

RIVER VALLEY HIGH SCHOOL
General Certificate of Education Advanced Level
Higher 2
J2 Prelim

COMPUTING

Paper 1

9569/01**17 Sep 2025****3 hours**

READ THESE INSTRUCTIONS FIRST

Write your center number, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
Approved calculators are allowed.

The number of marks is given in brackets [] at the end of each question or part question.
The total number of marks for this paper is **100**.

This document consists of **9** printed pages.

Answer **all** questions.

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1. In the HSG restaurant, dinners are served different types of food based on their appearance.

- Soup is served only if diner has short hair.
- All diners are served with steak. If diner wears spectacle and has short hair, gold plated steak is served.
- If dinner is female and has long hair, the chef will cut the steak for you.

Draw a reduced decision table for the above scenario.

[6]

2. The following pseudocode performs an operation on a Binary Search Tree (BST). The parameter `root` refers to the root node of the BST, and `Stack` is a dynamic data structure implemented using linked nodes.

```

01 FUNCTION foo(root):
02     stack ← Stack()
03     current ← root
04
05     WHILE current <> NULL OR NOT stack.isEmpty():
06         WHILE current <> NULL:
07             stack.push(current)
08             current ← current.left
09
10         current ← stack.pop()
11         OUTPUT current.data
12         current ← current.right
13
14 END FUNCTION

```

- a) Draw a flow chart for the pseudocode above.

[5]

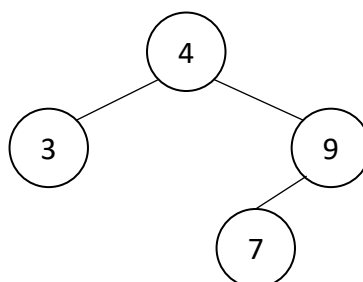
- b) State the purpose of `foo(root)`.

[1]

- c) Identify the exact line where dynamic memory allocation occurs.

[1]

A BST with root as the root of the tree is as follows.



- d) Draw a trace table to trace the `current`, `stack` and the OUTPUT when `foo(root)` is called.

[4]

- e) The following numbers are inserted in the above BST in the same order as shown below:

20, 15, 6, 25

Draw the BST after these numbers are inserted.

[2]

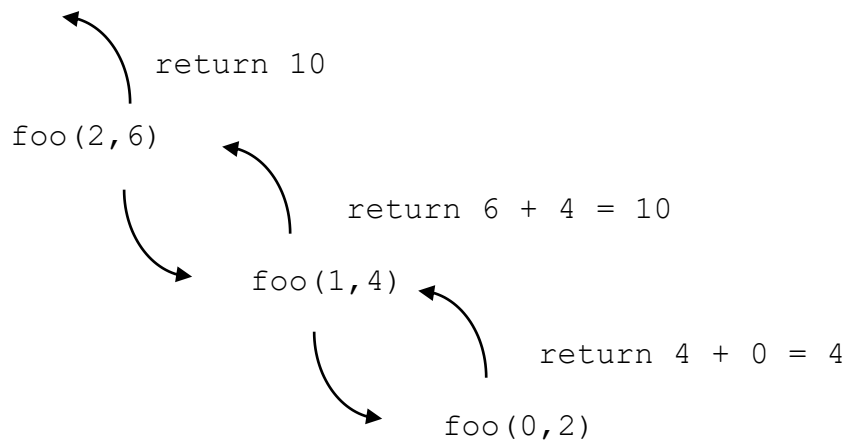
- f) State the pre-order and post-order of the BST.

[2]

3. Study the recursive function below.

```
def foo(n, m):
    if n == 0:
        return 0
    else:
        return m + foo(n-1, m-2)
```

- a) An example of a trace tree diagram showing the recursive function call `foo(2, 6)` is shown as follows:



Use the above example to create a trace tree diagram for the recursive function call `foo(4, 2)`.

[3]

- b) Write in pseudocode the iterative version of `foo(n, m)`.

[3]

4. In a real-time online car racing game, once a player completes a round, the time taken is sent to the server for ranking purposes.

