



**ANGLO-CHINESE JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION**

Higher 2

COMPUTING

9569/01

Paper 1 Written

24 August 2026

3 hours

READ THESE INSTRUCTIONS FIRST

An answer booklet will be provided with the 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 **9** printed pages and **1** blank page.



Anglo-Chinese Junior College

[Turn Over

- 1 A paper mill monitors its automated drying roll press during production to determine the machine's operational status.

The monitoring system has three sensors each to check whether

- the main roller power line is active,
- a paper tear is detected on the line,
- the temperature of dryer cylinder is at least 120 °C.

If the main roller power line is active and both a paper tear is detected and the temperature of dryer cylinder is ≥ 120 °C, the system triggers an Emergency Line Shutdown.

If the main roller power line is active and only one of these two faults occurs, the system issues an Urgent Maintenance Warning.

Otherwise, the system maintains Normal Operations.

- (a) Copy and complete the decision table. Include all possible combinations and do not remove redundancies at this point.

		Rules							
Conditions	Main roller power line is active								
	Paper tear detected								
	Temperature of dryer cylinder $\geq 120^\circ\text{C}$								
Actions	Emergency Line Shutdown								
	Urgent Maintenance Warning								
	Normal Operations								

[4]

- (b) Draw a simplified decision table by removing redundancies from your answer in part (a).

[2]

- (c) Write pseudo-code to input the status of the three sensors and output the appropriate system response from:

- 'Emergency Line Shutdown'
- 'Urgent Maintenance Warning'
- 'Normal Operations'

Use the following identifiers in your pseudo-code:

Identifier Name	Description
IsPowerActive	Boolean indicating if main roller power is active
IsPaperTear	Boolean indicating if a paper tear is detected
DryerTemp	Temperature of dryer cylinder in degree Celsius

[4]

- 2 Quicksort is an algorithm to arrange data items into ascending or descending order. The algorithm selects a pivot from the dataset, which is then used to divide the data into two subsets around the pivot.

An enhanced version of the Quicksort algorithm selects the pivot using a median-of-three strategy for any partition with 3 or more elements. This method compares the first, middle and last elements of the current array segment and selects the median value as the pivot. When a segment has 2 or fewer elements remaining, the pivot value chosen is the first element of that segment.

The contents of a given array with 15 elements are shown below:

42	18	85	31	67	4	99	53	12	76	29	61	90	38	45
----	----	----	----	----	---	----	----	----	----	----	----	----	----	----

- (a) State the pivot value that will be selected for the first partition pass of the array. [1]
- (b) Use annotated diagrams to show how this enhanced Quicksort algorithm will sort the data in the array into ascending order. [4]
- (c) Suggest **one** theoretical advantage of using the median-of-three strategy over choosing the first or last element as the pivot. [1]
- (d) Explain why the worst-case time complexity of this enhanced Quicksort algorithm remains $O(n^2)$. [1]
- (e) State one sorting algorithm that has a better worst-case time complexity than Quicksort when sorting an unsorted array. [1]

The Quicksort algorithm can also sort an array of text strings.

- (f) State one reason why Unicode is preferred over ASCII for character encoding when comparing and sorting multilingual data. [1]

The contents of the given array, sorted in ascending order, are shown below:

4	12	18	29	31	38	42	45	53	61	67	76	85	90	99
---	----	----	----	----	----	----	----	----	----	----	----	----	----	----

- (g) Explain why performing a linear search on a sorted array can be more efficient than on an unsorted array. [1]
- (h) A binary search algorithm could be used to search the sorted array. State the values that will be examined when searching for the value 80, which is not present in the array. [2]

- 3 A university is designing an information management system to track different people on campus using Object-Oriented Programming (OOP).

There are three categories of people: undergraduate students, postgraduate students, and professors.

All people, in the class `Person`, have these features:

- Attributes: `name`, `ID_number`
- Methods: `set_name`, `get_name`, `set_ID_number`, `get_ID_number`, `display_details`

Undergraduate students, in the class `UStudent`, have these additional features:

- Attributes: `GPA`
- Methods: `set_GPA`, `display_GPA`

Postgraduate students, in the class `GStudent`, have all the attributes and methods that undergraduate students have, and in addition, the following features:

- Attributes: `thesis_topic`
- Methods: `set_thesis_topic`, `display_thesis_topic`

Professors, in the class `Professor`, have these additional features:

- Attributes: `salary`
- Methods: `set_salary`, `display_salary`

- (a) Draw a class diagram that shows the following as described above:

- the superclass,
- any subclasses,
- inheritance relationships,
- attributes,
- appropriate methods.

[8]

- (b) State one role of a constructor when a new object instance (such as `Professor`) is created.

[1]

- (c) Explain why some attributes and methods in classes should be declared as private.

[2]

Polymorphism is applied when calling `display_details` on various `Person` objects.

- (d) State one advantage of using polymorphism in this scenario.

[1]

- 4 FreightGo is a smart logistics web platform that connects cross-border shoppers in Singapore with courier services for real-time parcel tracking.

