Cambridge Assessment International Education

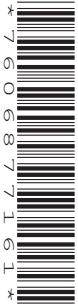# Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMPUTER SCIENCE **9618/31**

Paper 3 Advanced Theory **October/November 2024**

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 Numbers are stored in a computer using binary floating-point representation with:

- 10 bits for the mantissa
- 6 bits for the exponent
- two's complement form for both the mantissa and the exponent.

(a) Calculate the normalised binary floating-point representation of +201.125 in this system.

Show your working.

Mantissa

Exponent

Working ....

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....

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....

[3]

(b) Calculate the denary value of the given normalised binary floating-point number.

Show your working.

Mantissa

1	0	1	0	1	1	0	0	1	1

Exponent

0	0	0	1	0	1

Working ....

....

....

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....

Answer ....

[3]

2 Reduced Instruction Set Computers (RISC) is a type of processor.

Identify **four** features of a RISC processor.

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2 ....

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3 ....

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4 ....

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[4]

3 (a) Describe circuit switching as a method of data transmission.

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.... [3]

(b) State **one** benefit and **one** drawback of circuit switching as a method of data transmission.

Benefit ....

....

Drawback ....

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[2]

4 The TCP/IP protocol may be viewed as a stack that contains four layers: Application, Transport, Internet, Link.

Describe how the layers of the TCP/IP protocol stack interact with each other.

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.... [4]

5 (a) Explain what is meant by a hashing algorithm in the context of file access.

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.... [3]

(b) The use of a hashing algorithm can result in the same storage location being identified for more than one record.

Outline **two** methods of overcoming this issue.

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2 ....

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[2]

6 (a) Describe the user-defined data type **set**.

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.... [3]

(b) Write **pseudocode** statements to declare the set data type, SymbolSet, to hold the following set of mathematical operators, using the variable Operators.

+   –   *   /   ^

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.... [4]

7 The truth table for a logic circuit is shown.

INPUT				OUTPUT
A	**B**	**C**	**D**	**T**
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

(a) Write the Boolean logic expression that corresponds to the given truth table as the sum-of-products.

T = ...

.... [3]

(b) Complete the Karnaugh map (K-map) for the given truth table.

AB

CD

	00	01	11	10
00				
01				
11				
10				

[2]

(c) Draw loop(s) around appropriate group(s) in the K-map to produce an optimal sum-of-products.

[2]

(d) (i) Write the Boolean logic expression from your answer to part **(c)** as the simplified sum-of-products.

T = ...

.... [2]

(ii) Use Boolean algebra to write your answer to part **(d)(i)** in its simplest form.

T = ... [1]

8 **(a)** Describe the process of **segmentation** for memory management.

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.... [4]

(b) Explain what is meant by **disk thrashing**.

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.... [3]

9 A veterinary surgery wants to create a class for individual pets.
Some of the attributes required in the class are listed in the table.

Attribute	Data type	Description
PetID	STRING	unique ID assigned at registration
PetType	STRING	type of pet assigned at registration
OwnerTelephone	STRING	telephone number of owner assigned at registration
DateRegistered	DATE	date of registration

(a) State **one** reason why the attributes would be declared as PRIVATE.

....

.... [1]

(b) Complete the class diagram for Pet, to include:

- an attribute and data type for the name of the pet
- an attribute and data type for the name of the owner
- a method to create a Pet object and set attributes at the time of registration
- a method to assign a pet ID
- a method to assign the date of registration
- a method to return the pet name
- a method to return the owner's telephone number.

Pet	
PetID	: STRING
PetType	: STRING
OwnerTelephone	: STRING
DateRegistered	: DATE
.... :	
.... :	
....	
....	
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....	

