

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

Higher 2

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**COMPUTING**

**9569/01**

Paper 1 Written

**14 September 2020**

**3 hours**

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**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.

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This document consists of **8** printed pages.



**Anglo-Chinese Junior College**

**[Turn Over**

- 1 A food delivery app offers promotions to customers based on their usage pattern.

First time customers would receive a \$5 discount on their first purchase. If a customer has spent at least \$1000 on the app in the last 3 months, the app would upgrade the customer to Gold status and offer 10% discount on all orders.

Gold status customers who have been inactive for 1 month would be offered an additional 5% discount on top of the existing 10% discount. Customers who have made their first purchase and have been inactive for 1 month would receive a \$5 discount instead.

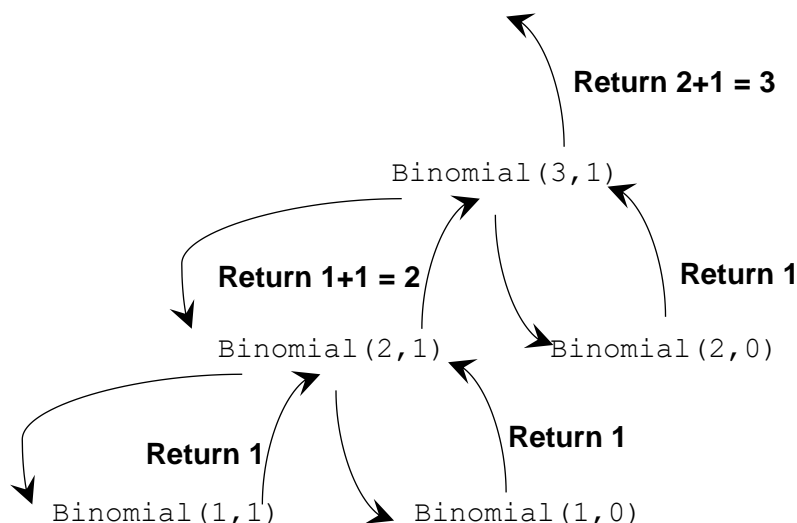
- (a) Create a decision table to show these conditions and actions. [4]  
 (b) Simplify your decision table by removing redundancies from the decision table. [1]

- 2 The recursive function `Binomial` has two parameters, `N` and `R`.

```

01 FUNCTION Binomial(N, R : INTEGERS) RETURNS INTEGER
02     IF R = 0 OR R = N
03     THEN
04         Answer ← 1
05     ELSE
06         Answer ← Binomial(N - 1, R) + Binomial(N - 1, R - 1)
07     ENDIF
08     RETURN Answer
09 ENDFUNCTION
  
```

- (a) State what is meant by a recursive function, and identify the line number that makes `Binomial` recursive. [2]  
 (b) An example of a trace tree diagram showing the recursive function call `Binomial(3,1)` is shown.



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

- (c) Give values of `N` and `R` which would cause the function to enter infinite recursion. [2]

- 3** The function `Evaluate` is designed to evaluate a polynomial at a given value of  $x$ . The polynomial is stored as a queue of coefficients in descending powers of  $x$ .

For example, the polynomial  $5x^3 - 2x^2 + 3x - 1$  is given as the queue  $[5, -2, 3, -1]$ , where 5 is at the head of the queue.

```

01  FUNCTION Evaluate(X : INTEGER, Coeffs : QUEUE) RETURNS INTEGER
02      Answer  $\leftarrow$  0
03      REPEAT
04          Answer  $\leftarrow$  Answer + DEQUEUE Coeffs
05          Answer  $\leftarrow$  Answer * X
06      UNTIL Coeffs IS EMPTY
07      RETURN Answer
08  ENDFUNCTION

```

- (a) Draw a trace table to determine the output of the function `Evaluate` for  $X = 2$  and `Coeffs` =  $[5, -2, 3, -1]$ , as described above. [4]
- (b) Describe the error in the function `Evaluate` as it is currently written. [1]
- (c) Rewrite the pseudo-code above so that `Evaluate` returns the correct value of the polynomial at a given value of  $x$ . [4]
- 4** During Home-Based Learning, many lessons were carried out over the Internet.
- (a) For lessons carried out by video conferencing, tools by external companies such as Zoom or Google Meet were used.
- Give one example of an ethical consideration companies such as Zoom or Google should take into account in this situation. [1]
- (b) Many lesson resources and homework submissions were carried out via file uploads. Describe how a file can be uploaded from a student's computer to a cloud drive by packet switching. [4]
- (c) For a Mother Tongue lesson, a teacher created a webpage in a non-English language. Some students who accessed the webpage saw random characters instead of the content intended by the teacher.
- (i) Describe the relevance of communications protocols in this context. [2]
- (ii) Describe how Unicode might address some of these problems. [1]

- 5 A printing shop offers printing services to its customers. When a printing order is sent to the shop, the following information is recorded down:

- Date of order
- Name of customer
- Number of copies
- Colour, or black and white, printing
- Whether express printing is required

The printing shop accepts three types of orders, leaflets, books and posters.

Customers printing leaflets or books need to indicate if they require single side or double side printing.

In addition, for books, the type of cover (hard cover or soft cover) would need to be recorded.

Leaflets and books are available in three sizes (A3, A4 or A5), while posters are only available in a fixed size of A2.

For poster printing, customers have a choice of either glossy or matte finishing.

The total charge to user is determined by the specifications of the order and the formula is unique for each type of order.

