NATIONAL JUNIOR COLLEGE
Mathematics Department

General Certificate of Education Advanced Level
Higher 2

COMPUTING 9569/01

Paper 1 Written **2 October 2020**

2 hours

Additional Materials: Pre-printed A4 Answer Booklet

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.

There are **6** questions totalling **70** marks.

Answer **all** questions.
Approved calculators are allowed.

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

This document consists of 5 printed pages and 3 blank pages.

1 The following Python code defines a recursive function that performs a specific task.

```
1  def recur(s):
2    if len(s) == 1:
3      return s[0]
4    ret=[]
5    for i in range(len(s)):
6      for ss in recur(s[:i]+s[i+1:]):
7        ret.append(s[i] + ss)
8    return ret
```

(a) Explain what is a recursive function ? [2]

(b) Explain the difference between an iterative solution and a recursive solution.to a problem. [2]

(c) Trace the recursive calls when the following code is executed:

`recur("ABC")`

You should clearly indicate the value of the argument used in each recursive call and the value returned, including the final result. [4]

(d) What task does the function `recur` perform ? [1]

(e) What is the run time complexity of the function `recur` ? Explain intuitively how you arrive at your answer. [2]

2 (a) Use pseudocode to describe a recursive function that performs the mathematical exponential function:

$f = x^n$, *where x is a rational number and n is an non-negative integer*.

You are allow to use **only** the four basic arithmetic operators: $+, -, \times$ and $\div$.

Your algorithm should have the most efficient time complexity. [5]

(b) State the time complexity of the algorithm and explain why your algorithm is the most efficient. [2]

3 **(a)** Using an insertion sort, show how the following list of strings can be sorted in alphabetical order:

"MYS", "AUS", "CAN", "SGN", "JPN". [3]

(b) Below is a bubble sort pseudocode for sorting a Python List in ascending order. [4]

Note that declaration statements are omitted in the pseudocode.

```
01    NoSwaps ← False
02    WHILE NoSwaps = FALSE
03          NoSwaps ← TRUE
04          UpperBound ← ListLength - 1
05          FOR Posn ← 0 TO ... A ...
06                IF List[Posn] > ... B ...
07                      THEN
08                            // Swap
09                            NoSwaps ← ... C ...
10                            Temp ← List[Posn]
11                            List[Posn] ← List[Posn + 1]
12                            List[Posn + 1] ← ... D ...
13                IF ENDIF
14          ENDFOR
15    ENDWHILE
```

Write the pseudocode for A, B, C and D in the algorithm.

4 The Income Tax Act for a country is dsecribed as follows :

For persons in the age group 16-65 (both inclusive) tax payment have to be calculated based on the person's annual income. A person earning less than $20,000 will pay 20% taxes, otherwise they pay 40% taxes. If the person has children he/she will receive a tax reduction of 10%.

(a) Create a decision table to describe all the possible conditions and the actions. [4]

(b) Simplify your decision table by removing redundancies [1]

(c) Draw a flow chart to calculate the total amount of taxes to be paid when an input of the annual income is given by a user. [4]

5 **(a)** Describe what is a singly linked Linked List. You may use a diagram to illustrate your answer. [2]

(b) How is a Linked List different from an Array ? Give an example of a use case where a Linked List is preferable to be used instead of an Array. [2]

(c) Using a Unified Modelling Diagram (UML) class diagram, design the class/es for a singly-linked Link List. You must include a brief description of the attributes and methods that you have included in your class/es. Your design must meet the requirements for question **3(e).** [4]

(d) For each of the methods that you have described in **3(c),** indicate the run time complexity in big O notation. [1]

(e) Given two singly linked Linked List `P` and `Q` that are sorted in ascending order, using either pseudocode or structured english, describe an algorithm that merges `P` and `Q` into a single Linked List, `M`, sorted in ascending order. You may make references to the class/es you designed in question **3(c)** [4]

(f) If a Queue data structure is to be implemented using a singly linked Linked List, describe the Queue class using a UML class diagram and describe the changes, if any, needed in your Linked List class/es that you have described in **3(c)**. [4]

6. A food delivery web service is to be build that offers food vendors the ability to submit and published their food delivery offerings on a web portal. Customers will need to register for an account before they are able to browse and order food from the different vendors.

A customer can select food items provided by different vendors for each order that he/she made and the system needs to keep track of the total amount payable by each customer per order. Multiple orders per customer can be made in each day. An extenal payment gateway web service will be used to complete the customer's transaction.

A food vendor needs to register and provide the following data items using the partial web form shown below in order to have their food items published in the web portal.

Store Name: ____ Business Registration Number: ____

Store Address: ____ Owner Contact Number: ____

Owner Name ____ Owner Email: ____

Type of Food: Chinese ◯ Western ◯ Halal ◯ Indian ◯ Others ◯
(Check all that apply):

Food Items offered:

Item No	Food Item	Description	Price(S$)
1			

Add Another Item

Customers will need to provide the following information when registering for an account in the web portal.

- Name
- Delivery Address
- Contact Number

A relational database system is to be used for building the data store used by the web application.

(a) Draw an Entity-Relationship Diagram (ERD) to describe the data model for the system to be build. [6]

(b) Describe the tables for the ERD that you have drawn in **(a)**, in the form of

```
TableName(Attribute1: DATATYPE, Attribute2: DATATYPE , ..)
```

The primary key is indicated by underlying one or more attributes. Foreign keys are indicated by am asterick(*). [6]

(c) When designing a web application, we need to be concern about providing a positive user experience. What is user experience in the context of web application design? How is it related to user interface design? [3]

(d) Design and draw the web form for the customer to order food items. Your design must allow the customer to search quickly for the type of food that he/she wishes to order, minimise user inputs and errors and provide a positive use experience. [4]

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