When a shopper visits the website (`www.freightgo.sg`) on their browser:

- The browser performs a Domain Name System (DNS) lookup.
- A secure HTTP (HTTPS) connection is established using TCP/IP with the company's central server.
- The shopper logs into their account, where shipping addresses and delivery records are accessed and updated.

- (a) Describe the role of a DNS server when the user types `www.freightgo.sg` into their browser URL bar. [2]

- (b) Explain how TCP and IP function together at their respective layers of the TCP/IP suite to ensure that a tracking report downloaded from FreightGo reaches the client machine reliably and intact. [4]

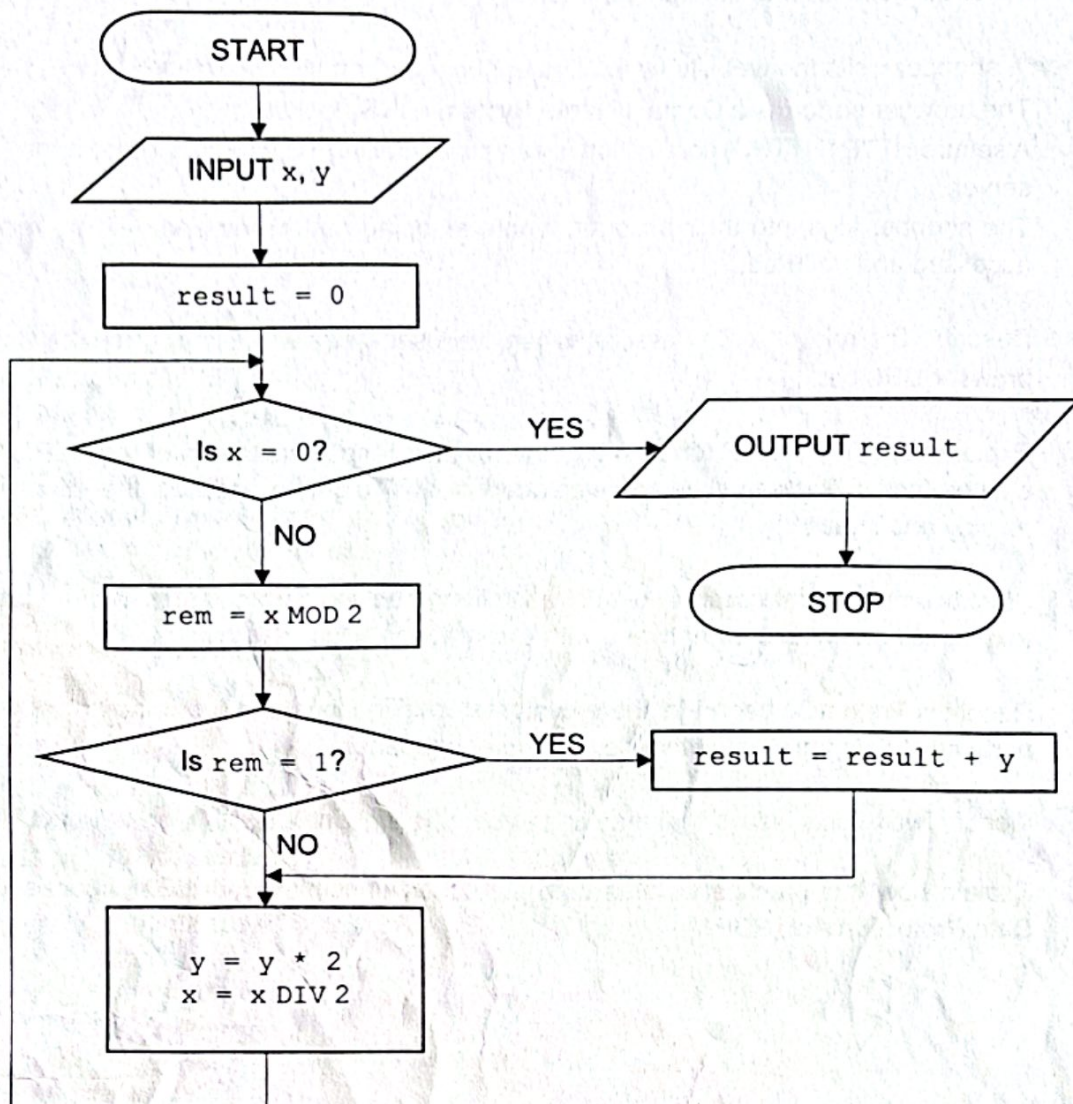
- (c) State two risks to data security when transmitting tracking data and user information in plain text across an unsecured network, with elaboration. [4]

Recently, FreightGo began to share customer tracking logs and browsing habits with third-party advertising brokers without explicit user consent.

- (d) Identify two ethical issues that may arise from this practice. [2]

- (e) Explain how this practice violates data protection principles under Singapore's Personal Data Protection Act (PDPA). [4]

- 5 The flowchart below shows an algorithm for multiplying two integers, x and y .



- (a) Draw trace tables for the following inputs.

(i) $x = 5, y = 12$ [3]

(ii) $x = 12, y = 5$ [4]

- (b) Explain why the following steps in the flowchart are easy to carry out when x is expressed in binary notation. You may use the values of x in (a) as examples.

