



**UNIVERSITI TEKNOLOGI MARA
FINAL EXAMINATION**

COURSE	:	DATA STRUCTURES AND ALGORITHMS
COURSE CODE	:	ECE532
EXAMINATION	:	JULY 2017
TIME	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. This question paper consists of five (5) questions.
2. Answer ALL questions in the Answer Booklet. Start each answer on a new page.
3. Do not bring any material into the examination room unless permission is given by the invigilator.
4. Please check to make sure that this examination pack consists of:
 - i) the Question Paper
 - ii) an Answer Booklet – provided by the Faculty
5. Answer ALL questions in English.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

This examination paper consists of 9 printed pages

QUESTION 1

- a) The program in **Figure Q1a** demonstrates a pointer dereferencing.

```
1  #include <iostream>
2
3  int mystery(int, int*, int&);
4
5  int main() {
6  int a = 0, b = 0, c = 0, d = 0;
7  mystery(a, &b, c);
8  cout << a << " " << b << " " << c << " " << d << endl;
9  mystery(c, &d, a);
10 cout << a << " " << b << " " << c << " " << d << endl;
11 c = mystery(b, &a, d);
12 cout << a << " " << b << " " << c << " " << d << endl;
13 a = mystery(a, &a, a);
14 cout << a << " " << b << " " << c << " " << d << endl;
15 return 0; }
16
17 int mystery(int a, int* b, int& c)
18 {
19     a++;
20     (*b)++;
21     c++;
22     return a;
23 }
```

Figure Q1a

- i) Indicate what are the outputs if statements in lines 8, 10, 12 and 14 are executed?

(4 marks)

- ii) Explain the operation that occurs in line 20.

(1 mark)

b)

```
struct node
{
    int data;
    struct node *next;
}*head,*tail;
```

Figure Q1b

Figure Q1b above shows the structure definition of a node in a linked list. Suppose we have series of nodes on a linked list, write function definition for `void operation()` that will calculate :

- i) The number of even numbers.
- ii) The sum of all odd numbers.

The function then will display both outputs.

(10 marks)

c) Identify **THREE (3)** differences between a general tree and a binary tree.

(5 marks)

QUESTION 2

a)

- i) Identify **TWO (2)** criteria shared by an array.

(1 mark)

ii)

```
int array1[5] = {4,5,6,7,8};  
int array2[3][2] = {4,5,6,7,8};
```

Based on the declaration shown above:

- 1) Identify what are the elements for array1[1] and array1[4].
- 2) Explain briefly the subscripts (locations) for array2. What do values 3 and 2 mean in the declaration?

(4 marks)

- b) Examine and calculate the following postfix expression by using **STACK**. Show your steps clearly.

4 5 + 3 2 * 2 ^ - 8 4 / + 3 +

(10 marks)

c)

$V(G2) = \{0, 1, 2, 3, 4, 5, 6\},$
 $E(G2) = \{(0,1),(0,2),(1,3),(1,4),(2,5),(2,6)\}$

- i) Illustrate a simple tree based on the set of vertices and edges information given above.
- ii) Identify the list of nodes based on Depth-first search (DFS) algorithm.
- iii) Identify the list of nodes based on Breadth-first search (BFS) algorithm.

(5 marks)

QUESTION 3

- a) Write the function definition for `int calculateSum(int A)`. This function will calculate the sum of all numbers between 0 and A (assuming A is a positive integer number). You must use a recursive function concept to find the answer.

(5 marks)

b)

- i) Identify the main difference between **QUEUE** and **STACK**.
- ii) Identify and explain **THREE (3)** notations (expressions) that can be represented by using stack.

(5 marks)

- c) Given the following array of data:

0	18	22	19	3	17	16	6	1	15	2
---	----	----	----	---	----	----	---	---	----	---

By using an insertion sorting concept, write the content of the array for each iteration. You must show the content of the array clearly in each iteration.

(10 marks)

QUESTION 4

a)

- i) In data structure, there are two types of stack which are static and dynamic stacks. Identify the difference between a static stack and a dynamic stack. Discuss how can we implement the static and dynamic stacks using C++ programming.

(4 marks)

- ii) Describe **TWO (2)** basic operations that can be performed by using stack.

(2 marks)

- iii) Suppose the following operations in **Table Q4a1** are performed on an empty stack:

Table Q4a1

Line	Statement
1	push(10);
2	push(0);
3	pop();
4	push(25);
5	push(50);
6	pop();
7	push(1);
8	pop();
9	pop();

Identify values in the following table (**Table Q4a2**) to show what will be stored in the static stack after the operations above have been executed.

Table Q4a2

After Line 1 was executed	After Line 2 was executed	After Line 3 was executed	After Line 9 was executed

(4 marks)

- b) **Figure Q4b** illustrates the distances between selected cities in Peninsular Malaysia. Apply Dijkstra's Algorithm to find the shortest path between KL (starting node) and all other nodes.

