



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

Higher 2

COMPUTING

9569/01

Paper 1 Written

3 September 2025

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 **7** printed pages and **1** blank page.



Anglo-Chinese Junior College

[Turn Over

- 1** In a sports club, the members have different ratings depending on whether they can meet certain performance criteria, namely:

- Running 2.4 km in at most 12 min;
- Doing at least 50 push ups in 1 min;
- Doing at least 40 sit ups in 1 min.

Members are ordinary members by default. If a member runs 2.4 km in more than 12 min, that member is still an ordinary member, regardless of how the member performs in the other criteria.

If the member runs 2.4 km in at most 12 min and meets one of the other criteria, that member is a silver member. If the member meets all three criteria, that member is a gold member.

(i) Create a decision table to show these conditions and actions. [4]

(ii) Simplify your decision table by removing redundancies from the decision table. [2]

- 2** A private school has two kinds of students, full-time students and part-time students. It uses object-oriented programming (OOP) to store data about the students.

For both kinds of students, their name and date of birth are stored. For full-time students, their address and telephone number are stored. For part-time students, the list of classes they are taking is stored.

Full-time students pay an annual school fee which is a constant amount. The school fee for part-time students is calculated based on the number of classes they are taking.

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

- The superclass;
- Any subclasses;
- Inheritance;
- Attributes;
- Appropriate methods. [6]

(b) Give an example of inheritance in the class diagram in part **(a)**. [1]

(c) Explain where and how polymorphism is useful in this context. [2]

The school needs to back up and archive data regularly.

(d) (i) Explain why there is a need to back up data. [2]

(ii) Explain why there is a need to archive data. [2]

- 3** The greatest common divisor (gcd) of two positive integers m and n is the largest integer that divides both m and n with a remainder of 0.

The pseudo-code below shows an attempt to write an algorithm to find the gcd of m and n .

```

00 INPUT m, n
01
02 DECLARE d : INTEGER
03 d ← 0
04
05 FOR i ← 1 TO m:
06     IF m MOD i = 0 OR n MOD i = 0 THEN
07         d ← i
08     ENDIF
09 ENDFOR
10
11 OUTPUT d

```

- (a) State the output when the input values $m = 21$, $n = 28$ are given to the algorithm. [1]
- (b) Identify the line where there is a logic error and give the correct pseudo-code to find the gcd. [2]

Euclid's Algorithm is a method to determine the greatest common divisor of two positive integers m and n .

The pseudo-code for a recursive implementation of Euclid's Algorithm is given below.

```

00 FUNCTION gcd(m, n : INTEGERS) RETURNS INTEGER
01
02     IF m = n THEN
03         RETURN m
04     ELSE
05         IF m > n THEN
06             RETURN gcd(m-n, n)
07         ELSE
08             RETURN gcd(m, n-m)
09         ENDIF
10     ENDIF
11
12 ENDFUNCTION

```

- (c) State the features of the function gcd that make it recursive. [3]
- (d) Draw a trace diagram for the input values $m = 21$, $n = 28$. [3]
- (e) Explain what will happen to the recursion and execution of the recursive function gcd when m is positive and n is negative. [2]
- (f) Rewrite the function gcd in pseudo-code to carry out Euclid's algorithm without using recursion. [3]

- 4** A hash table is implemented inside an array of length 10. The hash table is intended to store the names and ages of people.

Each record is to be stored as a tuple (name, age). The hash function is the number of characters in the name.

In the event of a collision, a linear search for an empty entry would be carried out starting from the index of the collision, looping back to the start of the array if necessary.

Copy the following array onto the answer sheet.

[1]	
[2]	
[3]	
[4]	
[5]	
[6]	
[7]	
[8]	
[9]	
[10]	

- (i)** Add the records into the array as they are inserted in the following order.

1. ('Jacky', 22)
2. ('Sam', 18)
3. ('Joel', 20)
4. ('Bob', 21)
5. ('Justin', 19) [5]

- (ii)** Describe how to look up Bob's age in the hash table. [4]

Suppose instead that the same records are to be stored in a binary search tree (BST), in order of age. The records are inserted into the BST in the same order as in part **(i)**.