- a) Explain why the finishing time records received by the server may not always arrive in strictly increasing order. [1]

The server needs to maintain these records in a data structure where search operations based on finishing time are performed very frequently.

- b) State the advantage of using a sorted array over a sorted linked list in this context. Support your answer with reference to time complexity. [2]

- c) State one disadvantage of using a sorted array over a sorted linked list in this context. [1]

In this racing game, the finishing times are generally increasing as players complete their rounds one after another.

- d) Explain why this makes a sorted array particularly efficient for insertion in this context. [2]

It was later discovered that some finishing time records are being altered during transmission, either accidentally or maliciously. The server must be able to detect such tampering and ensure that each record truly originates from the legitimate player.

- e) Suggest a method the server can use to verify the authenticity and integrity of each message. [1]

- f) Explain how this method works. [6]

5. Hash tables are often described as providing constant-time $O(1)$, search performance.

- a) State three different reasons why in practical, a hash table cannot always maintain $O(1)$ search time. [3]

- b) Explain what is meant by collision resolution. [1]

- c) For each of the following situations, state whether **open addressing** or **closed addressing** is the preferred collision resolution strategy.

- i. When the load factor may be greater than 1.
 - ii. When memory is very limited and space efficiency is important.
- [1]

6. A company provides an online registration form for customers. The form is shown below.

```

-----
|  ABC Services - New Customer Registration  |
|-----|
|  Full Name: [ _____ ] |
|  Date of Birth (DD/MM/YYYY) : [ _____ ] |
|  Email Address: [ _____ ] |
|  Confirm Email Address: [ _____ ] |
|  Contact Number: [ _____ ] |
|  |
|  [ Submit ] |
|-----|

```

- a) Define data validation and data verification in the context of data entry. [2]
- b) Suggest one validation check that could be applied to the field Date of Birth. [1]

The form asks the user to enter the email address twice ("Email Address" and "Confirm Email Address").

- c) Explain the purpose of asking the user to enter the email twice. [2]

A customer attempts to enter their Full Name using non-English characters and the system rejects it as it only supports ASCII characters.

- d) Suggest what the company should do to allow names from different languages to be accepted. [1]

Under the Personal Data Protection Act (PDPA), the company has legal obligations when collecting customer personal data through this form.

- e) State two responsibilities the company must fulfil to comply with PDPA. [2]

7. Answer all the questions.

a) You are the network engineer of a company. For each of the following scenarios:

- Identify which layer of the TCP/IP model is most directly involved.
- Suggest what you would check to troubleshoot the issue.

Scenarios:

- i. Users can connect to the Internet but cannot load the company's website in their browser.
- ii. A computer cannot even reach other machines on the same LAN, and pinging local devices fails.
- iii. The database server is running. Its IP address is reachable. However, client sessions to the database cannot be established and often time out, so applications cannot connect.
- iv. A user can connect to the local network but cannot reach external networks. [8]

b) State two differences between TCP and UDP. [2]

Company Z, a healthcare provider, has a central database storing patient records. One employee, John, receives an email with an attachment claiming to be an urgent invoice from a medical supplier. The attachment is actually malicious software that exploits outdated software on John's computer. When John opens the file, the malware quickly spreads through the network and encrypts the company's database, making patient records inaccessible.

- c) Identify the human mistake that allowed the attacker to carry out the attack. [1]
- d) Name the type of malware that encrypted the company's database. [1]
- e) State one recovery measure that Company Z should implement to reduce the impact in the future. [1]
- f) State one preventive measure that Company Z should implement to prevent such incidents in the future. [1]

8. Read the following description.

“This is a conceptual system for representing and modeling home appliances, such as washing machines and refrigerators, in an object-oriented programming (OOP) context. The system consists of several classes that work together to capture the characteristics and behaviors of these appliances.

At the heart of each appliance is the PowerUnit, represented by a class that captures its type (AC or DC), power rating, and brand.

The Appliance class serves as a foundation for all appliances. It has attributes such as power unit, colour, weight, and a Boolean flag to indicate whether the appliance is switched on or off. It also provides methods for switching on, switching off, and connecting to a smart home network.