[5]

10 Several syntax diagrams are shown.

letter → A / E / I / O / U / Y

operator → + / − / * / /

symbol → # / $ / ? / & / @

digit → 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9

label → letter → digit → digit (loop)

equation → label → = → label → operator → label
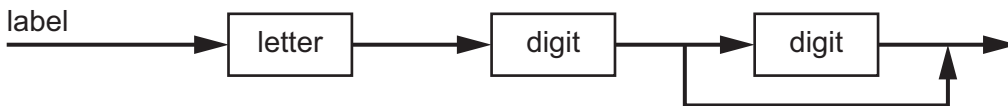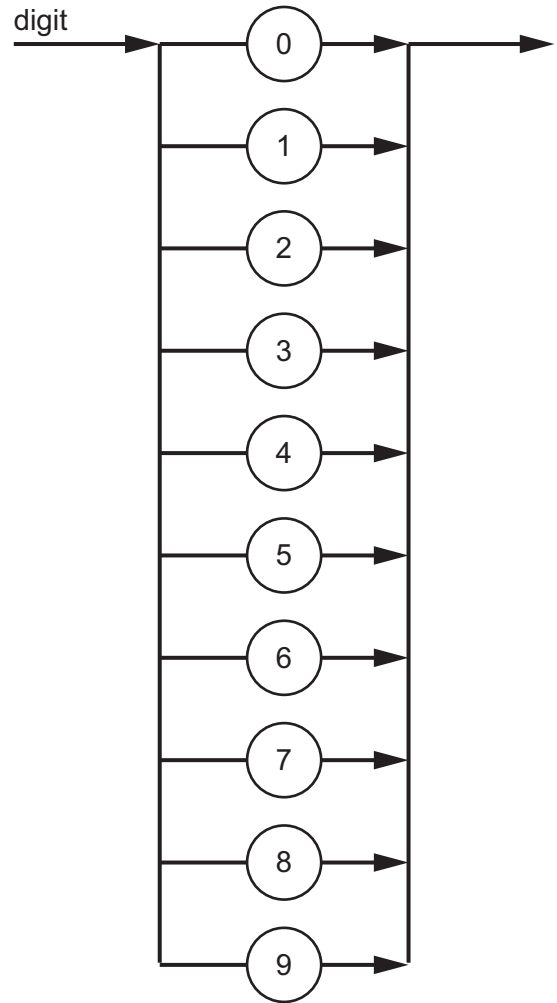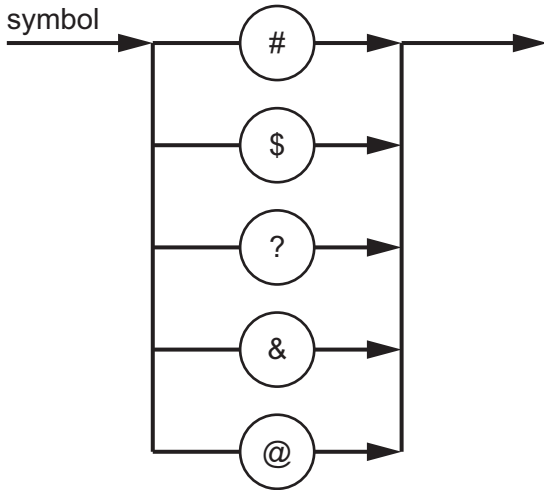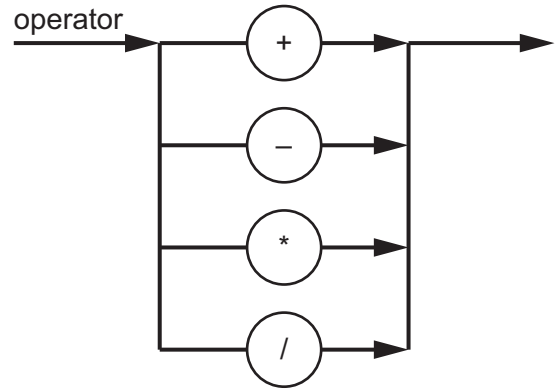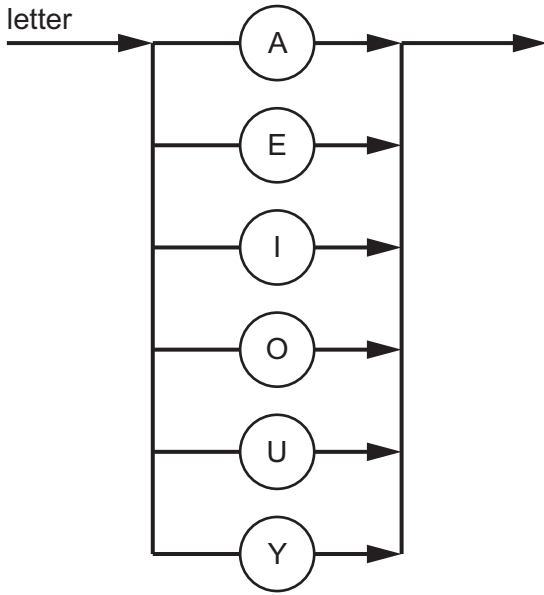
(a) Complete the Backus-Naur Form (BNF) for the given syntax diagrams.

```
<operator> ::=
```
....

