

ANGLO-CHINESE JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION

Higher 2

COMPUTING

9569/01

Paper 1 Written

24 August 2023

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



Anglo-Chinese Junior College

[Turn Over

- 1** Planetary bodies can be classified as planets, dwarf planets, or small solar system bodies. To qualify as a planet, the body must be in orbit around the sun, have sufficient mass to be spherical, and have cleared the neighbourhood around its orbit. A smaller spherical body that orbits around the sun, but have not cleared the neighbourhood around its orbit is classified as a dwarf planet. Pluto is an example of a dwarf planet. Finally, all other planetary bodies in orbit around the sun are collectively classified as small solar system bodies.

Create a simplified decision table to show the conditions and actions for classifying planetary bodies. [5]

- 2** (a) Unicode and ASCII are two different character encoding standards. Explain why characters need to be encoded. [2]
- (b) Explain one similarity and one difference between Unicode and ASCII. [2]
- (c) Convert 125 from denary to hexadecimal. Show your working. [2]
- 3** A country's transport authority would like to use Object Oriented Programming (OOP) to model the vehicles in the country.

All vehicles in the country have the following data recorded:

- Registration code
- Engine size
- Date of registration

The age of a vehicle can be calculated with the following equation:

$$\text{age} = \text{current date} - \text{registration date}$$

The amount of taxes required for a vehicle is determined by the engine size

Commercial vehicles have the following data recorded:

- Company type
- Vehicle purpose

The amount of taxes required for a commercial vehicle is determined by the company type and engine size of the commercial vehicle.

Emergency vehicles have the following data recorded:

- Vehicle type
- Last servicing date

- (a) Draw a class diagram that shows the following for the data in the game described above:
- The superclass;
 - Any subclasses;
 - Inheritance;
 - Properties;
 - Appropriate methods. [8]
- (b) Explain the purpose of inheritance using examples from this situation. [3]
- (c) Explain the purpose of making the attributes of an object private. [2]
- (d) The transport authority decided that emergency vehicles should not be taxed. Suggest a change to the class diagram to enable this and explain why it works. [2]

- 4 (a) The pseudo-code for a sorting algorithm is shown below. The indices in the list start from 1.

```

01 INPUT MyList
02 MaxIndex ← LENGTH(MyList)
03
04 FOR i ← 1 TO (MaxIndex - 1)
05     MinVal ← 999
06     MinValIndex ← 0
07
08     FOR j ← i TO MaxIndex
09         IF MyList[j] < MinVal
10             THEN
11                 MinVal ← MyList[j]
12                 MinValIndex ← j
13             ENDFOR
14     ENDFOR
15
16     Temp ← MyList[i]
17     MyList[i] ← MinVal
18     MyList[MinValIndex] ← Temp
19 ENDFOR

```

- (i) Using the list [8, 5, 7, 1, 4, 2] as input, write down the list after each pass of the FOR loop from lines 04 to 19. [5]
- (ii) State the time complexity of this algorithm. [1]
- (iii) State a list of positive integers that is an erroneous test case for this algorithm. [1]
- (iv) Explain how the algorithm can be modified so that logic errors of the type seen in (iii) do not occur. [2]
- (b) Bubble sort and merge sort are two sorting algorithms.
- (i) State one advantage of bubble sort over merge sort. [1]
- (ii) State one advantage of merge sort over bubble sort. [1]
- (iii) Merge sort is a recursive algorithm. State two characteristics of a recursive sorting algorithm. [2]

- 5 The following algorithm's input is a binary tree. It also makes use of two stacks which are initially empty.

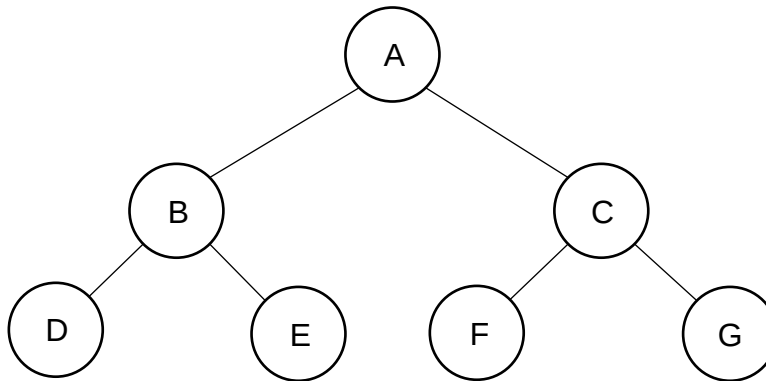
Stage 1

1. Push the root of the tree into Stack 1.
2. Repeat the following steps until Stack 1 is empty:
 - a. Pop from Stack 1. This will give a node *Node*.
 - b. If *Node* has a left child, push the left child of *Node* into Stack 1.
 - c. If *Node* has a right child, push the right child of *Node* into Stack 1.
 - d. Push *Node* into Stack 2.