Washing machines and refrigerators are two types of appliances that share all the characteristics of an appliance. They have additional attributes, such as drum size for washing machines and cooling capacity for refrigerators. Interestingly, they also have distinct ways of connecting to a smart home network.”

- a) By examining the attributes and methods of these classes, draw the UML class diagram. [6]
- b) Explain what polymorphism is. Circle the polymorphed functions. [2]
- c) Explain what data encapsulation is. Give an example using the example given. [2]

9. A new badminton complex was just built in Fernvale town. The management is planning to implement a new system for residents to book its courts. At present, residents must physically go down to the office in the complex to book the courts with the person in charge. Resident details are recorded in a spreadsheet on a shared laptop for their bookings with the following instructions:

- There are 4 courts for booking. The bookings for each court are recorded in each row.
- For each booking, NRIC number, name, date and time of usage are recorded; name and NRIC number will be recorded in a single cell.
- Bookings can be for multiple courts and for different dates and times at each time.
- Should the payment be made at the time of booking, status will be 'Paid' else it will be left empty. Payment will then be made on the day of use.

Below shows a part of the spreadsheet.

		Name	Date	Time	Status	Name	Date	Time	Status
Court 1	...	Tan A L (T1235831K)	23/10/25	9am - 12am	Paid	Tan A L (T1235831K)	24/10/25	10am - 12am	Paid
Court 2		C K Koh (S1234567H)	22/10/25	7pm - 8pm					
Court 3		Koh CK (S1234567H)	22/10/25	7pm - 8pm		Sim T L (T5671234I)	23/10/25	10am - 1pm	Paid
Court 4									

- a) Identify 1 possible social issue and 1 economic issue because of using the shared spreadsheet for booking management. [2]
- b) The spreadsheet is not in 1st Normal Form and thus is not suitable to use in a relational database. Identify all issues in the spreadsheet which does not make it to 1st Normal Form. [2]
- c) Is data redundancy present in the spreadsheet? Explain your answer. [2]

An attempt to normalise the spreadsheet for a relational database turn up with the following 3 tables.

Resident

resident_id	name	nric_last_4
001	Tan Ai Ling	831K
002	Koh Chee Keng	567H
003	Sim Toh Long	234I
...	...	...

Booking

booking_id	payment
2025001	Paid
2025002	Unpaid
2025003	Paid
...	...

Booking_Schedule

booking_id	resident_id	court	date	time
2025001	001	1	23/10/2025	0900
2025001	001	1	23/10/2025	1000
2025001	001	1	23/10/2025	1100
2025001	001	1	24/10/2025	0900
2025001	001	1	24/10/2025	1000
2025001	001	1	24/10/2025	1100
2025002	002	2	22/10/2025	1900
2025002	002	3	22/10/2025	1900
2025003	003	3	23/10/2025	1000
2025003	003	3	23/10/2025	1100
2025003	003	3	23/10/2025	1200
...	...	...	...	...

Resident table keeps the data of residents who made the booking. The attribute **resident_id** was generated for quick reference in the database; attribute **name** for addressing the resident; and attribute **nric_last_4** for quick verification on the day of usage.

Booking table keeps the data of bookings made. The attribute **booking_id** was generated for bookings made; Attribute **payment** is to keep track if payment has been made.

Booking_Schedule keeps the data of booking details for a **booking_id** which include attribute **resident_id** who made the booking, the **date** of usage, **court** and **time**. Time is recorded in an hour block with the starting time reflected in the table. Example time entry of 0900 means the court is booked for an hour from 0900 to 1000.

d) Explain the 2 aims of normalization in relational database. [2]

e) The above database that is made up of the 3 tables above is not normalized to 3NF. Identify which table is not normalized to 3NF. Explain your answer.

[2]

- f) 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 using a dashed underline.

Write table descriptions with normalised tables in the database.

Provide suitable Primary Key and indicate the Foreign Key for each table.

[9]

- g) Draw out the entity-relationship (ER) diagram for the normalised tables in the database.

[4]

End of Paper