UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

Department of Computing

B. Sc. Examination 2016

IS50003B
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.

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 odd numbers between 11 to 59, 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 list of numbers shown below is to be sorted into descending order.

25, 22, 30, 18, 29, 21, 27, 21

(a) i. 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 by conducting 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]

The numbers (now sorted from the question above) represent the lengths, in cm, of pieces to be cut from rods of length 50 cm.

(b) i. Show the result of using the first fit decreasing bin packing algorithm to this situation.

ii. State whether your solution to question b.(i) has used the minimum number of 50 cm rods.

[10]

Part B

Question 3 Allocation (assignment) problem

To raise money for charity it is decided to hold a doll making competition. Teams of four compete against each other to make 20 identical dolls as quickly as possible.

There are four stages: first cutting, then stitching, then filling and finally dressing.

Each team member can only work on one stage during the competition. As soon as a stage is completed on each doll the work is passed immediately to the next team member.

The table shows the time, in seconds, taken to complete each stage of the work on one doll by the members A, B, C and D of one of the teams.

	cutting	stitching	filling	dressing
A	66	101	85	36
B	66	98	74	38
C	63	97	71	34
D	67	102	78	35

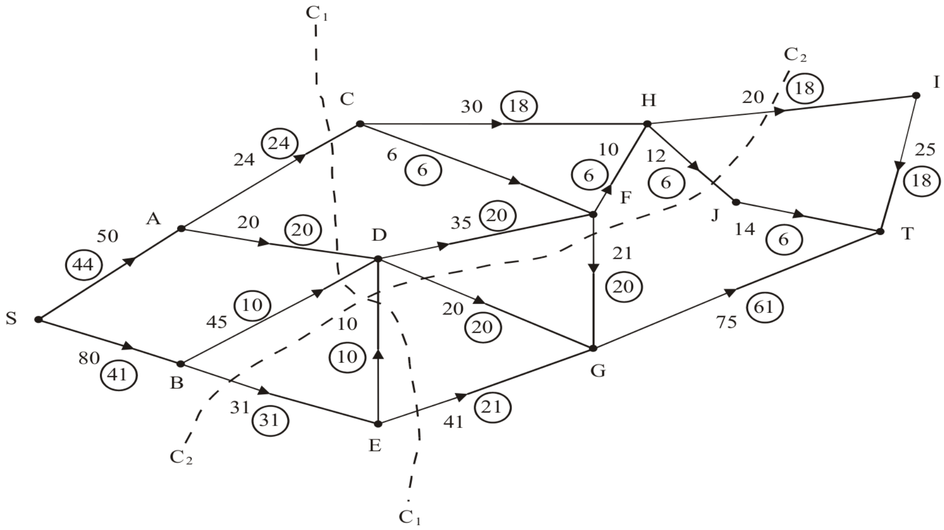
(a) Apply the Hungarian algorithm, reducing rows first, to obtain an allocation that minimises the time taken by this team to produce one doll. You must make your method clear and show the table after each iteration. [20]

(b) State the minimum time it will take this team to produce one doll. [4]

(c) Using the allocation found in (a), calculate the minimum total time this team will take to complete 20 dolls. You should make your reasoning clear and state your answer in minutes and seconds. [6]

Question 4 Network Flow

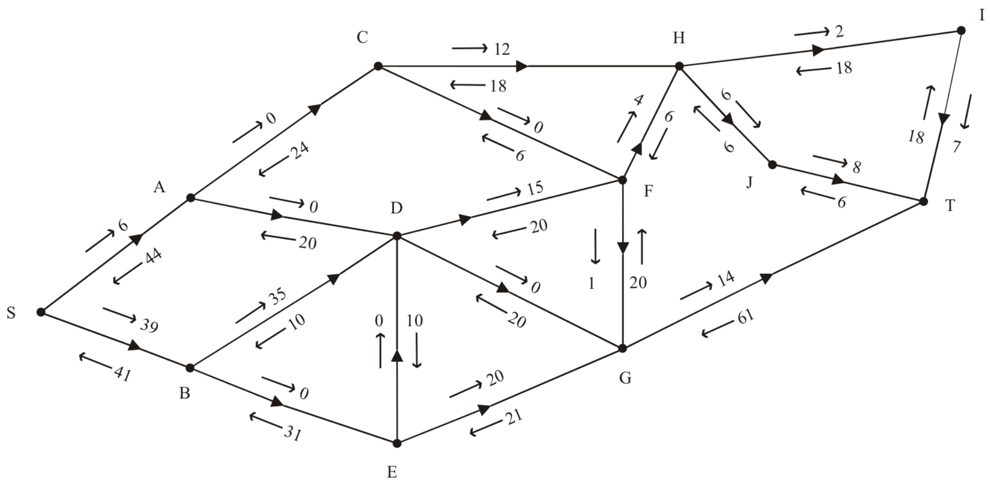
The figure below shows a directed, capacitated network. The number on each arc represents the capacity of that arc. The numbers in circles represent an initial flow along that arc.



(a) State the value of the initial flow. [3]

(b) State the capacities of cuts C_1 and C_2. [6]

The figure below illustrates the labelling procedure applied to the above network.



(c) Using the figure showing the labelling procedure, increase the flow by a further 19 units. You **must** list each flow-augmenting path you use, together with its flow. [15]

(d) Prove that the flow is now maximal. [6]

Question 5 Transportation problems

The table below shows the cost of transporting one block of staging from each of two supply points, X and Y, to each of four theatres, A, B, C and D. It also shows the number of blocks held at each supply point and the number of blocks required at each theatre. A minimal cost solution is required.

	A	**B**	**C**	**D**	**Supply**
X	28	20	19	16	53
Y	15	12	14	17	47
Demand	18	31	22	29	

(a) Use the north-west corner method to obtain a possible solution. [5]

(b) Taking the most negative improvement index to indicate the entering square, use the stepping stone method **twice** to obtain an improved solution. You must make your method clear by stating your shadow costs, improvement indices, routes, entering cells and exiting cells. [20]

(c) Is your current solution optimal? Give a reason for your answer. [5]