



RIVER VALLEY HIGH SCHOOL
General Certificate of Education Advanced Level
Higher 2
Preliminary Examination

COMPUTING

Paper 1

9569/01

18 SEP 2023

3 hours

READ THESE INSTRUCTIONS FIRST

Write your center number, index number and name on all 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, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.

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 **9** printed pages.

Answer **all** questions.

1. Reduce the following decision table.

Condition	C1	C2	C3	C4	C5	C6	C7	C8
A	Y	N	Y	N	Y	N	Y	N
B	Y	Y	N	N	Y	Y	N	N
C	Y	Y	Y	Y	N	N	N	N
Outcome								
1	X		X		X	X	X	
2	X		X	X	X	X	X	

[3]

2. Study the recursive procedure `unknown` below carefully.

```

01 def unknown(lst, i, value):
02     if i < len(lst): # Prevent list index out of range
03         if value == lst[i]:
04             lst.pop(i) # Remove lst[i] from lst
05             unknown(lst, i, value)
06         else:
07             unknown(lst, i+1, value)

```

- a) State the content of `lst` after the following code executes:

```

>>> lst = [1,4,3,1,1,2,3,4,1]
>>> unknown(lst, 0, lst[0])

```

[2]

- b) Explain the purpose of the procedure `unknown`.

[2]

Study the recursive procedure `foo` carefully.

```

01 def foo(lst):
02     def helper(i):
03         if i < len(lst):
04             unknown(lst, i+1, lst[i])
05             helper(i+1)
06     helper(0)

```

- c) State the content of `lst` after the following code executes:

```

>>> lst = [1,4,3,1,1,2,3,4,1]
>>> foo(lst)

```

[2]

- d) Explain the purpose of the procedure `foo`.

[1]

- e) State two pieces of information that are stored in a stack frame during a recursive call.

[2]

- f) Explain how stack frames are used during a recursive call.

[3]

3. The change in the position of the elements in an array during a sorting process is shown below.

```
[6, 3, 8, 1, 4, 9, 7, 2, 5]
[3, 6, 8, 1, 4, 9, 7, 2, 5]
[3, 6, 8, 1, 4, 9, 7, 2, 5]
[1, 3, 6, 8, 4, 9, 7, 2, 5]
[1, 3, 4, 6, 8, 9, 7, 2, 5]
[1, 3, 4, 6, 8, 9, 7, 2, 5]
[1, 3, 4, 6, 7, 8, 9, 2, 5]
[1, 2, 3, 4, 6, 7, 8, 9, 5]
[1, 2, 3, 4, 5, 6, 7, 8, 9]
```

- Identify the sorting algorithm used. [1]
- Explain your answer in **3a**). [1]
- State the time complexity of this sorting algorithm. [1]
- State a condition for this sorting algorithm to perform well. [1]
- Explain your answer in **3d**). [1]

The quicksort function `qs` is implemented as follow:

```
01 def qs(lst, start, end):
02     if start < end:
03         pivot = partition(lst, start, end)
04         print(lst, lst[pivot])
05         qs(lst, start, pivot-1)
06         qs(lst, pivot+1, end)
```

The function `partition` takes `lst[start]` as the pivot and returns the position of the pivot in `lst` after the partitioning process.

```
>>> lst = [5,3,8,1,4,9,7,2,6]
>>> qs(lst, 0, len(lst)-1)
```

The output of line 04 is partially shown below when the code above is executed.

```
[3, 1, 4, 2, 5, 8, 9, 7, 6] 5
[1, 2, 3, 4, 5, 8, 9, 7, 6] A
[1, 2, 3, 4, 5, 8, 9, 7, 6] B
[1, 2, 3, 4, 5, 7, 6, 8, 9] C
[1, 2, 3, 4, 5, 6, 7, 8, 9] D
```

- State the values of A, B, C and D. [2]
- State a condition for this sorting algorithm to perform badly. [1]

