



**Year 12 Mathematics Applications Unit 4
Test 6 2022**

**Section 1 Calculator Free
Networks and Decision Making**

STUDENT'S NAME _____

DATE: Monday 5th September

TIME: 15 minutes

MARKS: 16

INSTRUCTIONS:

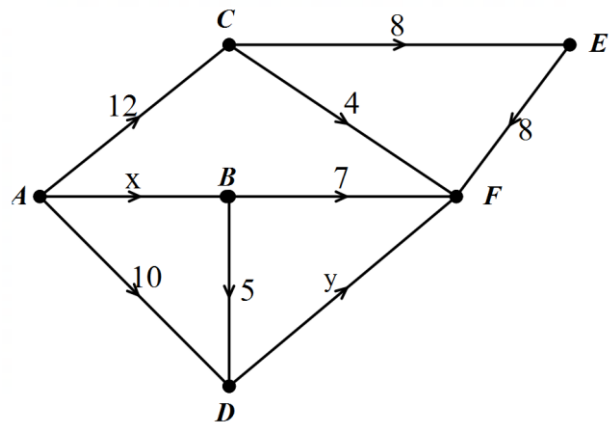
Standard Items: Pens, pencils, drawing templates, eraser, approved Formula sheet

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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1. (3 marks)

The diagram below shows the flow along each arc to achieve a maximum flow, in metres from the source to the sink.

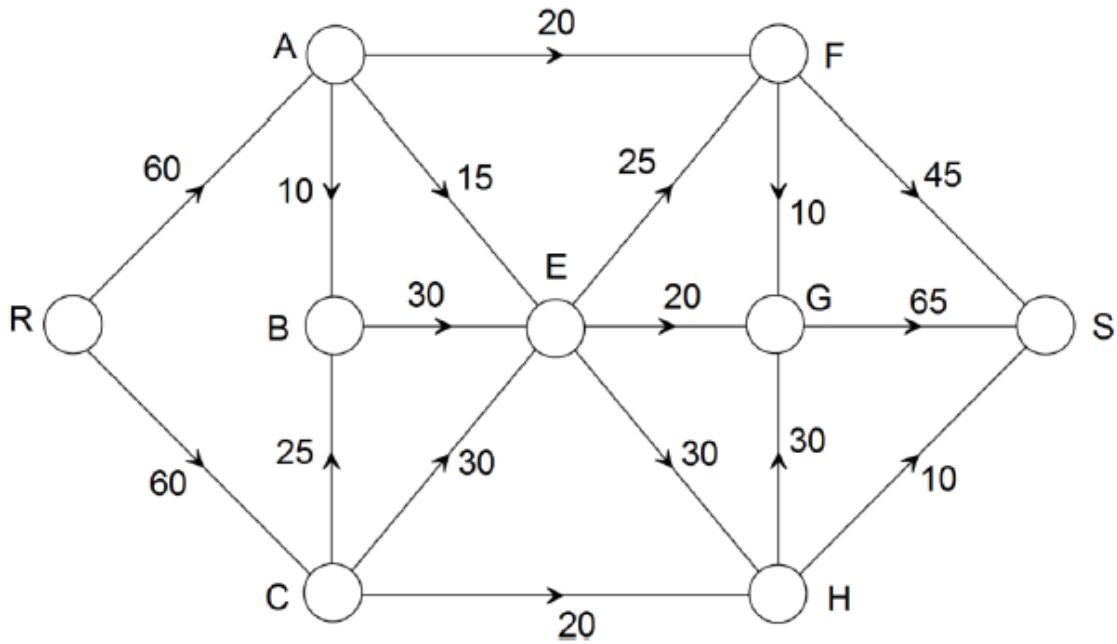


(a) Find the values of x and y [2]

(b) Calculate the maximum flow through this system. [1]

2. (7 marks)

The network for a airline running flights connecting nine cities is shown below. The maximum number of passengers, in hundreds, on each flight is shown on each edge.



