* 0000800000001 *

Cambridge Assessment International Education

# Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

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*T0865205599*

**COMPUTER SCIENCE** **9618/33**

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.

1 .....

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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 .....

.....

[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.

1 .....

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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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**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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**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:

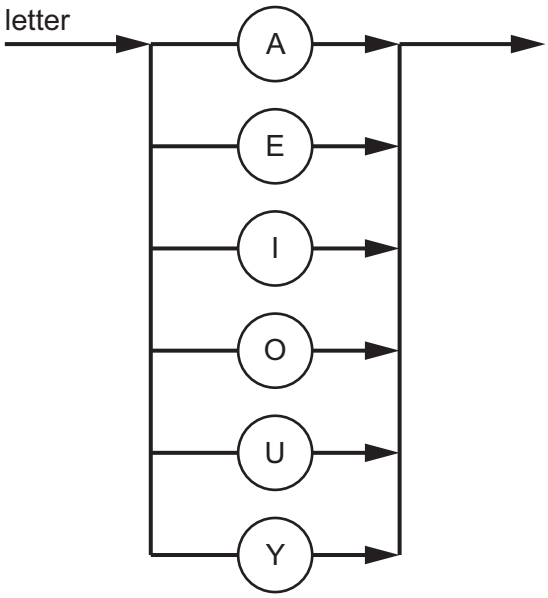
- an attribute and data type for the name of the pet
- an attribute and data type for the name of the owner
- a method to create a `Pet` object and set attributes at the time of registration
- a method to assign a pet ID
- a method to assign the date of registration
- a method to return the pet name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

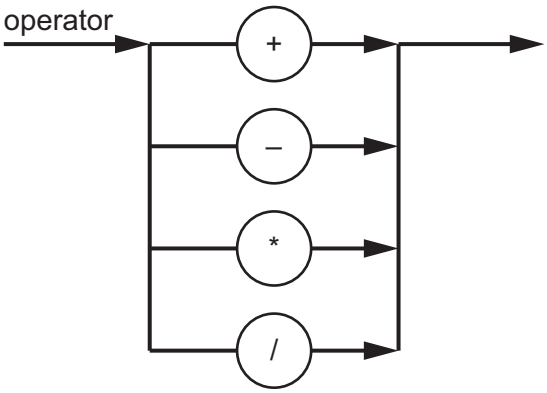
| **Pet** |
|---|
| `PetID : STRING`<br>`PetType : STRING`<br>`OwnerTelephone : STRING`<br>`DateRegistered : DATE`<br><br>..... : .....<br><br>..... : ..... |
| .....<br><br>.....<br><br>.....<br><br>.....<br><br>..... |

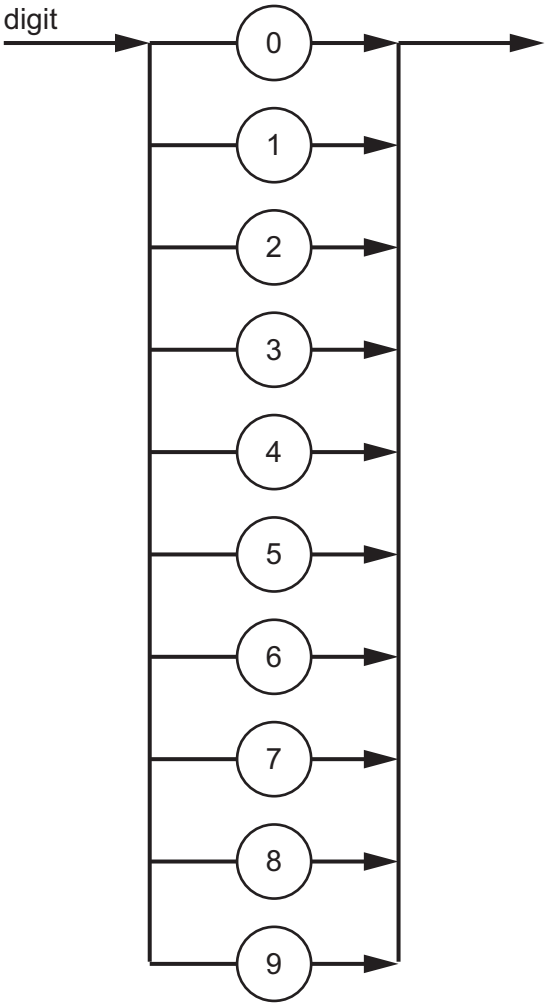
[5]