4. As the network engineer of the company, you are required to handle multiple technical issues related to computer networks. Below are some examples that you need to handle.
- i. Lost or out-of-order packets that affect the quality or integrity of the data.
 - ii. Congestion or overload on the network causes delays or timeouts.
 - iii. Malware or viruses that infect or compromise the application or the data.
 - iv. Broken or loose cables that prevent data from reaching the destination device.
 - v. Blocked or filtered ports that prevent applications from communicating with each other.
 - vi. Authentication or authorization failures that prevent access to the application or the data.
 - vii. Incompatible or outdated network interface cards (NICs) that do not support the required speed or protocol.
 - viii. Invalid or duplicate IP addresses that cause conflicts or confusion.
- a) For each of the technical issues mentioned above, identify the layer in TCP/IP protocol suite that you should look in. [5]
 - b) State a reason for defining TCP/IP protocol suite in layers. [1]
 - c) State 2 differences between TCP and UDP. [2]
 - d) Explain the function of the following devices. [2]
 - o Router
 - o Switch
 - e) State the most appropriate solution in preventing or protecting the following network threats. [4]
 - o Unauthorized access to system or network from known sources
 - o DDOS from unknown sources
 - o Malware
 - o Data theft or data leakage
 - f) Convert the following IPv4 address from hexadecimal to decimal. [2]

C0 . A8 . 03 . 9C
 - g) State 2 areas in which a digital signature can ensure. [2]
 - h) Explain how a digital signature works (about 6 steps). [3]

5. A recruitment company has many types of jobs to offer. These jobs can be commission based or salaried based. The company decides to implement recruitment application using object-oriented programming (OOP) so that users can easily view the job information and find out how much the job pays.

Each job will have the following information recorded:

- name – the name of the job e.g. software engineer, sales manager etc.
- company – the name of the company offering the job.
- description – description of the job including the job position.
- requirement – the skills, education, experience, and traits that an employer expected to be successful in the job position.

There are two types of jobs: Salaried based and Commission based.

Each salaried job pays by its base salary monthly and it includes an annual bonus. Each salaried job allows a maximum number of paid leaves.

Each commission job pays by commission, and it is the product of the total sale made monthly and the commission percentage. *Note: The total sale and commission percentage is an estimated value provided by the company which offers the job.*

- a) Draw a class diagram, based on the information above, showing:
- appropriate sub-classes,
 - inheritance,
 - the properties required,
 - appropriate methods, including but not limited to the constructor methods, and at least one pair of 'get' and 'set' methods for each class,
 - circle the polymorphed methods.

[6]

- b) Using the above example, state the definition of inheritance and explain its purpose/advantage in object-oriented programming.

[2]

The company is doing well and has attracted millions of views from many users. The company does not store any user's information initially. But in view of the current growth, the company decides to collect some users' information to facilitate better job matching and enhance its business model.

- c) Explain what the company should do so not to violate the Personal Data Protection Act (PDPA).

[4]

You are tasked to write a code of conduct for the recruitment company.

- d) Suggest 2 rules that you would expect to be included for company. Each rule given must be different.

[2]

- e) For each of the rules stated in **5d)**, give an example of the unethical behavior it is designed to prevent.

[2]

6. The company is organizing a lucky draw for its employees, where each participant will be assigned a random 4-digit lucky number. Each employee is identified by their 7-digit employee ID running from 0000001 to 9999999.

The lucky draw will have an estimated 7,000 participants out of the 10,000 employees in the company. To make it easy for the employees to check their lucky numbers, the company will provide a search function on its website. Employees can enter their employee ID and see their corresponding 4D number instantly.

- a) Explain clearly how you can use a hash table to achieve the above. [3]

10 unique lucky numbers are picked, the team needs to inform the lucky winners.

- b) Explain why the current implementation is inefficient for this purpose. [2]

- c) Suggest what you would do such that the above task can be done much more efficiently yet maintain the efficiency to search lucky number by employee id. [3]

7. A binary tree is implemented using an array, `b_tree`. Each element of the array comprises three parts: `l_ptr` and `r_ptr` are of data type integer and `data_item` is of data type char.

The root of the binary tree is stored in an integer variable, `root`.

The contents of `b_tree` is shown below. -1 represents the null pointer.

