Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5416314248

COMPUTER SCIENCE **9618/32**

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 **12** pages.

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1 Data types can be defined using pseudocode.

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

```
TYPE BuildingRecord
   DECLARE BuildingID : INTEGER
   DECLARE BuildingGroup : STRING
   DECLARE OwnerName : STRING
   DECLARE BuildingAddress : STRING
   DECLARE DateLastSold : DATE
   DECLARE PriceLastSold : REAL
ENDTYPE
```

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

```
DECLARE BuildingRegister : BuildingRecord
```

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

- `1067` to the `BuildingID` of `BuildingRegister`
- `house` to the `BuildingGroup` of `BuildingRegister`

.....

.....

.....

..... [2]

(b) The type definition for `BuildingRecord` is changed. The data type for `BuildingGroup` is changed to an enumerated type, `BuildingType`, with values of house, bungalow, apartment and farm.

(i) Write the type declaration for `BuildingType` in **pseudocode**.

.....

.....

.....

..... [2]

(ii) Write the new declaration for `BuildingGroup` in **pseudocode**.

.....

..... [1]

(iii) Write the new **pseudocode** statement to assign `house` to `BuildingGroup` of `BuildingRegister`.

.....

..... [1]

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(c) The program is to be rewritten using Object-Oriented Programming (OOP). The data type `BuildingRecord` is to be changed to a class, `BuildingClass`.

The properties for `BuildingClass` are `BuildingID`, `BuildingGroup`, `OwnerName`, `BuildingAddress`, `DateLastSold` and `PriceLastSold`.

All the properties are set to `PRIVATE`, for example:

```
PRIVATE PriceLastSold : REAL
```

(i) Write the declaration in **pseudocode** for `OwnerName` as `PRIVATE`.

.....

..... [1]

(ii) Explain why the properties have been set to `PRIVATE`.

.....

.....

.....

..... [2]

2 A declarative language is used to represent the following facts about a school.

```
01  teaches(alan, mathematics).
02  teaches(ioana, geography).
03  teaches(nina, history).
04  teaches(alan, statistics).
05
06  studies(ahmed, history).
07  studies(freya, history).
08  studies(kim, history).
09  studies(freya, geography).
10  studies(hua, mathematics).
11  studies(hua, statistics).
12  studies(hua, geography).
13
14  tutors(alan, kim).
15  tutors(alan, hua).
16  tutors(alan, freya).
17  tutors(nina, ahmed).
```

These clauses have the following meaning:

Clause	Meaning
01	Alan teaches mathematics.
06	Ahmed studies history.
14	Alan is Kim's tutor.

(a) More facts are to be included. Sam studies history and Nina is his tutor.

Write the additional clauses to record these facts.

18 .....

19 .....
[2]

(b) Using the variable `Student`, the goal:

```
studies(Student, history)
```

returns

```
Student = freya, ahmed, kim
```

Write the result returned by the goal:

```
studies(Student, geography)
```

Student = ... [1]

(c) Write the goal, using the variable `X`, to find all the students who have a tutor that teaches them. For example, Hua has Alan for a tutor and is also taught mathematics by Alan.

.....

.....

.....

..... [4]

3 The TCP/IP protocol suite has four layers. The application layer provides user services.

(a) Identify **two** protocols used by this layer. Describe the use of each protocol.

Protocol 1 .....

Description .....

.....

.....

Protocol 2 .....

Description .....

.....

.....

[4]

(b) Identify **two other** layers of the TCP/IP protocol suite. Describe the function of each layer.

Layer 1 .....

Description .....

.....

.....

Layer 2 .....

Description .....

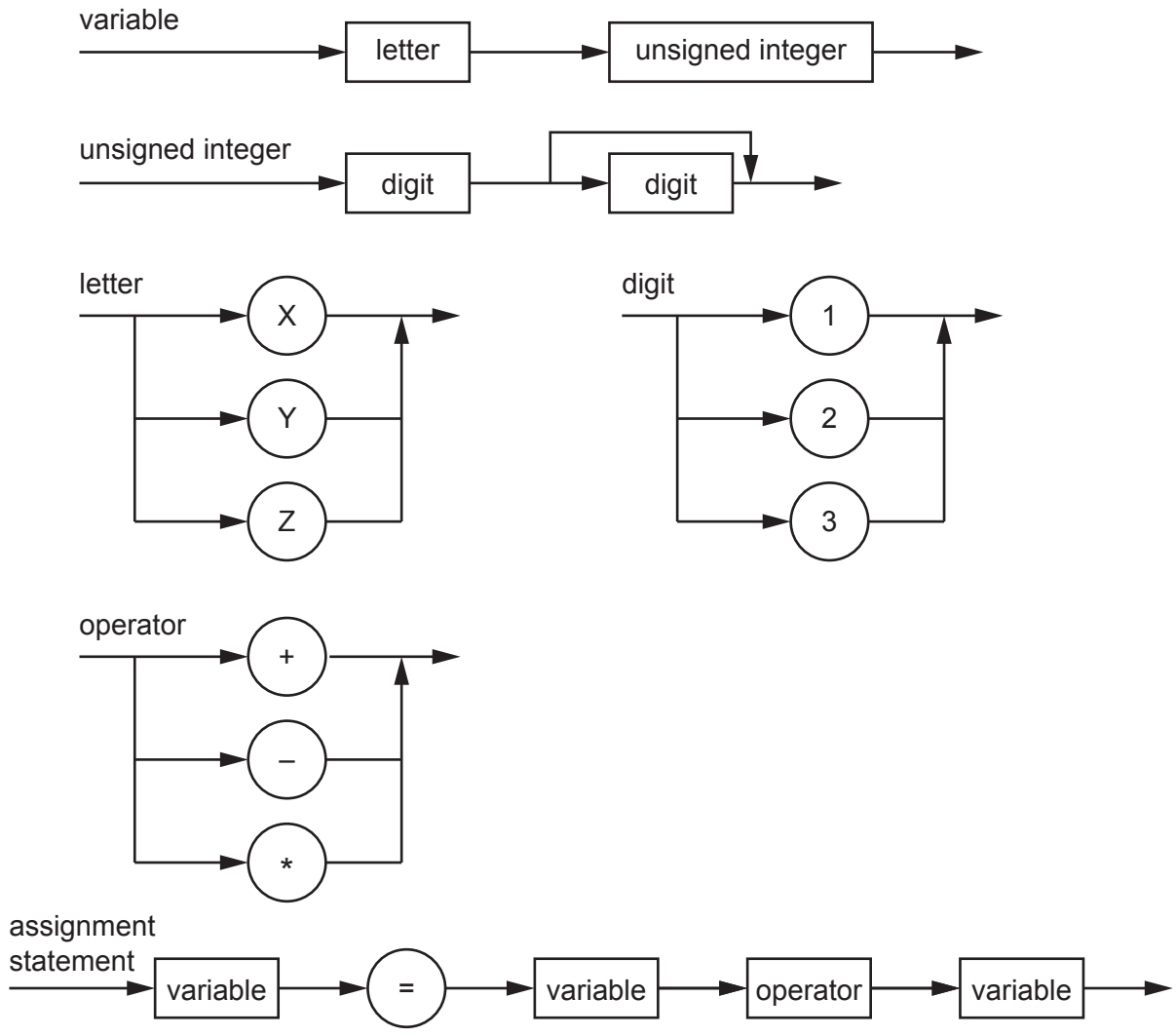
.....

