MINISTRY OF EDUCATION, SINGAPORE
in collaboration with
CAMBRIDGE INTERNATIONAL EDUCATION
General Certificate of Education Advanced Level

COMPUTING **9569/01**

Paper 1 Written **For examination from 2027**

SPECIMEN PAPER **3 hours**

You must answer on the answer booklet.

You will need: Answer booklet

INSTRUCTIONS
- Answer **all** questions.
- An answer booklet will be provided with this question paper. You should follow the instructions on the front cover of the answer booklet. If you need additional answer paper, ask the invigilator for a continuation booklet.
- You may use an approved calculator.

INFORMATION
- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **8** pages. Any blank pages are indicated.

Singapore Examinations and Assessment Board

CAMBRIDGE
International Education

[Turn over

1 Functions can be written iteratively or recursively.

(a) The iterative function `IterSum` has two parameters `m` and `n`

```
01 FUNCTION IterSum(m: INTEGER, n: INTEGER) RETURNS INTEGER
02    total = 0
03    FOR counter = 1 to m
04       total = total + (n * counter)
05    NEXT counter
06    RETURN total
07 ENDFUNCTION
```

(i) Identify **one** feature of the code in the function `IterSum` that has been used to make it more readable. [1]

(ii) Rewrite the function body to use a `WHILE` loop instead of a `FOR` loop. [4]

(iii) The function `IterSum` uses local variables.

Give **two** advantages of using local variables in `IterSum` instead of using global variables. [2]

(b) The recursive function `RecSum` has two parameters `m` and `n`

```
01 FUNCTION RecSum(m: INTEGER, n: INTEGER) RETURNS INTEGER
02    IF m = 1
03       RETURN n
04    ELSE
05       RETURN (m * n) + RecSum(m - 1, n)
06    ENDIF
07 ENDFUNCTION
```
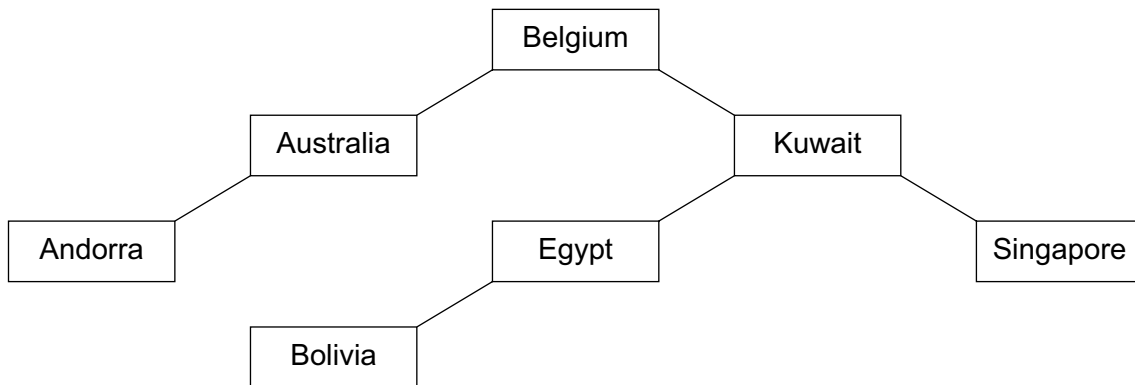
(i) Draw a recursion tree diagram for the function call `RecSum(4, 10)` to trace the execution of the function. [4]

(ii) State the significance of lines `02` and `03` in the function `RecSum` [1]

(c) Give **two** similarities between a recursive function and an iterative function. [2]

2 Trees and queues are examples of data structures.

A list of countries is stored in this binary search tree:

(a) Explain **one** advantage of storing the list of countries in a binary search tree rather than using a linked list. [2]

(b) Describe the steps that will take place when a value is inserted into a binary search tree. [5]

(c) Additional countries will be inserted into the binary search tree.

The countries to be inserted into the binary search tree are stored in a circular queue that can store a maximum of 5 items.

The current state of the circular queue is:

Index	0	1	2	3	4
Data			China	Oman	

HeadPointer → index 2
TailPointer → index 3

(i) State the purpose of the `HeadPointer` and the `TailPointer` [2]

(ii) `Enqueue()` will add an item to the tail of the queue and `Dequeue()` will remove an item from the head of the queue.

