



Cambridge International AS & A Level

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NAME

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NUMBER

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COMPUTER SCIENCE

9618/32

Paper 3 Advanced Theory

October/November 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. Any blank pages are indicated.

1 Normalised floating-point numbers are stored in a computer system using two's complement for both the mantissa and the exponent with:

- 11 bits for the mantissa
- 5 bits for the exponent.

(a) Write the largest positive two's complement binary number that can be stored in this system.

Mantissa	Exponent																	
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[1]

(b) Calculate the denary value of the given binary floating-point number. Show your working.

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

Working

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Answer [3]

(c) State when underflow occurs in a binary floating-point system.

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..... [2]

2 Lexical analysis and syntax analysis are stages in the compilation of a program.

(a) Identify **two other** stages that take place during the compilation of a program.

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2

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[2]

(b) Outline the purpose of syntax analysis.

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[2]

3 (a) Explain why a protocol is used in communication between computers.

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[2]

(b) The TCP/IP protocol implementation can be viewed as a stack.

Complete the diagram for the TCP/IP protocol stack.



[2]

(c) Describe the purpose of the IMAP protocol.

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[2]

4 A program to manage regular flight details at an airport requires some user-defined data types.

(a) Write **pseudocode** statements to declare the enumerated data type `Aircraft` to hold data about the types of aircraft used for a flight.

These types of aircraft are: C300, C350, D242, E757, X380.

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..... [2]

(b) Write **pseudocode** statements to declare the composite data type `Flight` to hold data about flights to a specific destination. These include:

- flight number, which could be any combination of letters and numbers
- destination
- date of departure
- type of aircraft used.

Use the enumerated data type you created in **part (a)**.

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..... [4]

(c) (i) Write the **pseudocode** statement to set up a variable for one record of the composite data type `Flight`.

.....
..... [1]

(ii) Write **pseudocode** to store the details of the following flight in the variable you set up in **part (c)(i)**.

Field	Data
flight number	XA782
destination	Cambridge
date of departure	12/12/2022
type of aircraft used	C350

Use the field names you created in **part (b)**.

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..... [3]

5 Describe what is meant by a **virtual machine**.
 Include in your answer **two** benefits and **two** drawbacks of using a virtual machine.

Description

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Benefit 1

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Benefit 2

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Drawback 1

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Drawback 2

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[6]

6 (a) State **two** differences between symmetric and asymmetric encryption.

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..... [2]

(b) Explain the process by which an organisation may acquire its digital certificate.

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..... [4]

7 Supervised and unsupervised learning are two categories of machine learning.

Describe supervised learning and unsupervised learning.

Supervised learning

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Unsupervised learning

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[4]

8 (a) Draw a logic circuit for an SR flip-flop **and** label the inputs.



[4]

(b) State the purpose of a flip-flop.

.....
 [1]

(c) Simplify the following expression using Boolean algebra, including De Morgan's laws. Show your working.

$$\overline{\overline{A.B} . \overline{A.C} . \overline{B.D}}$$

Working

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Answer

[3]

10 (a) Define these Object-Oriented Programming (OOP) terms:

Encapsulation

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Getter

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Setter

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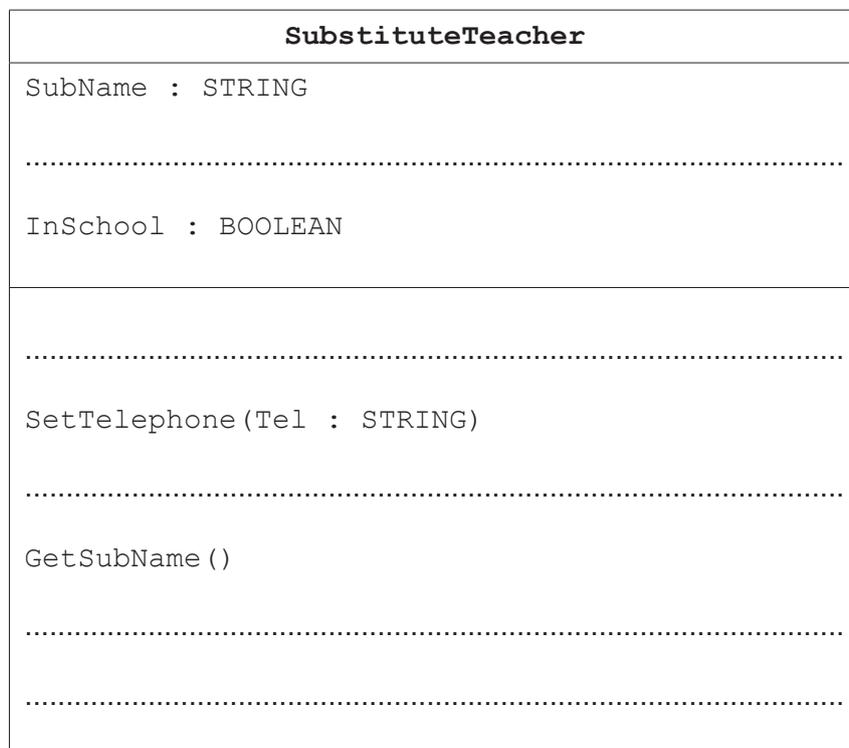
[3]

(b) A school has a program written using OOP to maintain its staff and student records.

The object `SubstituteTeacher` allows the details of the school's substitute teachers to be stored. This includes their full name, telephone number and whether or not they are in school today. For example:

SubName	Sarah Jones
Telephone	01223658721
InSchool	TRUE

Complete the diagram for the object `SubstituteTeacher`, including appropriate properties and their getters and setters.



[3]

11 A simplified linked list is used to store the names of flowers in alphabetical order. It is implemented using two 1D arrays:

- `Flower` stores the names of the flowers.
- `NextPointer` stores the pointer to the next flower name in the list.

`HeadPointer` indicates the index of the first flower name in the linked list.

HeadPointer

When the end of the linked list is reached, the next pointer has the value of 0.

The following table shows the initial content of the arrays.

Index	Flower	NextPointer
1	Rose	7
2	Marigold	1
3	Foxglove	10
4	Iris	9
5	Daisy	3
6	Dahlia	5
7	Saxifrage	0
8	Lupin	2
9	Lily	8
10	Hydrangea	4

(a) Several flower names have been deleted from the linked list. These are crossed out in the following table.

Complete the table to show the new values of `HeadPointer` and `NextPointer` to keep the remaining flower names in alphabetical order.

HeadPointer

Index	Flower	NextPointer
1	Rose	
2	Marigold	
3	Foxglove	
4	Iris	
5	Daisy	
6	Dahlia	
7	Saxifrage	
8	Lupin	
9	Lily	
10	Hydrangea	

[3]

(b) Complete the pseudocode algorithm so that it achieves the following when applied to the arrays:

- The flower name is input.
- The linked list is searched, in order, for the flower name.
- If the flower name is found, an appropriate message is output to indicate it has been found.
- If the flower name is not found, an appropriate message is output to indicate it has not been found.
- The algorithm terminates when the next pointer value is 0.

```
Pointer ← HeadPointer
Found ← 0
OUTPUT "Enter a flower name "
.....
.....
    IF Flower[Pointer] = FlowerName THEN
        Found ← Pointer
        Pointer ← 0
    ELSE
        .....
    ENDIF
ENDWHILE
.....
    OUTPUT Flower[Found], " is found"
ELSE
    .....
ENDIF
```

[5]

(c) Explain how you could improve the simplified linked list structure.

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..... [2]

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