



VICTORIA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

COMPUTING

9569/01

Paper 1 Written

17 September 2025

3 hours

READ THESE INSTRUCTIONS FIRST

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.

Answer **all** questions.

Approved calculators are allowed.

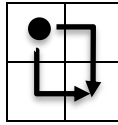
The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 100.

This document consists of **10** printed pages and **2** blank pages.

- 1 A programmer is writing a program to manage and search for records. The records include phone numbers, which comprise 8 decimal digits.
- (a) Convert the phone number 62842281 to:
- (i) Hexadecimal representation [2]
 - (ii) ASCII value for each digit.
('0' has an ASCII value of 48 and '9' has an ASCII value of 57.) [2]
- (b) The programmer's supervisor suggests a binary search tree instead of a sorted array for managing phone numbers.
- Suggest **two** reasons for the supervisor's advice. [2]

- 2 A recursive function `countPaths` is designed to find the number of different possible paths from the top-left corner to the bottom-right corner of a grid. The function can only move right or down at each step.



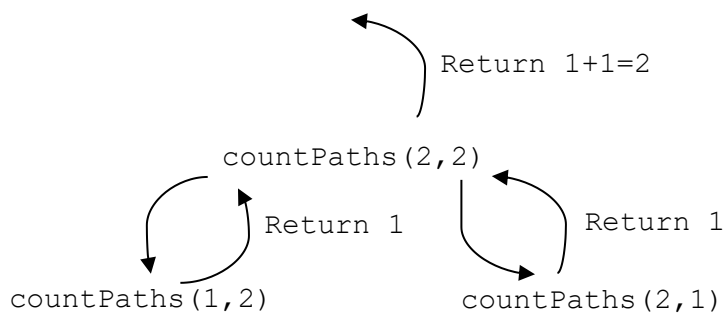
For example, in a 2x2 grid, where `row = 2` and `col = 2`, there are two possible paths from the top-left corner to the bottom-right corner of the grid:

- Right → Down
- Down → Right

The function is defined as follows:

```
01 FUNCTION countPaths(row : INTEGER, col : INTEGER) RETURNS INTEGER
02   IF row = 1 OR col = 1 THEN
03     RETURN 1
04   ENDIF
05   RETURN countPaths(row - 1, col) + countPaths(row, col - 1)
06 ENDFUNCTION
```

- (a) An example of a trace tree diagram showing `countPaths(2, 2)` is shown as follows:



Use the above example to create a trace tree diagram for the recursive function call `countPaths(3, 2)`. [4]

- (b) Explain how the base case in lines 02 to 03 prevents infinite recursion. [2]
- (c) Write an iterative version of the original `countPaths` function. [5]

- 3 A software company is developing a print server that handles print jobs from multiple users. Each print job has a job ID and number of pages. The system needs to handle both regular and priority print jobs.

(a) The regular print jobs use a linear queue data structure.

Explain why a linear queue would be appropriate for regular print jobs. [2]

(b) The company decides to implement the queue as a circular queue using a static array of size 5.

State **one** difference between a linear queue and a circular queue. [2]

(c) Draw a diagram showing the state of a circular queue after the following operations, showing the positions of front and rear pointers:

1. Enqueue jobs: 101, 102, 103, 104
2. Dequeue two jobs
3. Enqueue jobs: 105, 106

[3]

(d) Explain **one** disadvantage of using a circular queue instead of a linear queue for this implementation. [2]

(e) The print server keeps a history of completed print jobs in a stack data structure.

(i) Explain how a stack data structure would be appropriate for implementing an "undo" feature that allows the system administrator to restore recently completed print jobs back to the queue. [2]

(ii) Write pseudocode for a procedure `restoreJobs` that takes three parameters: the stack object, `historyStack`, the queue object, `printQueue` and an integer `N`. The pseudocode should restore the `N` most recently completed jobs from the `historyStack` back to the `printQueue`, maintaining their original print order. [6]

4 Most applications require data entry as an essential step for processing and output.

(a) During data entry, validation and verification are commonly applied.

(i) State the purpose of validation.

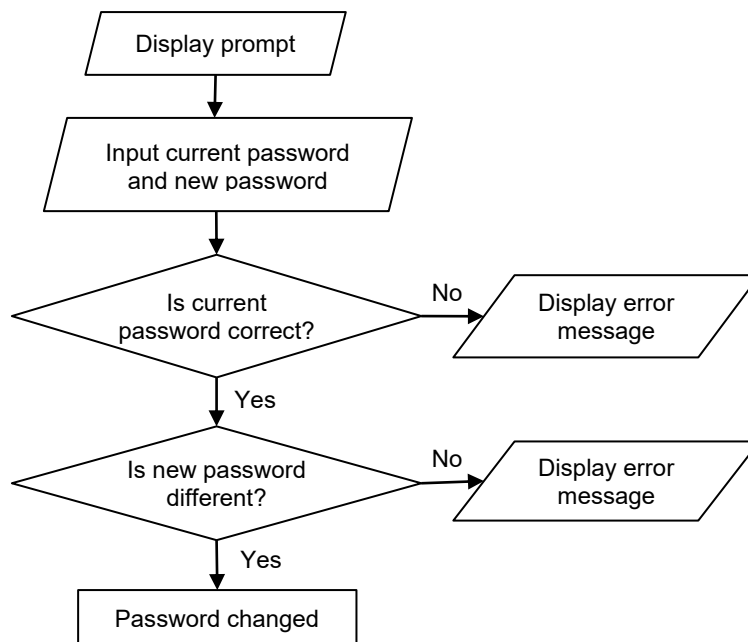
[1]

(ii) State the purpose of verification.

