* 0000800000001 *

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

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* 7 6 0 8 7 7 6 1 6 1 *

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.

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[Turn over

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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.....

.....

[3]

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

Show your working.

Mantissa										Exponent					
1	0	1	0	1	1	0	0	1	1	0	0	0	1	0	1

Working .....

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Answer .....

[3]

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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]

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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]

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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]

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

CD \ AB	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]

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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]

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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

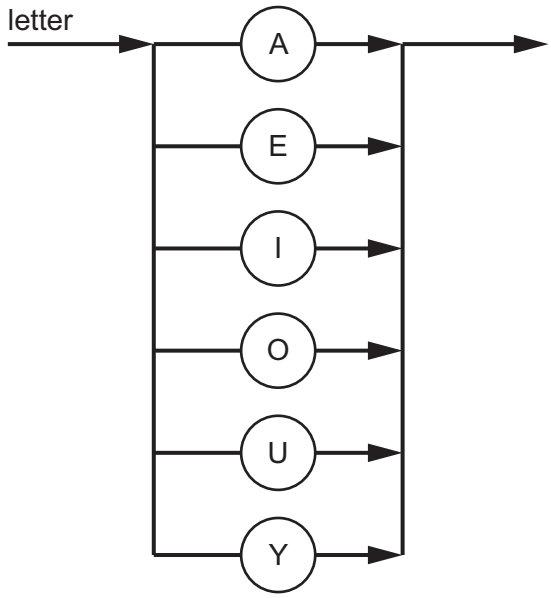
`PetID : STRING`
`PetType : STRING`
`OwnerTelephone : STRING`
`DateRegistered : DATE`
 	
..... : .....
 	
..... : .....

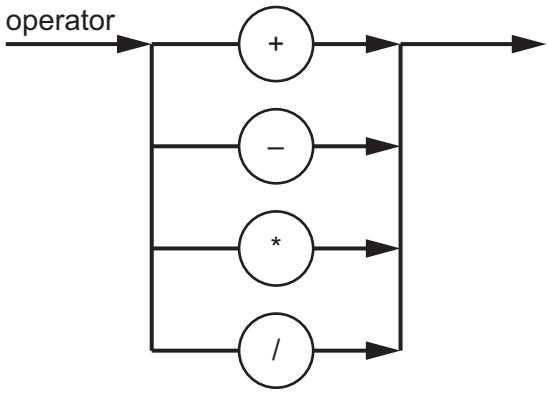
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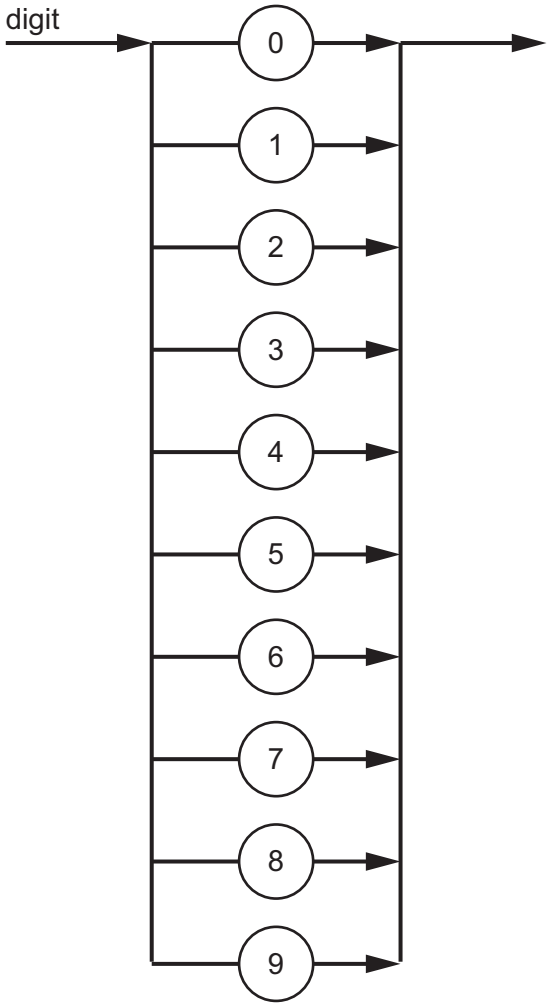
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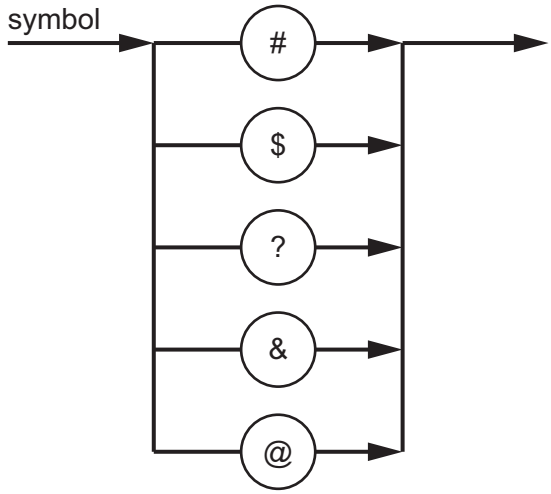
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10 Several syntax diagrams are shown.