.....

[4]

4 The following syntax diagrams show the syntax of:

- a variable
- an unsigned integer
- a letter
- a digit
- an operator
- an assignment statement.



(a) The following assignment statements are invalid. State the reason in each case.

```
X1 = Y2 - 12
```

Reason .....

.....

```
Z = Y12 + Z1
```

Reason .....

.....

[2]

(b) Complete the Backus-Naur Form (BNF) for the syntax diagrams shown.

<letter> has been completed for you.

<variable> ::= .....

.....

<unsigned_integer> ::= .....

.....

<letter> ::= X | Y | Z

<digit> ::= .....

.....

<operator> ::= .....

.....

<assignment_statement> ::= .....

.....

[5]

(c) The syntax of an assignment statement is changed to allow each of the variables on the right-hand side of the '=' symbol to be either a variable or an unsigned integer.

(i) Draw a syntax diagram for the new syntax of the **assignment statement**.

[3]

(ii) Write the Backus-Naur Form (BNF) for your syntax diagram.

.....

.....

.....

..... [3]

5 There are four basic categories of computer architecture. Single Instruction Single Data (SISD) is one architecture.

Identify the **three other** categories of computer architecture.

Describe each category that you identify.

Architecture 1 .....

Description .....

.....

.....

.....

Architecture 2 .....

Description .....

.....

.....

.....

Architecture 3 .....

Description .....

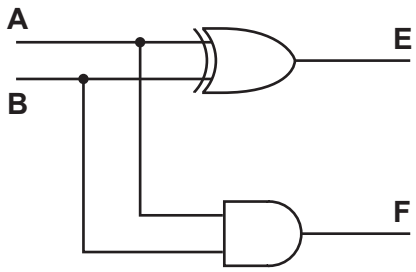
.....

.....

.....

[6]

6 A logic circuit has two inputs **A** and **B**, and two outputs **E** and **F**.



(a) Complete the truth table for this logic circuit.

INPUT		OUTPUT	
A	**B**	**E**	**F**
0	0		
0	1		
1	0		
1	1		

[2]

(b) (i) State the name of this logic circuit.

..... [1]

(ii) State the purpose of each output **E** and **F**.

Purpose of **E** .....

Purpose of **F** .....

[2]

7 A digital signature is used to validate the authenticity of an electronic message.

In order to produce a digital signature, a digital certificate is required.

(a) State how a digital certificate is obtained.

.....

.....

.....

.....

.....

..... [3]

(b) **(i)** Explain how a digital signature is produced before the message is sent.

.....

.....

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.....

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.....

.....

..... [3]

(ii) Explain how the digital signature can be checked on receipt to ensure that the message has not been altered during transmission.

.....

.....

.....

.....

.....

.....

.....

..... [4]

8 A binary search or a linear search can be used to look for a specific value in an array.

(a) Complete this pseudocode algorithm for a linear search.

```
DECLARE MyList : ARRAY[0:9] OF INTEGER
DECLARE MaxIndex : INTEGER
DECLARE Index : INTEGER
DECLARE Found : BOOLEAN
DECLARE ValueToFind : .....

INPUT ValueToFind
Found ← FALSE
Index ← 0
MaxIndex ← .....

REPEAT
   IF MyList[Index] = ValueToFind THEN
      Found ← TRUE
   ENDIF
   Index ← .....
UNTIL Found OR Index > MaxIndex

IF Found THEN
   OUTPUT "Value found at position ", Index
ELSE
   OUTPUT .....
ENDIF
```

[4]

(b) **(i)** State the necessary condition for a binary search.

.....

..... [1]

(ii) Describe how to perform a binary search.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(iii) Explain how the performance of a binary search varies according to the number of values in the array.

.....

.....

..... [1]

(c) Compare the performance of the algorithms for a binary search and a linear search using Big O notation for order of time complexity.

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.....

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.....

..... [3]

9 State the reasons for including exception handling routines when writing a program.

Include an example of an exception in your answer.

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..... [4]

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