UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	ALGORITHM AND COMPLEXITIES
COURSE CODE	:	BIE 20303
PROGRAMME CODE	:	BIP
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **THREE (3)** PAGES

Q1 (a) Estimate the time complexity for the following procedure based on steps count. The explanation is required to support the answer.

```
#include  <stdio.h>
#include  <stdlib.h>
void main()
{
   int i,j, x=1,y=1
   for (i=1; i<2n;i++)
    for (j=1;j<=i;j++)
     {
      x = x+y;
      y = y+z;
      }
   printf("The value for x, y and z is :\n")
   printf("%d    %d    %d",x,y,z)
}
```

(6 marks)

(b) An algorithm with time complexity $O(f(n))$ and processing time $T(n)= cf(n)$, where $f(n)$ is known a function of n, spends 10 seconds to process 1000 data items. How much time will be spent to process 10,000 data items if $f(n) = n$ and $f(n) = n^4$.

(4 marks)

Q2 (a) Let S_n be a sequence of `1,4,7,...,(3n-2)`

Find a series of S_n.

(6 marks)

(b) Write a recursive algorithm to answer Q2(a) above.

(4 marks)

Q3 (a) Write an algorithm for merge sort for a set of numbers $\{a_1, a_2, \ldots, a_n\}$.

(4 marks)

(b) What is the worst case complexity of the algorithm in **Q3(a).**

(3 marks)

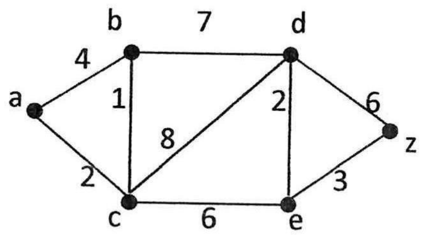
(c) Sort `5 9 4 12 7 19 2` using merge sort algorithm.

(3 marks)

Q4 (a) Write a Dijkstra's algorithm for weighted graph issue.

(4 marks)

(b) Find the length of shortest path between the vertices a and z in the weighted graph below (steps are required).



(6 marks)

Q5 (a) Suppose that a computer can execute an operation of an algorithm in 10^{-17} seconds. What is the largest size problem that can be solved on such machine for different durations and running times for **Table 1**?

(6 marks)

Table 1: The largest size problems that can be solved

	n	n^2	n^3	2^n
1 hour				
10 hours				
100 hours				
1000 hours				

(b) Let $f(n)$ be a recursive function such that $f(n) = a^k f(1) + c\sum_{j=0}^{k-1} a^j$,

where $a \geq 1$ and c is a constant.

Show that $f(n) = O(n^{\log_b a})$ when $n \neq b^k$.

(4 marks)

- END OF QUESTIONS –