This system is to be implemented using object-oriented programming (OOP).

- (a) Draw a class diagram, showing:

- Any derived classes and inheritance from the base class
- The properties needed in the base, and any derived classes
- Suitable methods to support the system with at least one getter and setter

The base class is `BASIC_ORDER`.

[8]

- (b) Explain the purpose of inheritance in object-oriented programming.

[2]

- 6 In a computer game, players' names and scores are stored in a binary search tree, in increasing order of score.

The binary search tree has its data inserted in the following order:

Ryan	18
Bella	25
Joshua	27
Shane	20
Jasmine	17
Alexis	21
Leslie	15

- (a) Draw the binary search tree. [4]
- (b) The binary search tree is implemented using the two dimensional array shown below. Copy and fill in the entries in the array.

Index	Name	Score	Left Pointer	Right Pointer
0				
1				
2				
3				
4				
5				
6				

[5]

- (c) To delete a node from a binary tree, the following cases are considered:

Case	Action
Node has no children	<ul style="list-style-type: none"> <li>Node is removed from tree</li> </ul>
Node has one child	<ul style="list-style-type: none"> <li>Node is replaced with its child</li> </ul>
Node has two children	<ul style="list-style-type: none"> <li>Call the node to be deleted <i>D</i>. Do <b>not</b> delete <i>D</i>.</li> <li>Look for the node <i>E</i> that comes after <i>D</i> in an in-order traversal.</li> <li>Copy the data of <i>E</i> into <i>D</i>.</li> <li>Delete <i>E</i> using one of the previous two cases.</li> </ul>

Draw the tree at each step after the following players are deleted, one after another:

- (i) Joshua [1]
- (ii) Jasmine [1]
- (iii) Ryan [2]
- (d) The program has a feature which allows the user to enter an integer. The program then returns a list of players whose score is greater than that integer. Describe how the program can create this list using the binary search tree. [4]

- 7 (a) The following is the pseudocode for an in-place quicksort algorithm for sorting in ascending order.

```

01 FUNCTION Partition(L, R : INTEGERS, MyList : LIST) RETURNS INTEGER
02     Pivot ← MyList[R]
03     i ← L
04     j ← L

05     REPEAT
06         IF MyList[j] > Pivot
07             THEN
08                 A
09             ELSE
10                 Temp ← MyList[j]
11                 MyList[j] ← MyList[i]
12                 B
13             ENDIF
14     UNTIL j = R

15     MyList[R] ← MyList[i] // swap elements with index i and R
16     MyList[i] ← Pivot
17     C
18 ENDFUNCTION

19 PROCEDURE Quicksort(L, R : INTEGERS, MyList : LIST)
20     IF D
21     THEN
22         PivotPos = Partition(R, L, MyList)
23         CALL Quicksort(L, PivotPos - 1, MyList)
24         E
25     ENDIF
26 ENDPROCEDURE

```

- (i) Write pseudo-code to replace **A**, **B**, **C**, **D** and **E** in the above algorithm. [5]
- (ii) State the time complexity of the algorithm in the above pseudo-code. [1]
- (iii) State and explain when the worst case scenario (for running time) for quicksort arises in the above algorithm. [3]
- (iv) Another programmer suggested insertion sort would be more efficient during the worst case scenario in (iii).  
State and explain if insertion sort is indeed more efficient in this instance. [2]

**(b)** A program needs to store an array of names and scores in a two dimensional array and perform the following:

- Output the names and scores in alphabetical order.
- Check for the presence of a particular name

The data to be stored in the array is as follows:

Peter	68
Mary	70
Kelvin	48
Casper	44
Luther	76

**(i)** Draw a flowchart to represent a linear search algorithm that returns the score of a particular name. [4]

**(ii)** Instead of storing the data in an array, it is suggested that the names could be stored in a hash table instead.

With reference to the requirements of the program, suggest one advantage and one disadvantage of storing the names in a hash table instead of an array. [2]

**(iii)** An array can be used to create the hash table data structure. Describe the process of inserting the above data into a hash table. You may assume there will be no collisions. [3]

- 8** A programmer is tasked to write a program to store the examination scores of students in the entire school. For each student, the database would need to store the following data: name, form class, subject class, subject, score and subject teacher.

**(a)** Suggest a suitable data type for each of the following fields:

- Name
- Class
- Score

[2]

**(b)** The programmer is considering storing this data in either a relational or non-relational database.

**(i)** State three key differences between the two types of databases.

[3]

**(ii)** State and explain which database system the programmer should choose.

[3]

A healthcare group would like to store patient data in a relational database. When a patient visits the clinic, the clinic will record the following information:

- Date and time of visit
- Name of attending doctor and his NRIC
- Patient name and NRIC number

After the doctor has attended to the patient, the patient would be given a prescription. The prescription would record the medication which the patient is supposed to take. Each prescription, which consists of at least one medicine, would have its own unique identification number. Each medicine would have a unique identification number, name and price.

The data is stored in a relational database with five tables:

Patient, Doctor, Appointment, Prescription and Medicine.

**(c)** Draw the Entity-Relationship (E-R) diagram to show the tables in third normal form (3NF) and the relationships between them.

[7]

**(d)** A table description can be written as:

TableName (Attribute1, ..... Attribute3, ...)

The primary key is indicated by underlining one or more attributes. Foreign keys are indicated by using a dashed underline.

Using the information provided, write table descriptions for the tables you identified in part **(c)**.

[8]