 <b>CORPUS CHRISTI COLLEGE</b> <small>SEQUERE DOMINUM</small>	<b>Corpus Christi College</b>
	<b>12 MATHEMATICS Applications</b>
	<b>Test 5</b>

Name:
Teacher:

**Date:** 6 Sep 2018  
**Time:** 50 minutes  
**Weight:** 8%  
**Total:** 51 marks

**TOPIC:** Network and Decision Maths

**INSTRUCTIONS:**

- Answer the questions in the spaces provided
- Show all necessary working out
- Marks may be deducted for careless or untidy work.
- Calculator and ONE A4 page back and front of notes are allowed.

Result
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**Student Reflection**

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	TOTAL
Allocation	Minimum Spanning Tree	Maximum Flow	Project Networks	Allocation	Allocation	Minimum Spanning Tree	Project Networks	
<b>6</b>	<b>6</b>	<b>11</b>	<b>8</b>	<b>6</b>	<b>7</b>	<b>4</b>	<b>3</b>	<b>51</b>

**What Went Well:**

I did well at...

**Areas for Development:**

I need to improve...

1. [4,2]

A manufacturer has four different machines that can produce four different parts at different rates. The following table illustrates the total output of each machine after one day.

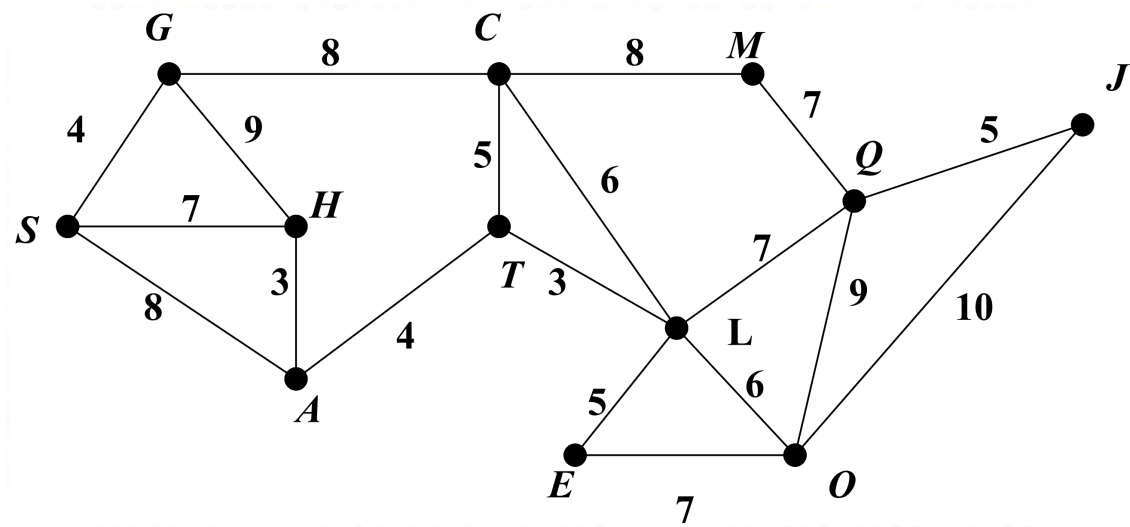
	Part 1	Part 2	Part 3	Part 3
Machine A	50	70	69	58
Machine B	55	69	71	62
Machine C	62	73	55	64
Machine D	75	50	75	66

(a) Use the Hungarian Algorithm to state which machine should be allocated to produce each part to **maximise** output.

(b) Clearly state which part should be allocated to each machine, and the maximum output of each machine?

2. [3,1,2]

The school network is being upgraded to improve performance. However, there are a few extra paths that don't necessarily need to be upgraded. The school is looking for a way to reduce cabling around the campus. Below is a Network diagram that shows the cost (in thousands of dollars) of upgrading each cable.



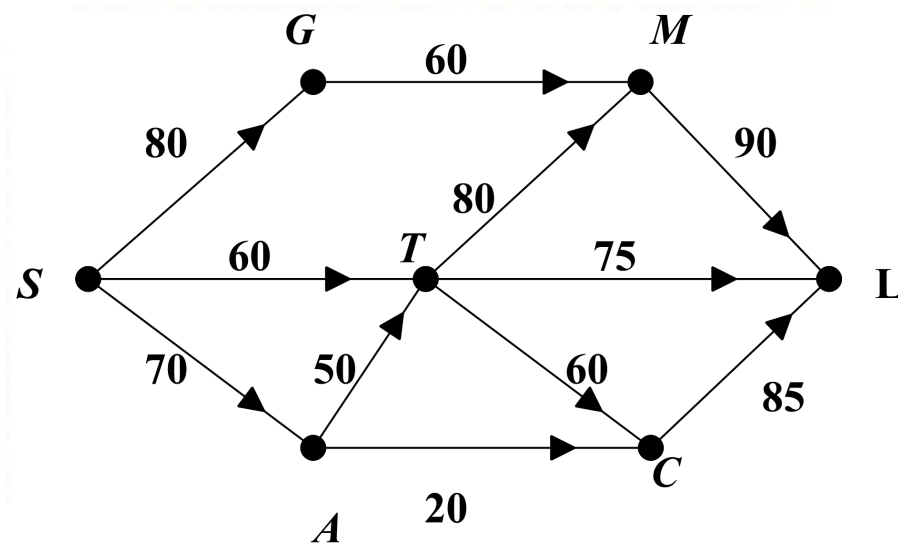
(a) Using the diagram, complete the Minimum Spanning Tree to determine the minimum cost to upgrade the school network.

