Name:		Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

COMPUTING (Higher 2) 9569/01

Paper 1 Written **22 September 2023**

3 hours

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** the questions.

Approved calculators are allowed.

You are reminded of the need for good English and clear presentation in your answers.
Please ask the invigilator if you require additional paper.

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.

1 The manager of a company `East Construction Pte. Ltd.` wishes to keep records of the employees. Each employee has the following data recorded:

- `EmpID` is used to identify a particular employee and is at most six characters. The first character is an upper-case letter and the remaining five are digits, e.g. `A23588`.
- `Name` represents the employee's name and is at most 20 characters.
- `PhoneNo` is the telephone number of the contact in case of a problem and is fixed at eight digits.
- `Type` is used to indicate whether the employee is a salaried employee (`S`) or an hourly paid employee (`H`).

Additional data now needs to be stored on the employees:

- `Salary` is used to indicate the monthly salary if the employee is a salaried employee.
- `HourlyRate` is the rate of pay per hour if the employee is an hourly paid employee.
- `HoursWorked` is used to indicate the number of hours per week that an hourly paid employee.

All data of the employees are sensitive.

(a) Draw a diagram that shows suitable classes and their relationships for a solution to this problem the uses object-orientation programming (OOP) techniques. Include appropriate attributes and methods in each class. Method `Payroll()` will be used for generating the payment slips for employees. [18]

A function, `createemployee()`, which when called will allow the user to enter and store data into a text file named `PAYRECORDS.DAT`. The file has the following structure.

```
<NumberOfEmployees>
<EmpID><Name><PhoneNo><Type><HoursWorked><HourlyRate><Salary>
<EmpID><Name><PhoneNo><Type><HoursWorked><HourlyRate><Salary>
:::
```

Following is a sample records for `PAYRECORDS.DAT:`

```
2
Z23669|Tan Chee Yong|85668877|H|5|25.00|0.00
D23456|Shiva Kumar  |93744552|S|0| 0.00|3000.00
```

(b) Explain the purpose of using `<NumberOfEmployees>` in `PAYRECORDS.DAT.`

[1]

(c) Name **two** suitable validation techniques that might be applied to the telephone number.

[2]

(d) Draw **object diagrams** for the sample records from the file PAYRECORDS.DAT. [2]

(e) Programmers who use OOP languages frequently design programs in which objects that are instantiated from different classes respond to identical messages. Explain why this is an important feature of OOP and give an example with reference to **(a)** and **(b)** of how it can be achieved in code. [4]

For the past five years the company used native application for generating payslips and recently transferred to online application. Employees can access the monthly payment online via the company's web application.

(f) Explain **two** benefits and **two** shortcomings each for using native and web applications. [8]

(g) State and apply **two** usability principles in the design of web applications. [4]

(h) Give **three** reasons why companies allow intranet access rather than Internet access to their employees. [3]

2 A linked list can be ordered or unordered.

(a) Explain the difference between searching for an item in an ordered list compared with searching an unordered list. [2]

(b) The table below includes an unordered list of maximum 10 **Name**(s).

Complete the **Next Pointer (1)** column to link the list in ascending alphabetical order. Using **null** for end of list. [3]

Index	Name	Next Pointer (1)	Next Pointer (2)	Next Pointer (3)
0	Smith			
1	Jones			
2	Ahmed			
3	Lewis			
4	Thomas			
5	Brown			
6				
7				
8				
9				

(c) Add Murphy and Collins to the linked list and complete the **Next Pointer (2)** column. [4]

Index	Name	Next Pointer (1)	Next Pointer (2)	Next Pointer (3)
0	Smith			
1	Jones			
2	Ahmed			
3	Lewis			
4	Thomas			
5	Brown			
6				
7				
8				
9				

(d) Complete the **Next Pointer (3)** column to **delete** Smith. [2]

Index	Name	Next Pointer (1)	Next Pointer (2)	Next Pointer (3)
0	Smith			
1	Jones			
2	Ahmed			
3	Lewis			
4	Thomas			
5	Brown			
6				
7				
8				
9				

(e) Describe how a **Name** can be inserted to the end of the linked list. [3]

(f) Explain what needs to be implemented for unused **Name**(s), if new **Name**(s) are only inserted to the end of the linked list. [3]

(g) Draw a representation of a binary tree using the **Name**(s) from question **2(b)** as key values. [3]

3 A chef keeps her recipes on a single-table database system**.** Some assistants help to prepare the foods. **Figure 1** shows the `Recipe` Table.