(i) $\text{rem} = x \% 2$ [2]

(ii) $x = x // 2$ [2]

- (c) Give an example of integer values of x and y which would lead to a logic error, and explain why the error occurs. [2]

- 6 A library wishes to store data about its members and books. The library stores the telephone numbers of the members. The library may have multiple copies of the same book; it also wishes to store data about the conditions of the books.

Part of the data in the library's database is shown below. The dates are in YYYYMMDD format.

Book Title	Condition	Copy Number	Member Name	Member Phone	Date borrowed	Date due	Returned
Hamlet	Good	1	Sue	92353535	20260612	20260630	Y
Lear	Good	1	Bob	94682222	20260614	20260716	Y
Hamlet	Fair	2	Bob	94682222	20260614	20260716	Y
Macbeth	Fair	2	Tom	93429898	20260701	20260715	Y
Hamlet	Good	1	Sue	92353535	20260809	20260823	N

- (a) Explain why the table is not in second normal form (2NF). [1]
- (b) Give an example of redundancy in the table above, and explain how storing the data in third normal form (3NF) can remove the redundancy. [2]
- (c) 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.
 Write table descriptions for all the required tables in the database so that they are in third normal form (3NF). [4]
- (d) Draw the entity-relationship (ER) diagram of the above database. [3]
- (e) Suppose that the database is in third normal form following the schema in part (c). Write an SQL query to output the names of the members who have not yet returned their copy of Hamlet. [4]
- (f) The library is considering stocking and lending out other forms of media, such as magazines and DVDs. State, with reasons, whether it would be advantageous for the library to start using a non-relational database instead. [2]
- (g) Explain what a backup is and why it is important in this context. [3]

7 A mathematical expression consists of:

- numbers, which may be integers or floats,
- operators, which are +, −, × and ÷ (representing addition, subtraction, multiplication and division respectively),
- parentheses, which are the characters '(' and ')

It can be defined recursively as the concatenation of three terms

$$A B C$$

where B is an operator, and A and C are either numbers or mathematical expressions enclosed in parentheses.

For example,

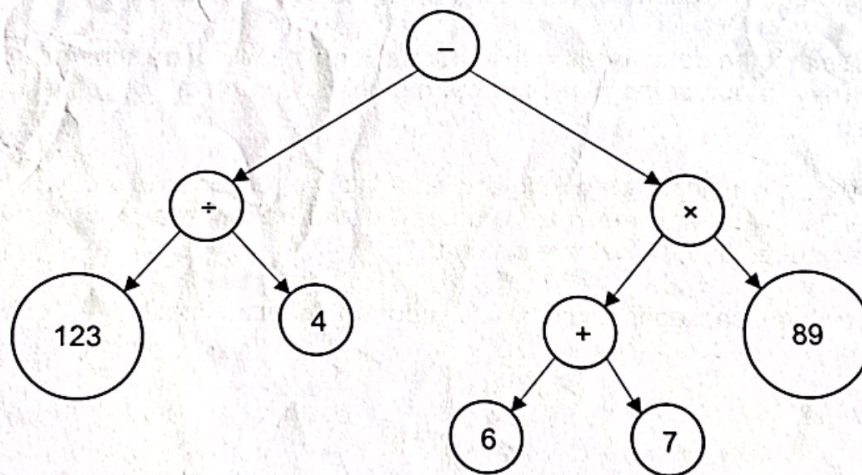
$$(123 + 4) - ((6 + 7) \times 89)$$

is a mathematical expression where

$$123 + 4$$

- A is $(123 + 4)$, which is the mathematical expression $123 + 4$ enclosed in parentheses,
- B is the operator $-$ (subtraction), and
- C is $((6 + 7) \times 89)$ which is the mathematical expression $(6 + 7) \times 89$ enclosed in parentheses, and is itself the concatenation of
 - the mathematical expression $6 + 7$ enclosed in parentheses,
 - the operator $\times$, and
 - the number 89.

A mathematical expression can be expressed as a tree, with B as the parent node, and A and C as left and right subtrees respectively. For example, the mathematical expression above can be expressed in tree form as:



(i) List the elements of the tree in:

(a) pre-order traversal;

[1]

(b) in-order traversal;

[1]

(c) post-order traversal.

[1]

The mathematical expression $(123 + 4) - ((6 + 7) \times 89)$ can be evaluated to give an answer of -1126.25.

(ii) A mathematical expression is given as a tree. Describe a recursive algorithm by which the expression can be evaluated to give the correct answer. [3]

(iii) A mathematical expression is put into a tree, and the elements are enqueued into a queue in post-order.

Using only the queue and an additional stack, describe how the expression can be evaluated to give the correct answer. [6]

8 A sender sends an email to a receiver from a different organisation over a public network. The email contains very sensitive information which may affect both their organisations adversely if the information is leaked. Both the sender and receiver are using a public key cryptography system.

(i) Explain the sender can ensure that a third party cannot read the information in the email even if the third party has access to the email. [2]

(ii) Explain how the sender can authenticate the email so that the receiver can be sure that the sender is not being impersonated. [4]