....

```
<label> ::=
```
....

....

```
<equation> ::=
```
....

....
[4]

(b) A new syntax rule, **password**, is required. It must begin with a letter or a symbol, followed by a digit and end with one or two symbols.

(i) Draw a syntax diagram for **password**.

[3]

(ii) Write the BNF for **password**.

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.... [2]

11 The following diagram shows an ordered binary tree.
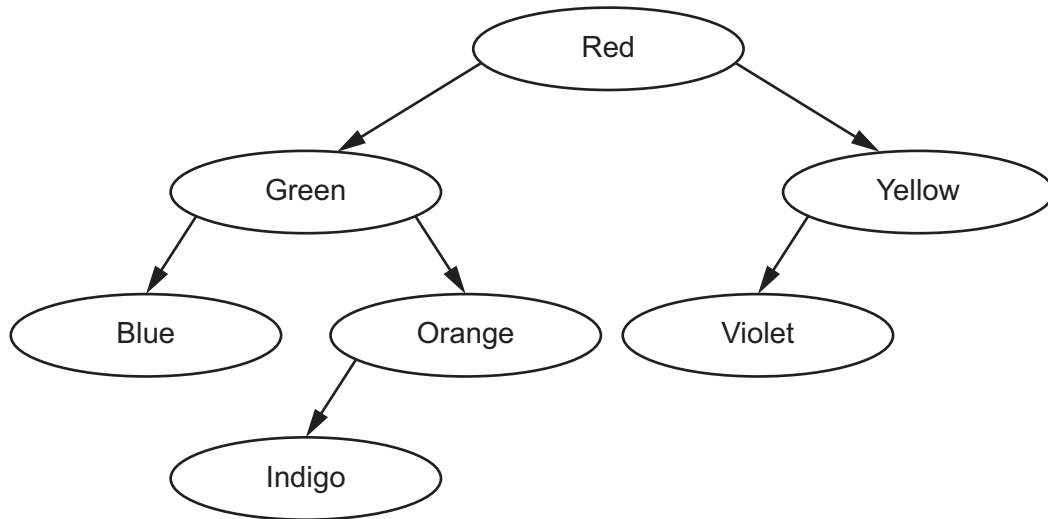
(a) A linked list of nodes is used to store the data. Each node consists of a left pointer, the data and a right pointer.

–1 is used to represent a null pointer.