- (iii)** Draw the resulting BST. [3]

- (iv)** List the names in a post-order traversal of the BST. [2]

- (v)** Explain how you would use the BST to determine who is the second oldest person. [3]

- 5 The pseudo-code for a bubble sort algorithm to sort an array of integers in increasing order is shown below. The indices in the array start from 1.

```

01 PROCEDURE BubbleSort(Arr : ARRAY OF INTEGER)
02     DECLARE N, Temp : INTEGERS
03     N ← LENGTH(Arr)
04
05     FOR i ← 1 TO N-1
06         FOR j ← 1 TO N-1
07             IF ... (A) ... THEN
08                 Temp ← Arr[j+1]
09                 Arr[j+1] ← ... (B) ...
10                 Arr[j] ← ... (C) ...
11             ENDIF
12         ENDFOR
13     ENDFOR
14 ENDPROCEDURE

```

- (a) Write the correct pseudo-code for (A), (B), (C) in the algorithm above. [3]
- (b) State two ways in which the time complexity of the algorithm above can be improved. [3]
- (c) State the worst-case time-complexity of bubble sort. [1]

In a merge sort algorithm, a helper function is needed to combine two sorted lists into one sorted list. The pseudo-code for the helper function is given below. The indices in both arrays start from 1.

```

01 FUNCTION Combine(Arr1, Arr2 : ARRAYS OF INTEGER)
02     DECLARE N1, N2, i, j : INTEGERS
03     N1 ← LENGTH(Arr1), N2 ← LENGTH(Arr2)
04     i ← 1, j ← 1
05
06     DECLARE Arr[1:(N1 + N2)] : ARRAY OF INTEGER
07
08     WHILE ... (D) ...
09         IF ... (E) ... THEN
10             Arr[i+j-1] ← Arr1[i]
11             i ← i+1
12         ELSE
13             Arr[i+j-1] ← Arr2[j]
14             j ← j+1
15         ENDIF
16     ENDWHILE
17
18     WHILE i+j-1 ≤ N1 + N2
19         IF ... (F) ... THEN
20             Arr[i+j-1] ← Arr1[i]
21             i ← i+1
22         ELSE
23             Arr[i+j-1] ← Arr2[j]
24             j ← j+1
25         ENDIF
26     ENDWHILE
27
28     RETURN Arr
29 ENDFUNCTION

```

- (d) Write the correct pseudo-code for (D), (E), (F) in the algorithm above. [3]
- (e) Write a function to perform merge sort, using the helper function above, in pseudo-code. [4]

6 A user on a website has to fill out a form to register for an account. The user needs to create a username and a password. The password needs to be at least 8 characters long and contain at least one uppercase letter, one lowercase letter, one digit, and one punctuation symbol.

- (a) State the difference between data validation and data verification. [2]
- (b) In this context, describe how data validation can be carried out. [2]
- (c) In this context, describe how data verification can be carried out. [2]

The data on the form is sent from the user's computer to the website's server over the internet. The password is sent via a public key cryptography system.

- (d) Describe how public key cryptography prevents a third party from being able to see the password. [2]
- (e) Describe how the three-way handshake in the TCP protocol ensures that the data is sent completely and accurately. [3]

To prevent passwords from being leaked, the server's database does not store users' passwords in raw form, but in a hashed form instead.

- (f) Explain how this prevents passwords from being leaked, and describe what happens when a user tries to log in with an incorrect password. [3]
- (g) Describe another security feature the server can use to ensure security of the user passwords. [1]

When the server sends a message to the user, it uses a digital signature to authenticate the message.

- (h) Describe how the digital signature is generated. [2]
- (i) Suppose the message is intercepted and edited by a malicious third party before it reaches the user. Describe how the user can detect the fact that the message has been intercepted and edited. [3]

- 7 An art company engages a number of artists to produce artworks. These artworks are displayed for sale at various studios which are run by the company. Each artwork has a unique title.

Part of the data in the database is shown in the table below.

Artwork Title	Medium	Price (\$)	Artist Name	Artist Contact	Studio Name	Studio Address
Lion Head	Stone	3 000	Fariz	fariz@b.com	La Galleria	123 King Road
Tiger Head	Stone	3 000	Fariz	fariz@b.com	New Studio	456 Jalan Kayu
Fire Star	Watercolour	1 500	Sue Tan	sue@tan.com	La Galleria	123 King Road
Thunder Bird	Oil paint	4 500	Sue Tan	sue@tan.com	New Studio	456 Jalan Kayu
Banana	Plastic	5 000	Surya	surya@k.co	New Studio	456 Jalan Kayu
Guava	Steel	4 000	Surya	surya@k.co	La Galleria	123 King Road

- (a) Explain why the table is not in third normal form (3NF). [1]
- (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.
- Write table descriptions for **all** the required tables in the database so that they are in third normal form (3NF). [4]
- (c) Draw the entity-relationship (ER) diagram of the above database. [3]
- (d) Explain why it is recommended to maintain multiple tables in 3NF instead of storing all the data in one table as shown above. [2]
- (e) Write an SQL query to output all the names of the artists who have at least one artwork displayed in La Galleria that costs at most \$3500. [4]
- (f) State any **two** ways the privacy of the artists' data should be provided for under the Personal Data Protection Act (PDPA). [2]