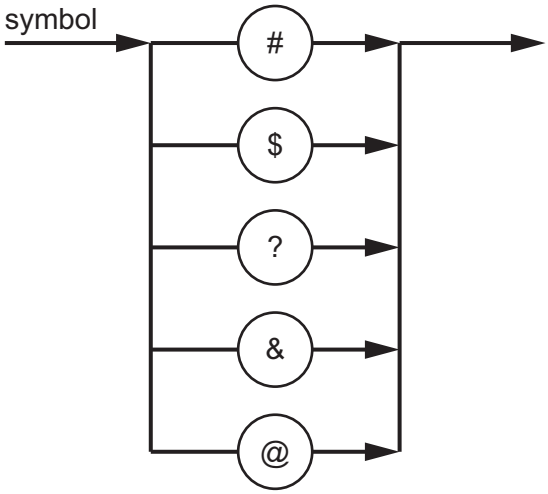
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**10** Several syntax diagrams are shown.










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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**.

.....

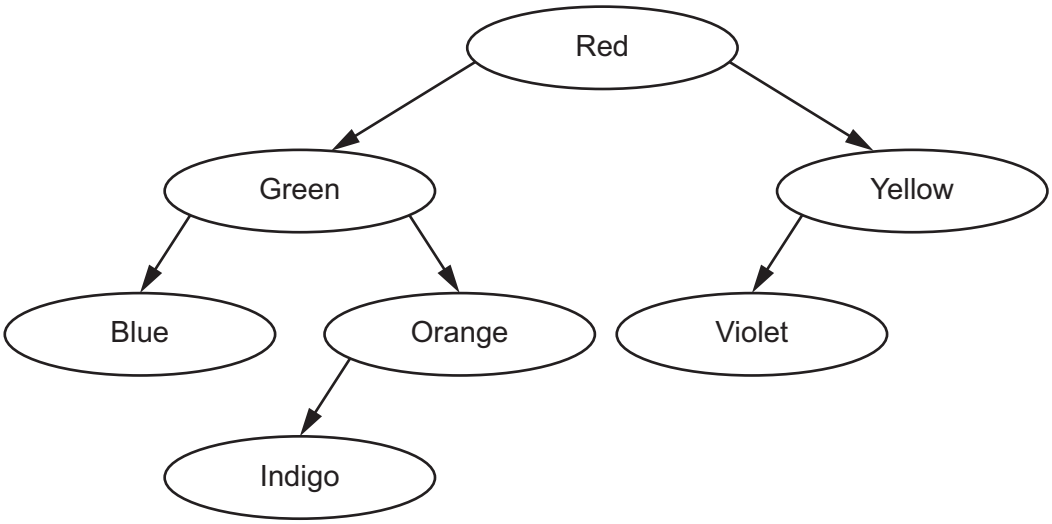
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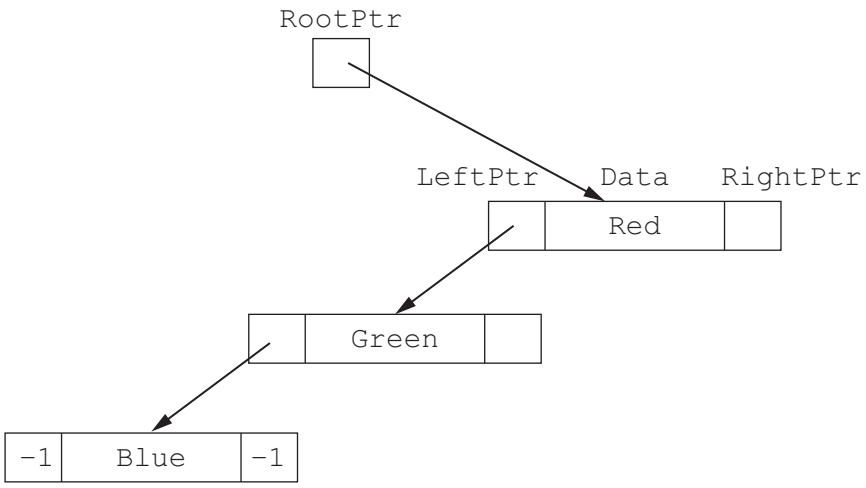
**11** The following diagram shows an ordered binary tree.




**(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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