UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

Department of Computing

B. Sc. Examination 2018

IS50003B, IS50003C
Foundations of Problem Solving

Duration: 2 hours 15 minutes

Date and time:

This paper is in two parts: part A and part B. You should answer ALL questions from part A and TWO questions from part B. Part A carries 40 marks, and each question from part B carries 30 marks. The marks for each part of a question are indicated at the end of the part in [.] *brackets.*

There are 100 marks available on this paper.

The use of calculator is allowed. Students are required to note the model of the calculator in the answer sheet.

Electronic calculators must not be programmed prior to the examination. Calculators which display graphics, text or algebraic equations are not allowed.

THIS PAPER MUST NOT BE REMOVED
FROM THE EXAMINATION ROOM

Part A

Question 1

In order to write a program for finding the sum of even numbers between 8 to 69 (consider both 8 and 69 in your program), you have been asked to perform the following tasks:

i. Write the pseudo code of your algorithm to solve the problem. [10]

ii. Draw the flowchart of your algorithm. [10]

Show clearly the variables used in your algorithm as well as the start and the end of your algorithm.

Question 2

The aim is to sort the numbers shown below in descending order

9, 6, 14, 2, 13, 5, 11, 5

(a) i. For the sorting purpose, use bubble sort to perform the first pass, giving the state of the list after each exchange. And state the number of comparisons needed to perform the first pass.

ii. Continue with the bubble sort and perform further passes, showing the state of the list after each pass, until the algorithm terminates. State how many passes are needed in total before the algorithm terminates.

[10]

(b) Assume you have the list of all the letters in the alphabet, sorted in alphabetical order.

i. Show you work clearly on how to use a binary search to find letter P. In each iteration, clearly show the letter picked, as well as the part of the list you keep.

ii. State what is the maximum number of iterations needed in order to find any particular letter of the alphabet. And justify your answer.

[10]

Part B

Question 3

The cost of transporting each unit of stock from each of the the supply locations, 1, 2, 3, 4, to each of the demand location, A, B and C is shown in the table below. The table also shows that the supply held at each supply location and the demand required at each demand location. The goal is find a minimal cost solution.

	A	B	C	Supply
1	31	29	32	20
2	22	33	27	22
3	25	27	32	20
4	23	26	38	38
Demand	35	25	30	

i. In your answer sheet, add a dummy demand destination to the table above, and insert the appropriate values. [2]

ii. Use north-west corner method to find an initial solution. [8]

The table below, shows some of the improvement indices for this solution.

	A	B	C	D
1		-13		-9
2			-11	
3				
4	1	-7		

iii. Calculate the missing improvement indices as well as the shadow costs, then enter them into Table 3 in the answer sheet. [10]

iv. To obtain an improved solution, use the stepping-stone method. You must make your route clear and state your entering cell and exiting cell. [10]

Question 4

The table below shows the least costs, in pounds, of travelling between 6 cities, labelled as A, B, C, D, E and F.

	A	B	C	D	E	F
A	-	36	18	28	24	22
B	36	-	54	22	20	27
C	18	54	-	42	27	24
D	28	22	42	-	20	30
E	24	20	27	20	-	13
F	22	27	24	30	13	-

Alice must visit each city at least once. She will start and finish at A and wishes to minimise the total cost.

(a) Use Prim's algorithm, starting at A, to find a minimum spanning tree for this network. [5]

(b) Use your answer to part (a) to help you calculate an initial upper bound for the length of Alice's route. [4]

(c) Show that there are two nearest neighbour routes that start from A. You must make your routes and their lengths clear. [10]

(d) State the best upper bound from your answers to (b) and (c). [2]

(e) Start by deleting A, and all of the arcs connected to it, and find a lower bound for the route length. [9]

Question 5

You have been asked to maximise P subject to some constraints.

$$\begin{aligned} P = 5x + 7y &= 4z \\ 5x + \frac{1}{2}y &\leq 5 \\ x - 2y + 4z &\leq 3 \\ 8x + 4y + 6z &\leq 6 \end{aligned}$$

i. Map the equations above into a Simplex Tableau. [4]

ii. Identify the pivot column, pivot row and the pivot value. [6]

iii. In a new table, find the row operations for each row and update the values in the table accordingly. [16]

iv. Convert the last row of the table into an equation and then state your reason why the value you have found is the maximum value. [4]