Advantage

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Disadvantage

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Packet switching

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.....

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

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.....

.....

CISC

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.....

.....

[4]

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

1

.....

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2

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[2]

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

$$\begin{aligned}
 j &= 3 \\
 k &= 2 \\
 m &= 10 \\
 n &= (j + k) / (j - k) \\
 p &= m * (m - j * k)
 \end{aligned}$$

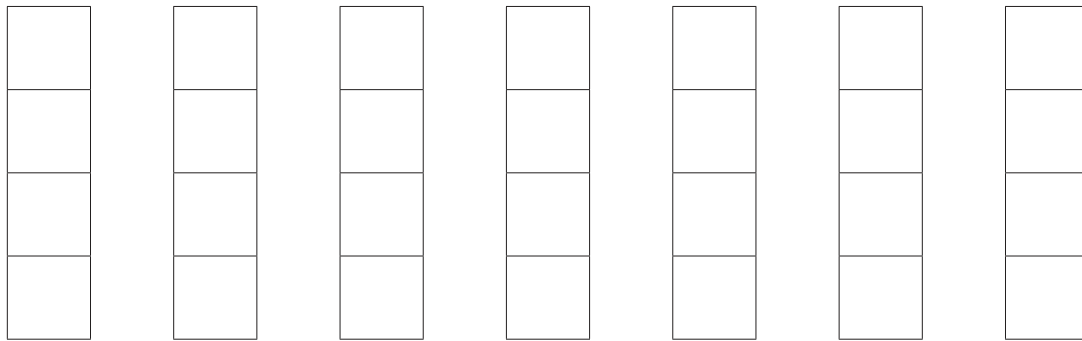
(a) Write the Reverse Polish Notation (RPN) for the expression:

$$(j + k) / (j - k)$$

..... [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

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.....

Benefit 2

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.....

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Limitation

.....

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[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.

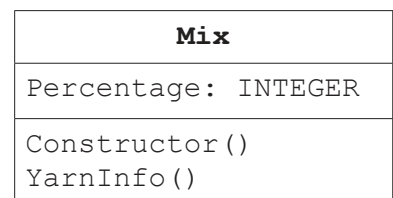
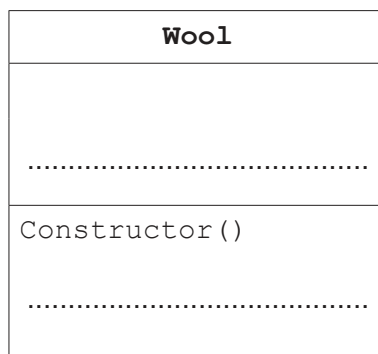
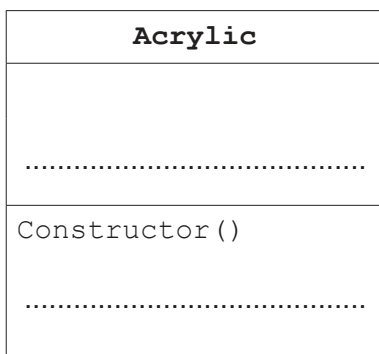
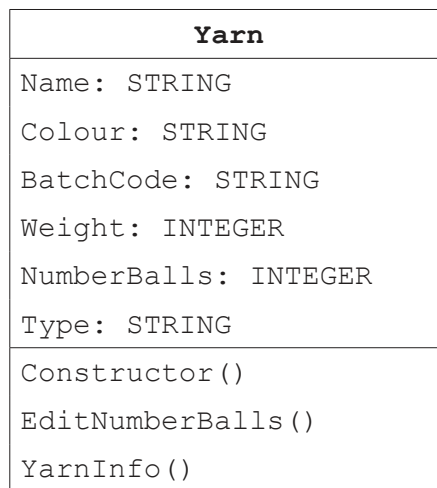
- Name
- Colour
- Batch code
- Weight
- Number of balls of yarn in stock (can be edited)
- Type of yarn

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**.



[5]

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

Properties

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Methods

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.....

.....

Inheritance

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.....

[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

.....

.....

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2

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.....

[2]

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

1

.....

.....

.....

2

.....

.....

[2]

(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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