Greenwood College
Year 12 Applications
Test 6 2019
Resource-Free

GREENWOOD

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LEARN GROW CHANGE

COLLEGE

Name……………………………………………………………………………………

No calculators nor notes allowed.   Formula sheet allowed.
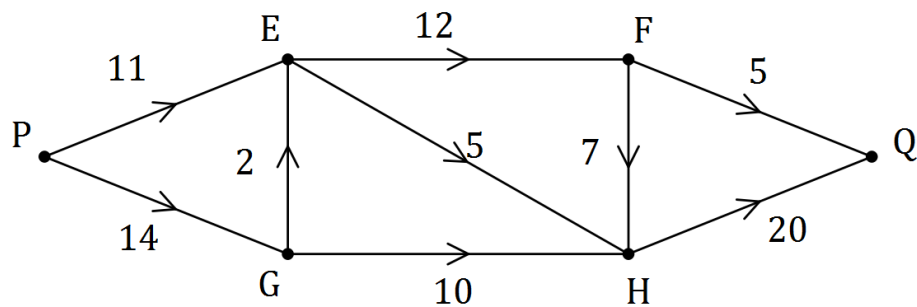27 mark total.   30 minute time limit.

Question 1   **(5 marks)**

The network shows a system of pipes with the maximum capacity for each pipe, in litres per second, shown on the edges.

(a)   Determine the maximum flow through the system from P to Q.   (3 marks)

(b)   Show the cut on the network that has capacity equal to the maximum flow.
                                                                    (2 marks)

Question 2 **(5 marks)**

Cabling between ten distribution boards in a factory is to be upgraded to ensure the supply of electricity between all boards in an emergency. The upgrade costs between adjacent boards, in thousands of dollars, are shown on the edges in the weighted graph.
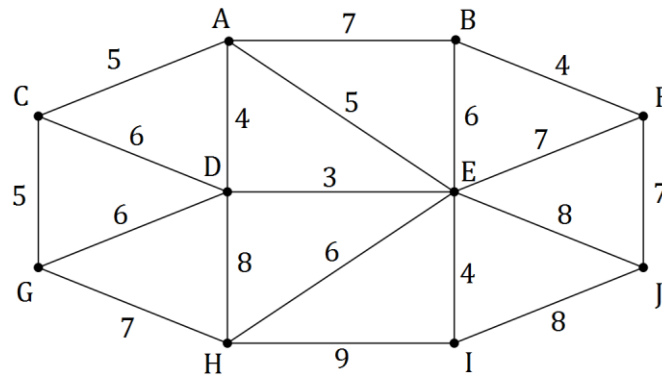
(a)   Determine the minimum spanning tree for the graph, clearly showing it on the graph. (3 marks)

(b)   Calculate the cost of upgrading the cabling that forms the minimum spanning tree. (2 marks)

Question 3   **(7 marks)**

Five people, A, B, C, D and E are to be allocated to five tasks, $1, 2, 3, 4$ and 5. The bipartite graph below shows the tasks that each of the five people can carry out.
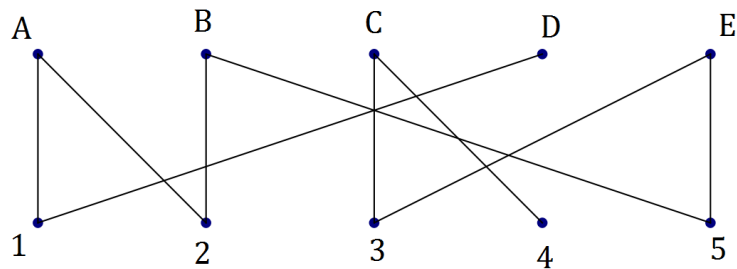
(a)   Does the graph contain a bridge? Explain your answer.   (2 marks)

(b)   Explain why the graph is not a complete bipartite graph.   (1 mark)

(c)   If person B is assigned to task 2, explain why a complete matching of people to tasks is not possible.   (2 marks)

(d)   Determine a complete matching of people to tasks.   (2 marks)

Question 4   **(10 marks)**

The following table shows the scores of four people, Peta, Qi, Ro and Sam after taking four tests in accounting (A), economics (E), finance (F) and law (L).

	Peta	Qi	Ro	Sam
A	11	15	10	14
E	11	16	13	12
F	12	13	14	11
L	10	12	11	12

Each of the four people are to be assigned to one of the four tests so that the total score is maximised. No-one can be assigned to more than one test.

(a)   Explain why the Hungarian algorithm may be used to find the optimal assignment if each number in the table, n, is replaced by $16 - n$.   (2 marks)

(b) Form a new table by replacing each number in the original table, n, with $16 - n$.   (1 mark)

	Peta	Qi	Ro	Sam
A				
E				
F				
L				

(c) Use the Hungarian algorithm to determine how each of the people should be assigned to the four tests to maximise their total score, and state what this maximum score is.   (5 marks)

	Peta	Qi	Ro	Sam
A				
E				
F				
L				

	Peta	Qi	Ro	Sam
A				
E				
F				
L				

	Peta	Qi	Ro	Sam
A				
E				
F				
L				

	Peta	Qi	Ro	Sam
A				
E				
F				
L				

	Peta	Qi	Ro	Sam
A				
E				
F				
L				

(d)   A statistics test score (S) is recorded for each student.   To apply the Hungarian algorithm again what has to be done to the matrix?   (2 marks)

	Greenwood College **Year 12 Applications** **Test 6 2019** **Resource-Allowed**

Name……………………………………………………………………………………………

Formula sheet, one A4 page single-sided of notes and calculators allowed.