[1]

(b) The image below shows the password change dialog box for a web application.

The flowchart below shows the process for changing a user's password.



(c) Redraw the flowchart to include, for the new password:

- **one** suitable validation technique
- **one** suitable verification technique

[6]

(d) State **two** ways the password change interface can be improved using suitable usability principles.

[2]

- 5 A company, ImageMaps, wishes to develop an application that scans a user's device for photographs, detect the associated location, and display the images on a map using the associated locations.
- (a) State the actions ImageMaps must take to secure critical business data such as user data against catastrophic hardware failure. [4]
 - (b) State the consequences, should ImageMaps suffer such a hardware failure. [2]
 - (c) ImageMaps needs to store a large quantity of data that will not be frequently accessed. State how they can reduce costs while doing so. [2]
 - (d) State **two** actions the company must take regarding the collection and use of personal user data to comply with Singapore's Personal Data Protection Act (PDPA). [4]
 - (e) State whether a native or web application is more suitable for ImageMaps's application. Explain your answer. [3]

6 A commercial bank is strengthening its cybersecurity framework after experiencing multiple security breaches.

(a) Compare between a Trojan horse and a worm in terms of how they spread and how they are executed in the targeted network or device. [2]

(b) Describe **two** characteristics that make ransomware particularly dangerous to financial institutions. [2]

(c) The bank has deployed a firewall and Intruder Protection System (IPS).

Explain why implementing both a firewall and IPS provides better security than using either system alone. [2]

(d) Describe the complete process of generating and verifying a digital signature for an electronic funds transfer request. [3]

(e) The bank must choose between biometric authentication and security tokens for employee access to sensitive systems.

Evaluate which method would provide better security, giving **two** reasons for your choice. [3]

- 7 A packet switching network breaks data into packets, which are sent independently across the network and reassembled at the destination.

(a) Describe how networking protocols address the following problems:

(i) Data packets may arrive out of order and require reassembly [2]

(ii) Data packets may be corrupted in transit. [2]

(b) State and explain the time complexity of the following operations:

(i) Adding an item to a sorted array [2]

(ii) Adding an item to a balanced binary search tree (BST). [2]

(c) A data structure is used to hold data packets that are being reassembled.

Describe **one** advantage and **one** disadvantage of each of the following data structures for packet reassembly.

(i) Statically allocated array [2]

(ii) Dynamically allocated BST. [2]

- 8 A software company is writing a program for a vehicle hire business. Both cars and vans are available for hire.

For all vehicles, the data that will be stored include:

Vehicle Registration Number (VRN)
 Total distance travelled (km)
 Date hired
 Date of return
 Cost per day
 Available for hire

For cars, the additional data stored include:

Fuel type (petrol, diesel, electric, hybrid)

For vans, the additional data stored include:

Maximum load (kg)

The odometer in the vehicle displays the total distance the vehicle has travelled since manufacture.

When a vehicle is hired:

- total distance travelled is set to the odometer's value
- date hired is set to the current date
- return date is set to the date the vehicle is expected to be returned
- available for hire is set to FALSE.

When a vehicle is returned:

- hire cost is returned as the cost per day multiplied by the number of days the vehicle was hired
- total distance travelled is set to the odometer value
- date returned is set to the current date
- available for hire is set to TRUE.

The programmer uses a database to store vehicle hire data. Each row in the table represents a vehicle hire record. A vehicle must be hired for a minimum of one day.

Vehicle hire data is stored in the following table:

VRN	TotalDistance	DateHired	DateReturned	CostPerDay	Available	FuelType	MaxLoad

(a) Identify a suitable primary key for the above table. [1]

(b) Identify suitable SQL data types for the following columns:

(i) DateHired [1]

(ii) Available [1]

- (c) State whether the above table is in Third Normal Form (3NF). Explain your answer. [4]

A database consultant rewrites the above table into the following table descriptions:

```
Vehicle (VRN, Type, TotalDistance, CostPerDay, Available)
Hire (VRN, DateHired, DateReturned)
Car (VRN, FuelType)
Van (VRN, MaxLoad)
```

The vehicle type is stored as either 'Car' or 'Van'.

- (d) Draw an entity-relationship (ER) diagram representing the four tables. [4]
- (e) Write an SQL query to retrieve from the above tables the VRNs of hybrid cars and their latest date of hire. [6]