Figure 1

RecipeID	Dish	RecipeIngredients (including quantity)	PreparationTime	CookingTime	NoOfServings	CookingInstructions
1	Hummus	250g chickpeas 6 cloves garlic 50ml lemon juice 340g tahini	20 minutes	2 hours	8	Cook chickpeas until soft. Puree in food processor. Add remainder of ingredients, mix well.
2	Feta Salad	400g tomatoes 250g feta cheese 1 cucumber 50g olives 45ml vinaigrette	15 minutes	none	4	Mix all salad ingredients together. Season with salt and pepper. Dress with vinaigrette.
3	Casserole	500g chickpeas 400g tomatoes 450g potatoes	10 minutes	2 hours	4	Cook chickpeas until nearly soft. Add cubed potatoes and tomatoes.
:	:	:	:	:	:	:

The chef's only supplier provides her with an on-line price list for her ingredients. **Figure 2** shows the `PriceList` Table.

Figure 2

FoodItemID	FoodItemName	PackSize	Price
Tom001	Tomatoes	400g	$0.55
Chi002	Chickpeas	250g	$0.75
Cuc003	Cucumber	single	$0.50
:	:	:	:

(a) (i) Which of the above two tables is **not** in First Normal Form? [1]

(ii) Why? [1]

(b) The chef would like to be able to cost the ingredients for her dishes and is asking you to help her design a database which would allow the costing of dishes without retyping any of the pricelist details.

Database theory states that database tables should be ***fully normalised***.

(i) What does fully normalised mean? [1]

(ii) Why is it desirable that tables are fully normalised? [1]

(c) When the data in **Figure 1** and **Figure 2** are stored in a fully normalised relational database, three relations, **`Recipe`, `FoodItem`** and **`RecipeIngredient`** are needed. For each of these, complete the relations, making sure the primary key attribute(s) are underlined.

(i) **`Recipe`**(

) [1]

(ii) **`FoodItem`**(

) [1]

(iii) **`RecipeIngredient`**(

) [2]

(d) Using the SQL commands SELECT, FROM, WHERE, ORDER BY and any others that you consider appropriate, write the SQL statement to list all the ingredients and their quantities required for Feta Salad. The results table should also show the pack size of the food item and the associated price. The list should be in alphabetical order of ingredient. [5]

(e) Describe the ways in which access rights can be used to protect the data in the database from unauthorised access. [3]

4 (a) State **three** factors that may affect the performance of a sorting algorithm [3]

(b) The given algorithm is a simple bubble sort that arranges a set of scores stored in a one-dimensional array into **descending** order and orders the corresponding students' names stored into a one-dimensional array in the same order as the scores. All the arrays are indexed from 1.

The contents of both arrays after sorting are shown

	Score
1	97
2	95
:	
:	
248	15
249	10

	Name
1	Paik Poh Leong
2	Lim Hai Choo
:	::
:	::
248	Peters Tan
249	Feng Jun

```
YearSize ← 249
Flag ← TRUE
WHILE Flag = TRUE
      Flag ← FALSE
      FOR Student ← 1 TO YearSize - 1
            IF Score[Student] < Score[Student + 1] THEN
                  Temp1 ← Score[Student]
                  Temp2 ← Name[Student]
                  Score[Student] ← Score[Student + 1]
                  Name[Student]  ← Name[Student + 1]
                  Score[Student + 1]  ← Temp1
                  Name[Student + 1]   ← Temp2
                  Flag ← TRUE
            ENDIF
      NEXT Student
ENDWHILE
```

Write an algorithm, using pseudocode, that will perform the same task using an **insertion sort**. [6]

(c) Big O notation is used to classify efficiency of algorithms.

(i) State the Big O notation for time complexity of bubble sort. [1]

(ii) Compare the time complexity of a bubble sort and insertion sort [2]

5 An email is sent from one email server to another using packet switching.

(a) State two items that are contained in an email packet apart from the data [2]

(b) Explain the role of routers in sending an email from one email server to another [3]

(c) Sending an email message is an appropriate use of packet switching. Explain why this is the case. [2]

(d) Packet switching is not always an appropriate solution. Name an alternative communication method of transferring data in a digital network [1]

(e) Name an application for which the method identified in part **(d)** is an appropriate solution. Justify your choice [2]

End of Paper