Complete this linked list to represent the given binary tree.
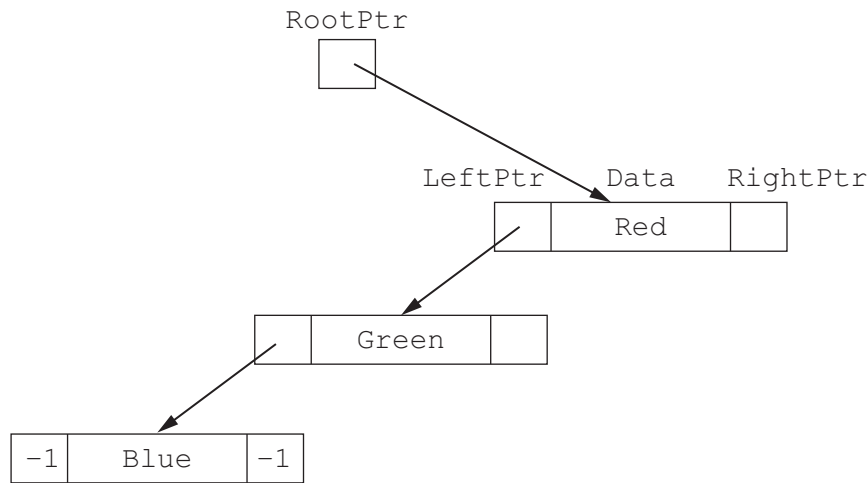
[4]

(b) A user-defined record structure is used to store the nodes of the linked list in part **(a)**.

Complete the diagram, using your answer for part **(a)**.

RootPtr

0

Index	LeftPtr	Data	RightPtr
0		Red	
1		Green	
2		Yellow	
3		Blue	
4		Orange	
5		Indigo	
6		Violet	
7			

FreePtr
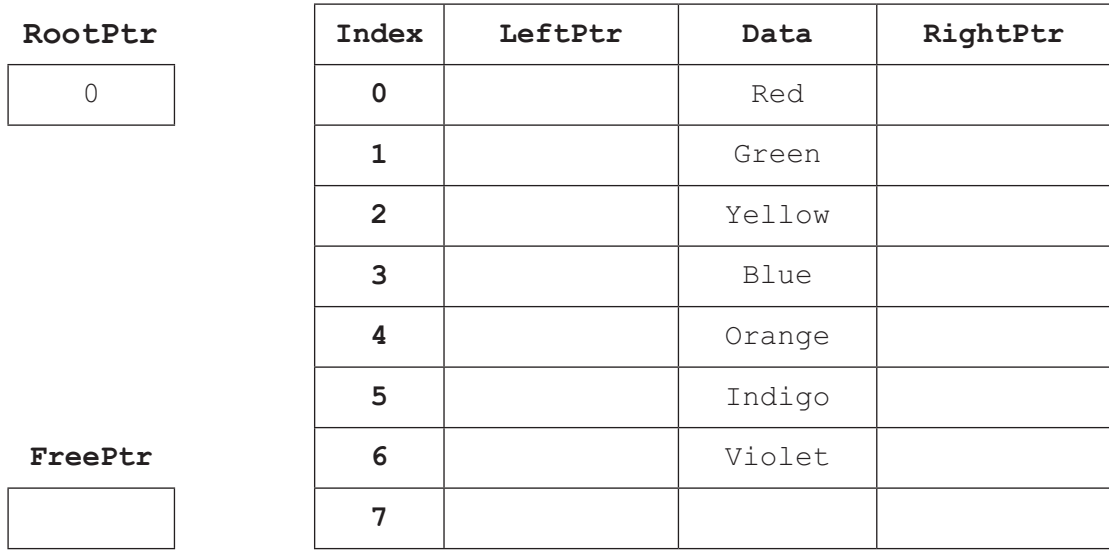
[4]

(c) The linked list in part **(a)** is implemented using a 1D array of records. Each record contains a left pointer, data and a right pointer.

The following pseudocode represents a function that searches for an element in the array of records `BinTree`. It returns the index of the record if the element is found, or it returns a null pointer if the element is **not** found.

Complete the pseudocode for the function.

```
FUNCTION SearchTree(Item : STRING) ..................................................................................

   NowPtr ← ...........................................................................................................................
   WHILE NowPtr <> -1

      IF ..................................................................................................... THEN
         NowPtr ← BinTree[NowPtr].LeftPtr
      ELSE
         IF BinTree[NowPtr].Data < Item THEN

            ...........................................................................................................................
         ELSE
            RETURN NowPtr
         ENDIF
      ENDIF
   ENDWHILE
   RETURN NowPtr
ENDFUNCTION
```

[4]

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