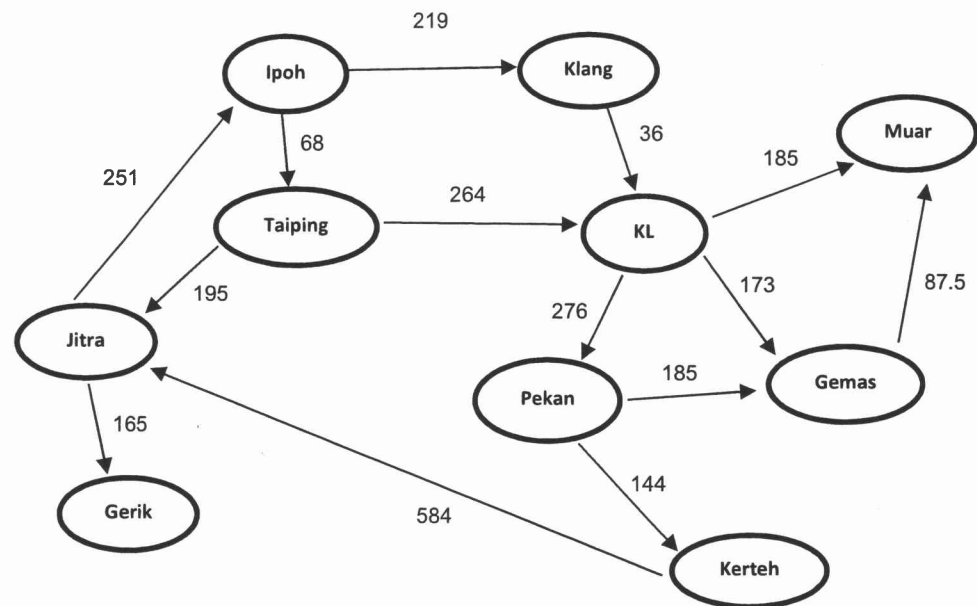


Figure Q4b

(10 marks)

QUESTION 5

a)

- i) Write the function definition for selection sorting algorithm using C++ programming codes based on the following function prototype (parameter n is the number of elements in the array):

```
void selectionSort (int [ ], int n);
```

(4 marks)

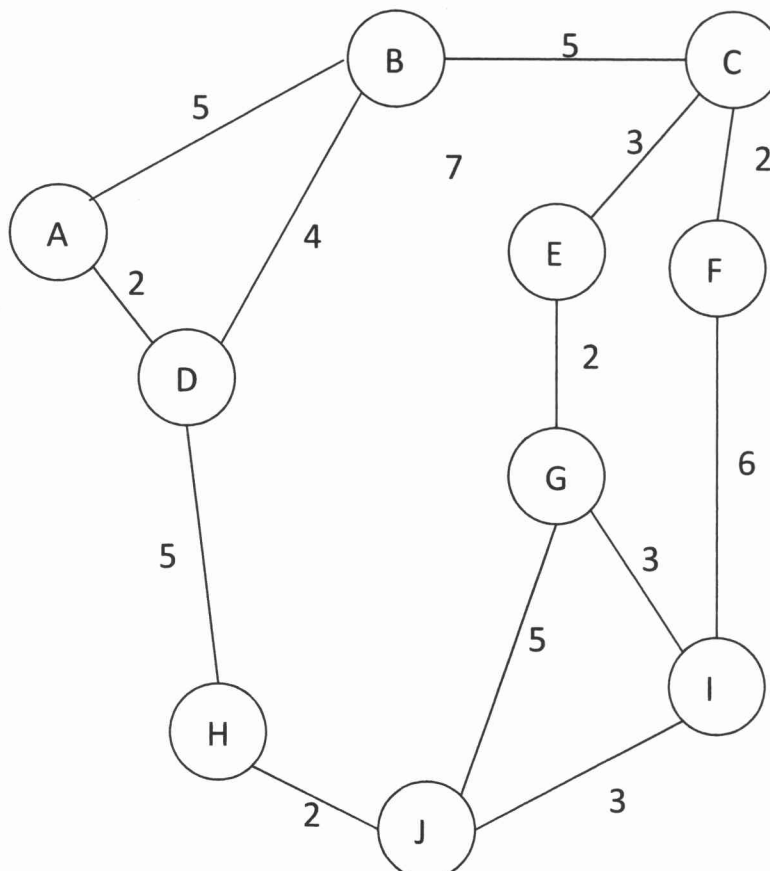
- ii) Using selection algorithm on the numbers shown in **Figure Q5a**, re-arrange the numbers in every iteration.

70	30	20	50	60	10	40
----	----	----	----	----	----	----

Figure Q5a

(5 marks)

- b) A minimum spanning tree is a graph which consists of all vertices, and it may not contain all original edges. By using Kruskal's Algorithm, design the minimum spanning tree for the graph shown in **Figure Q5b**.

**Figure Q5b**

(6 marks)

- c) Linear search is a very simple algorithm, it uses a loop or a recursion to sequentially step through an array, starting with the first element. It compares each element with the value being searched for and stops when either the value is found or the end of the array is encountered.

Given the function prototype as follows:

```
int LinearSearch(int array[], int key, int size);
```

write a recursive function definition to perform linear search ,where array[] is the set of numbers, key is the special member that uniquely identifies the item in the data set and size is the array size.

(5 marks)

END OF QUESTION PAPER