(b) Determine the total cost for the upgrade.

(c) The contractor suggests a new link be created from the Library (L) to the Main block (M) for \$8000 instead of the current upgrade path. Should the school purchase the new link? Explain your answer.

3. [4,2,2,3]

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  $S$  to  $L$  by listing each path used and the flow along each path.

(b) On the diagram, show the cut that illustrates this maximum flow

(c) Re-draw the diagram showing all unused capacity of the system.

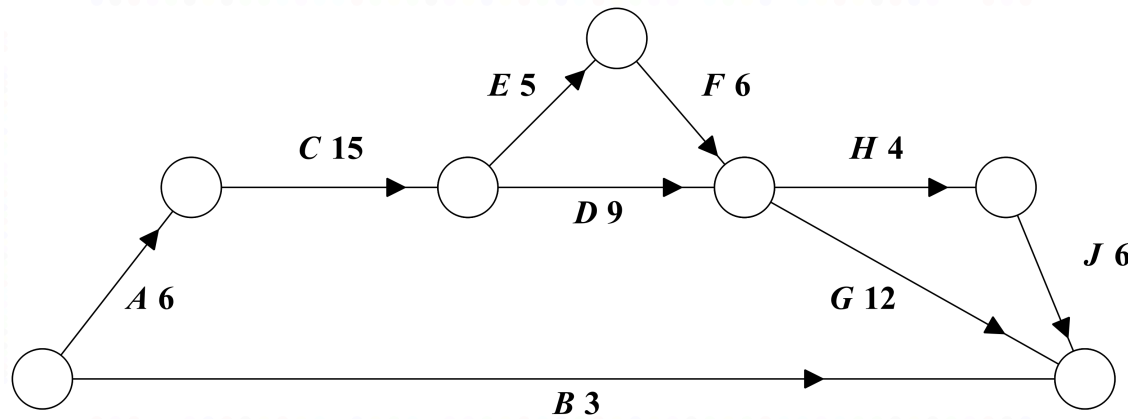
(d)

i. Which pipe could be upgraded to improve the maximum flow?

ii. How much could you increase it by? Explain your answer.

4. [3,2,2,1]

John the builder has a contract to build a house. The list of tasks and their duration (in days) has been defined in the below Project Network Diagram:



(a) From the diagram above, state the Minimum Completion Time and Critical Path of the Network.

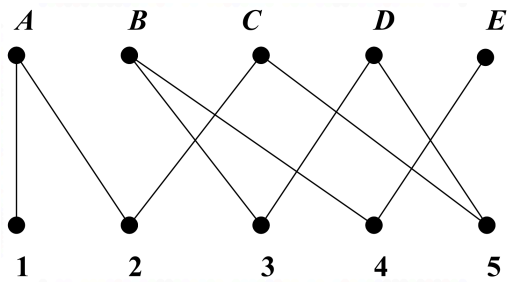
(b) If we increased G by 3 days, what effect would it have on the Minimum Completion Time? Explain your answer.

(c) If we increased D by 2 days, what effect would it have on the Minimum Completion Time? Explain your answer.

(d) When is the latest B can start without affecting the Minimum Completion Time?

5. [2,2,2]

Review the Bipartite Graph below. Five people: A, B, C, D and E are to be allocated to five tasks: 1, 2, 3, 4 and 5. The graph illustrates the tasks that each person can carry out.



(a) Is this a complete Bipartite Graph? Explain your answer.

(b) If person B was to complete task 4, explain why a complete matching of people to tasks is not possible.

(c) Determine the complete matching.

6. [5,2]

Four contractors are competing for three jobs and have provided a quote for each. The table below illustrates the contractor's quotes (in thousands of dollars) for each job. Your job is to select the appropriate contractor for each job that will result in the **minimum total cost**.

	Job 1	Job 2	Job 3
Contractor A	15	20	22
Contractor B	17	30	35
Contractor C	16	25	27
Contractor D	13	27	33

(a) Using Hungarian Algorithm, determine which Contractor is **not** selected for any job.

(b) Clearly state the minimum total cost to complete all three jobs.



7. [4]

A University has 6 buildings that need to be connected to the campus network. Cables are to be installed to create a spanning tree for the network with vertices at A, B, C, D, E, and F. Using Prim's Algorithm, find the minimum length of cable required given the below table which shows the distances between each building in metres.

	A	B	C	D	E	F
A	-	29	7	12	17	18
B	29	-	24	9	19	6
C	7	24	-	9	19	6
D	12	9	26	-	14	21
E	17	19	14	3	-	16
F	18	6	21	28	16	-

8. [3]

A project has been defined by the following table:

Activity	Immediate Predecessor	Duration (in hours)
A	-	2
B	-	6
C	-	4
D	A	3
E	C	5
F	A	4
G	B,D,E	2

Complete a Project Network Diagram to represent the information above.

END OF TEST