`root`

5

index	<code>l_ptr</code>	<code>data_item</code>	<code>r_ptr</code>
0	2	D	3
1	-1	F	-1
2	-1	B	6
3	-1	E	1
4	-1	A	-1
5	0	G	7
6	4	C	-1
7	-1	H	-1

- a) Draw the binary tree represented by `b_tree`. [3]
- b) State and explain if `b_tree` is a binary search tree. [2]

A procedure, `P`, uses recursion.

```

01 PROCEDURE P(Index: INTEGER)
02   IF b_tree[Index].l_ptr <> -1 THEN
03     P(b_tree[Index].l_ptr)
04   ENDIF
05   OUTPUT b_tree[Index].data_item
06   IF b_tree[Index].r_ptr <> -1 THEN
07     P(b_tree[Index].r_ptr)
08   ENDIF

```

- c) State the output when procedure `P` is called with the parameter value of 0. [2]

8. RV ICT department is asking RDeV, a full stack development team, to work out a database system to manage loan of spare Personal Learning Device (PLD) for students whose PLDs are unavailable or require additional PLDs for projects.

The database will store loan data on details of student borrowers, the details of the PLD loaned and the loan details.

The loan will operate with the following details:

- Each student can loan out many PLDs.
- Each PLD can be loaned out to many different students at different times.
- All records of borrower who loan the PLD will be retained for tracing purposes.
- A unique student matriculation number is recorded with the name in the loan detail for accurate identification of the borrower.
- Any loan details which loan date is missing means the PLD is still on loan.
- Loan return date will only be recorded after the PLD is returned.

Before the use of relational database, the loan details are captured in a form which are then transferred into a spreadsheet. A snippet of the spreadsheet is shown below:

Device ID	Device Description	PLD Purchase Date	Loan Details (name, Matriculation, loan date, return date)
R9-133846	Lenovo L13 20R5	10/10/2021	Loh TK, 532861R, 11/10/2021, 17/10/2021; Tan KS, 534952E, 21/10/2021, 30/10/2021; Lim KK, 533495F, 02/11/2021
NXVPNSG0011491AF3D7600	Acer TMP214-53	04/05/2022	
R9-1345W	Lenovo L13 20R5	10/10/2021	Tan KS, 534952E, 01/11/2021, 05/11/2021 Oh CW, 538539G, 11/11/2021, 17/11/2021; Yip HN, 532341P, 21/11/2021, 30/11/2021;
...

- Explain why the table is not in the first normal form (1NF). [1]
- Explain if data redundancy occurs in the table? [1]
- Explain with example, one possible issue which may arise from using the spreadsheet database as a direct consequence of data redundancy. [2]

RDeV decided on 4 entities to define the data that needs to collect:

- Student – details of student borrowers
- PLD – details of PLD
- Loan – details of loan
- Return – return of the loan

The following are samples of the data collected under the 4 entities after RDeV attempt on normalisation:

Student

Matriculation	Name
534952E	Tan KS
532861R	Loh TK
533495F	Lim KK
...	...

PLD

Device ID	Device Brand	Device Model	Date Purchase
R9-133846	Lenovo	L13 20R5	10/10/2021
R9-1345W	Lenovo	L13 20R5	10/10/2021
NXVPNSG0011491AF3D7600	Acer	TMP214-53	04/05/2022
...

Loan

Loan ID	Student Matriculation	Device ID	Loan Date
PLD220001	532861R	R9-133846	11/10/2021
PLD220002	534952E	R9-1345W	01/11/2021
PLD220003	533495F	R9-133846	02/11/2021
...

Return

Return ID	Loan ID	Return Date
R220001	PLD220001	17/10/2021
R220002	PLD220002	05/11/2021
...

- d) Give suitable primary key(s) for table Student, PLD, Loan and Return. [4]
- e) Explain the 2 aims for normalization in relational database. [2]
- f) Explain with reference to normal form requirements if the table Loan is in 3NF? [2]
- g) Draw out the entity-relationship (ER) diagram for the 4 entities. [6]

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 using a dashed underline.

- h) Write table descriptions for the required tables in the database so that they are in third normal form (3NF). [7]

The End