21 mark total.   25 minute time limit.

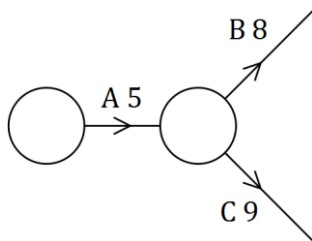**Question 5**   **(3 marks)**

The tasks involved in a construction project are shown in the table below.

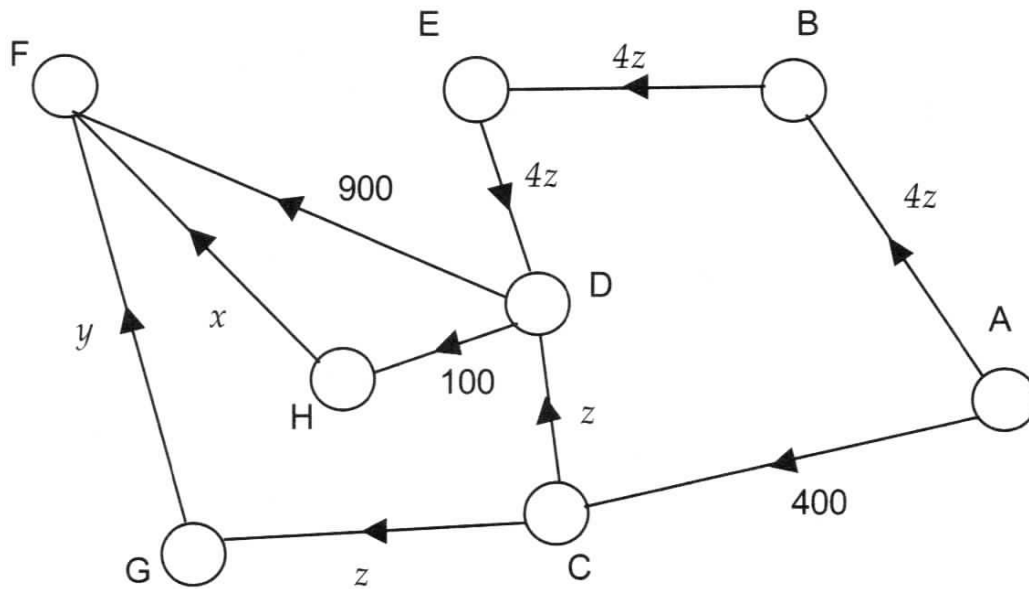| Task	A	B	C	D	E	F	G	H	J
Duration (days)	5	8	9	7	8	10	2	11	6
Immediate predecessors	-	A	A	B	B	C	D, E, F	C	G, H

Complete the project network below.   (3 marks)

Question 6 **(9 marks)**

The following network diagram shows the flow in a system of pipes that achieve the maximum flow for the system (in Litres per minute).
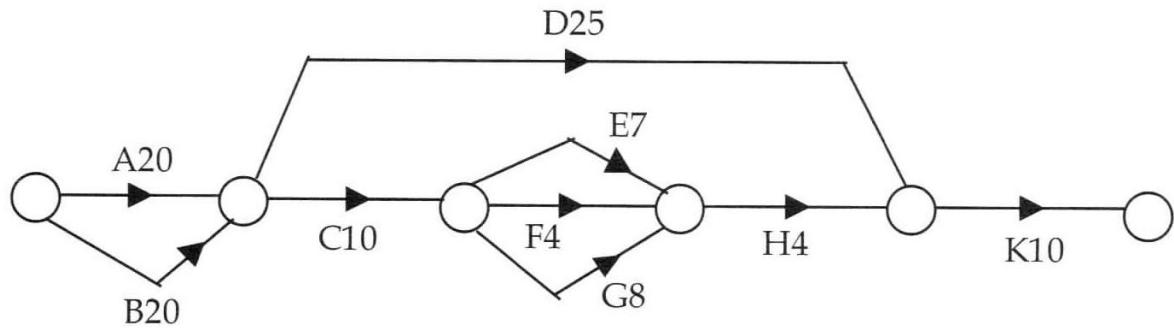

(a) State the source abd sink. (1 mark)

(b) Calculate x, y and z. Justify your answers. (6 marks)

(c) Calculate the maximum flow. (2 marks)

Question 7 (9 marks)

Amy is involved in setting up a function room for a party. The diagram below shows the project network for this task. Each activity requires a person's full attention and the associated time is measured in minutes.

(a) What is the minimum time required by Amy, working alone, to complete the job? Justify your answer. (2 marks)

(b) What would the minimum completion time if Mary gave Amy a hand right from the start? Justify your answer. (3 marks)

(c)   By how much would the minimum completion time in part (b) change if John and Mary were available to help Amy from the start? Justify your answer.

(4 marks)