Stage 2

1. Repeat the following steps until Stack 2 is empty:
 - a. Pop from Stack 2 and output the data of the node that was just popped.

Use the following tree as input for the algorithm.



- (a) Write down the full contents of Stack 1 and Stack 2 at the end of each pass of the Repeat loop in Stage 1. [6]
- (b) Write down the output that the algorithm has produced in Stage 2. [1]
 State whether this is a pre-, post- or in-order traversal of the tree. [1]
- (c) Explain whether it is possible to reconstruct the tree if the only knowledge you have is the output in Stage 2, and the type of traversal that it represents. [1]

6 A linked list is implemented inside an array as shown below.

	Data	Pointer	
[0]	"ADA"	None	FreeListPointer = 4
[1]	" "	None	LinkedListPointer = 2
[2]	"BOB"	3	
[3]	"EVE"	5	
[4]	" "	1	
[5]	"PUP"	0	

The following steps are carried out in order:

1. A node whose data is "SUS" is added at the head of the linked list.
 2. The node at the end of the linked list is deleted.
 3. The node whose data is "EVE" is deleted.
- (a) Write down the full contents of the array, as well as the values of FreeListPointer and LinkedListPointer. [6]
- (b) Explain why it is not suitable to perform a binary search to look for a particular data value. [1]
- (c) Suppose the array is very large but the linked list contains only a few items. Describe how a linear search can be carried out to look for a particular data value. [4]

7 A music record store uses an SQL database to record information about their records and customers.

- Each album is recorded by an artiste, and is given a genre and price.
- When a customer buys an album, the date and time of the purchase are recorded. Since there is more than one cashier, two customers may purchase records at the same time.

The following set of tables represents a first attempt at constructing the database.

Albums:

AlbumID	AlbumName	Artiste	Genre	Price
K01	Circle One	Whitepink	K-pop	35.00
K02	Why You Like That	Whitepink	K-pop	35.00
K03	Everyday Strife	Hotplay	Rock	30.00
K04	Most Stories	Hotplay	Rock	32.00
K05	Ocean Pies	Billy Eyelash	Pop	40.00
K06	Good Guy	Billy Eyelash	Pop	35.00

Purchases:

CustomerID	CustomerName	Customer PhoneNo	AlbumID	Datetime	Quantity
0001	Roy Tan	94682222	K03	2022-08-22 17:35	1
0001	Roy Tan	94682222	K04	2022-08-22 17:35	1
0002	Sharifah	93459898	K03	2022-08-22 17:35	1
0001	Roy Tan	94682222	K04	2022-09-01 17:35	2
0003	Jane Lee	92255582	K01	2022-09-01 18:21	1
0003	Jane Lee	92255582	K02	2022-09-01 18:21	1

- (a) Explain which table(s) in the above database is not in third normal form (3NF). [2]
- (b) Normalize the table(s) in (a) to third normal form (3NF).

Draw the Entity-Relationship (E-R) diagram to show the tables in 3NF and the relationships between them. [3]

- (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 3NF. [4]

- (d) Suppose the database is set up as described in (c). Write an SQL query to output the most expensive K-pop album purchased by Jane Lee. [5]
- (e) State **two** advantages of using a NoSQL database in this context. [2]

8 An online coding school based in Singapore created a registration website that requires its members to enter their ages, email addresses, mobile phone numbers and residential addresses.

- (a) Explain the difference between data validation and data verification. [2]
- (b) Describe one data verification technique that can be incorporated into the design of the registration website. [2]
- (c) State two data validation techniques that can be incorporated into the registration website. [2]
- (d) State three actions the school must take regarding the collection, disclosure and use of this data under the Personal Data Protection Act (PDPA). [3]
- (e) Explain what the school can do to protect itself against cyber criminals stealing sensitive student data. [2]
- (f) Describe how a digital signature is used for authentication. [6]
- (g) State two other techniques of authentication. [2]
- (h) Explain the purpose of the domain name server (DNS). [2]
- (i) Explain the difference between a MAC address and an IP address. [2]
- (j) Explain the main difference between IPv4 and IPv6. [2]