Show the contents of the queue and both pointers after executing these actions:

```
Dequeue()
Enqueue("Togo")
Enqueue("USA")
Dequeue()
```
[2]

(iii) The items that were dequeued in **2(c)(ii)** are inserted into the binary search tree.

Draw the updated binary search tree. [2]

3 A drawing program uses Object-Oriented Programming to model shapes.

Shapes are categorised as rectangles, squares or circles.

Each shape has these properties:

- `x_coordinate`
- `y_coordinate`

Each rectangle has these properties:

- `height`
- `width`

Each circle has the property `radius`.

Squares are a special case of rectangles where the height and width are the same value.

The area of a rectangle is found by multiplying its height by its width. The area of a circle is found by squaring the radius and multiplying it by pi (π).

(a) Draw a class diagram that shows appropriate:

- classes
- inheritance relationships
- attributes
- methods.

[8]

(b) The constructor method for square is defined as:

```
PUBLIC PROCEDURE NEW(length : REAL)
   SUPER.NEW(length, length)
ENDPROCEDURE
```

Explain what this method does.   [2]

(c) Explain why get and set methods are used in Object-Oriented Programming.   [2]

4 A college is designing a relational database to store data about students, courses, lockers and year group levels.

Each student has their student ID, name, gender and date of birth recorded.

Each course has a course code and name recorded.

Each locker has a locker number and combination code recorded. There are many lockers in the school.

Each year group level has a level ID and name recorded.

Each student:

- is assigned a year group level.
- has one locker
- may enrol on several different courses.

(a) The database will use several tables to store the data.

Draw an entity-relationship (ER) diagram to show the tables in third normal form (3NF) and the relationships between them. [5]

(b) A table description can be expressed as:

```
TableName (Attribute1, Attribute2, Attribute3, …)
```

The primary key is indicated by underlining one or more attributes.
Foreign keys are indicated by using a dashed underline.

Use the information given to write table descriptions for the tables you identified in **4(a)**. [7]

(c) Write an SQL statement that will output the locker number and combination for each locker that has **not** been assigned to a student. [4]

(d) Data is validated when it is entered into the database.

Give **three** different types of validation checks that can be performed on the student's name, gender and date of birth respectively. [3]

5 Data can be represented in different forms.

(a) Give **two** reasons why the hexadecimal number system is used by computer scientists. [2]

(b) Convert the hexadecimal value CAFE into decimal.

You must show your working. [2]

(c) The following list of values are to be sorted in ascending order using an insertion sort.

swift	kite	plover	avocet	swallow

Copy and complete the table to show the state of the list at the end of each pass of the insertion sort.

pass	list				
1	swift	kite	plover	avocet	swallow
2					
3					
4					
5					

[4]

(d) Give **two** factors that can affect the performance of a sorting algorithm. [2]

6 Computers can be networked.

    (a) Explain why communication protocols are needed in a network. [2]

    (b) Outline how packet switching is used to transmit messages in a packet-switching network.
[5]

    The CIA triad of data confidentiality, integrity and availability is a common model that forms the basis for the development of security systems.

    (c) State **two** ways that the availability of data may be compromised. [2]

    (d) Encryption is one method that can be used to maintain the confidentiality and integrity of data.

        (i) State what is meant by a private key. [2]

        (ii) Describe how asymmetric encryption prevents eavesdropping. [2]

        (iii) Explain how a digital signature can be used to verify the integrity of a message when it is received. [4]

7 Many internet sites and services first ask users to input their login name and password, followed by sending a text message to the user's alternative electronic device for verification purposes.

    (a) Identify the cybersecurity feature described. [1]

    (b) State and explain how the feature identified in **7(a)** may be compromised if users are not well-educated about basic cybersecurity. [2]

    (c) Identify the Act that may be applicable against those who compromise the feature described and explain the reason. [2]

    (d) It is found that entering a maliciously crafted login name and password allows an attacker to make unauthorised changes to the site's database.

    Identify the web application vulnerability that is most likely to be responsible and suggest a solution to prevent its exploitation. [2]

8 Machine Learning (ML) is a technique used in Artificial Intelligence (AI).

    (a) Define what is meant by the term Machine Learning. [2]

    (b) Outline the steps involved in ML. [6]

8

BLANK PAGE