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(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**.

.....

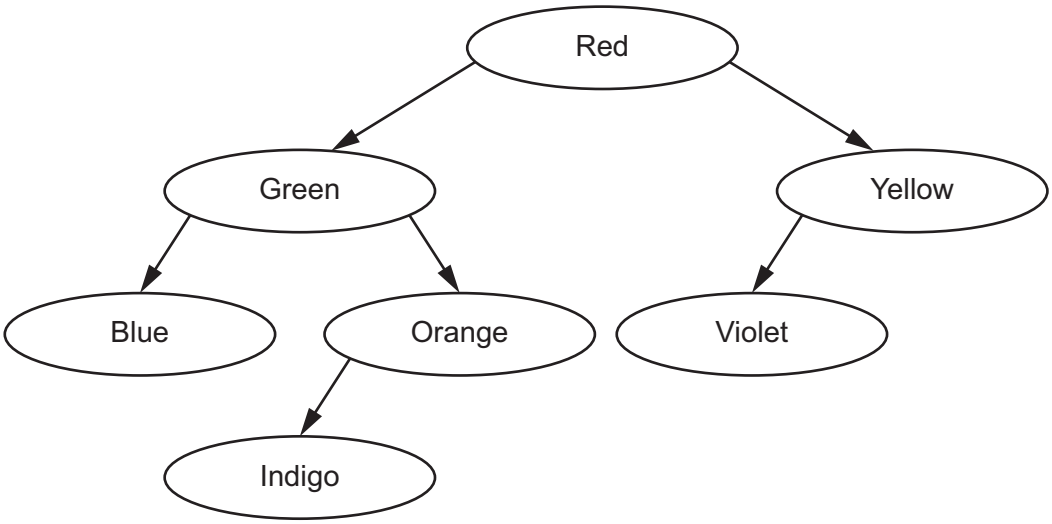
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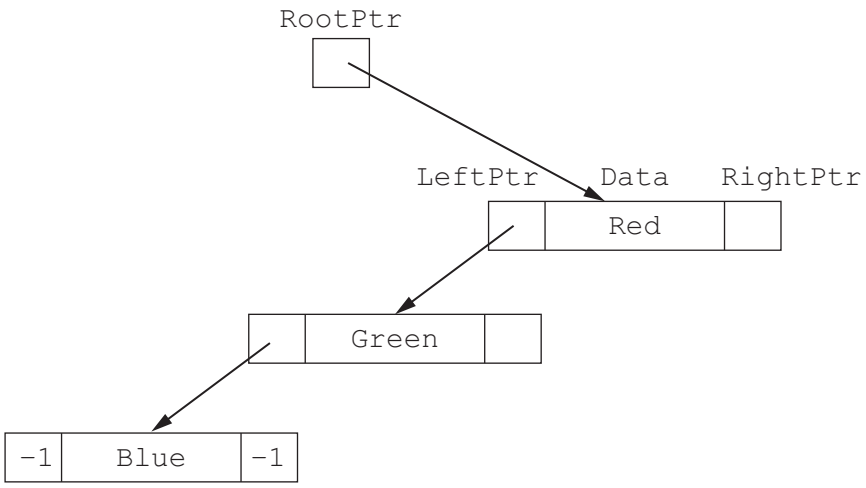
11 The following diagram shows an ordered binary tree.



(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]

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(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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