- (a) What is the maximum number of passengers that can be transferred from city R to city S? To obtain full marks, you must show systematic working. [4]

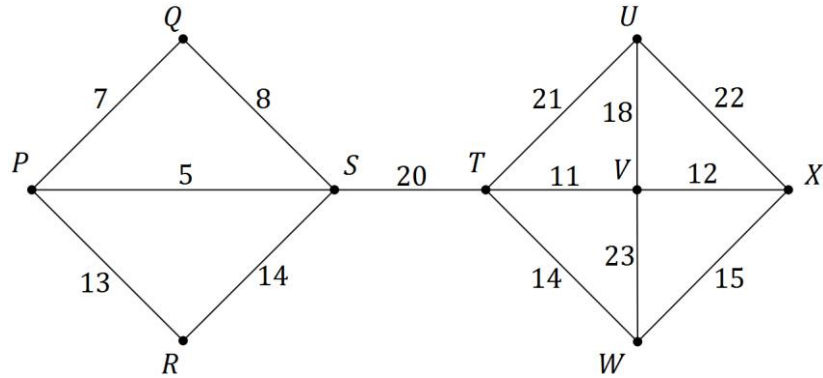
- (b) The owners of the company have identified one route between two cities that can be stopped without affecting the maximum flow. State which link this is. [1]

- (c) The route from city A to city F is to have an aeroplane upgrade so that the numbers of passengers for this route will increase. Determine the largest possible increase in the overall maximum passenger flow once the upgrade is complete. [1]

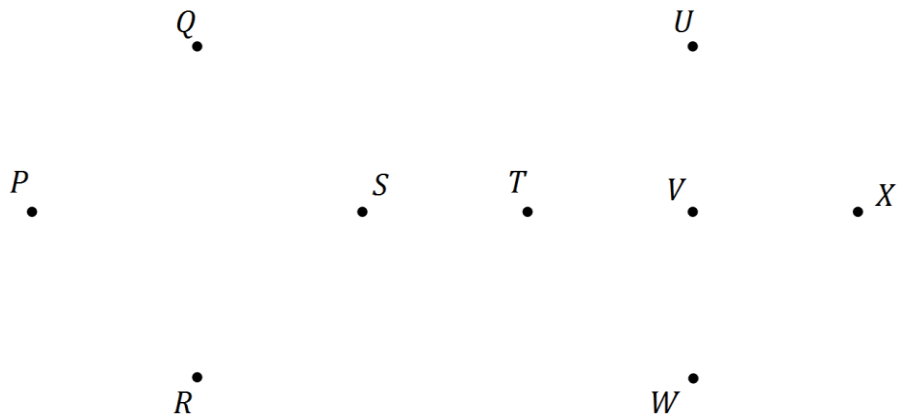
- (d) Find the minimum cut and mark it clearly on the diagram. [1]

3. (6 marks)

The network below shows the cost, in millions of dollars, of establishing the National Broadband Network (NBN) between nine suburbs, P, Q, R, \dots, X .



(a) Determine a minimum spanning tree for the network and draw the minimum spanning tree below. [2]



(b) State the minimum cost of establishing the NBN across the network. [2]

(c) The cost of constructing the NBN along UX has been overestimated by \$5 million. By how much does this information change the minimum cost of constructing the network? Justify your solution. [2]



**Year 12 Mathematics Applications Unit 4
Test 6 2022**

**Section 2 Calculator Assumed
Networks and Decision Making**

STUDENT'S NAME _____

DATE: Monday 5th September

TIME: 30 minutes

MARKS: 28

INSTRUCTIONS:

Standard Items: Pens, pencils, drawing templates, eraser, approved Formula sheet

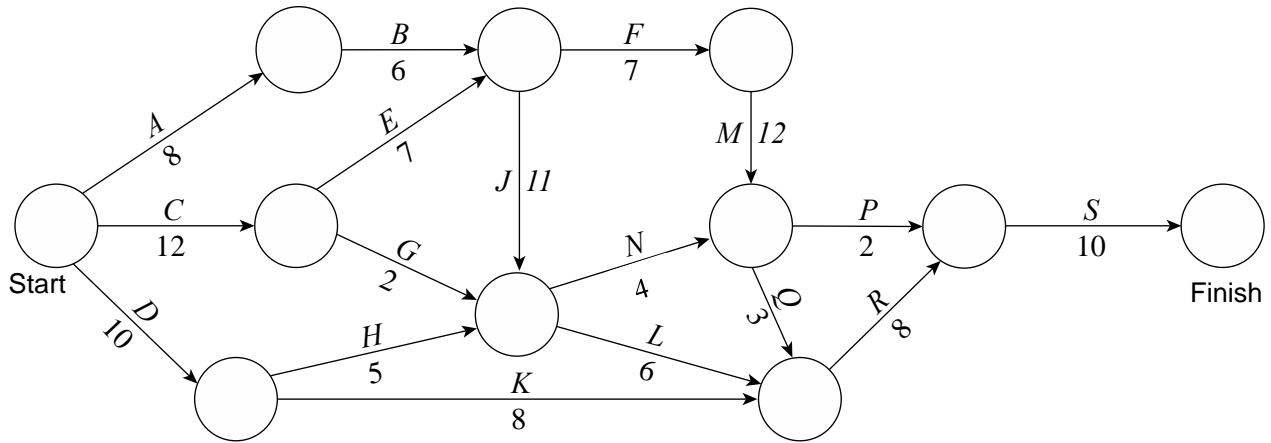
Special Items: Three calculators, notes on one side of a single A4 page (these notes to be handed in with this assessment)

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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4. (10 marks)

An engineering company has designed a super-fast battery charger. For the product to be manufactured it needs to go through several processes. The times needed to complete each process (in minutes) and the order of completion are shown on the following network:

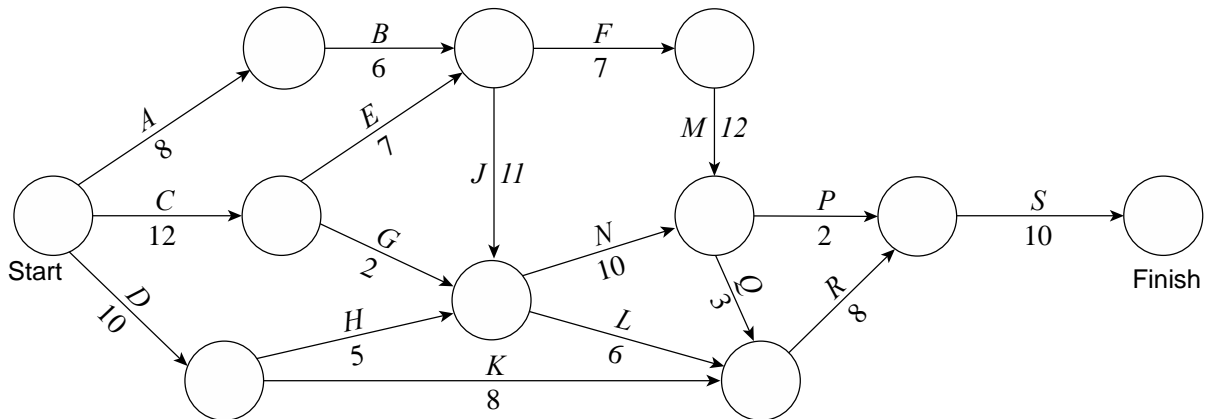


(a) List all the processes that need to be undertaken before process *N* can start. [2]

(b) Using the network diagram above, determine the critical path and the minimum completion time for the battery charger to be manufactured. [3]

(c) Calculate the amount of float time for process *P*. [1]

- (d) The engineer in charge has redesigned the battery charger slightly, and as a result the time to complete process *N* has now increased from 4 minutes to 10 minutes:



(i) State the new critical path for the network diagram above. [1]

(ii) Calculate the difference between the original minimum completion time and the new minimum completion time. [1]

(iii) The engineer can also change either process *J* or process *H* to make either process 3 minutes faster to complete. State which process the engineer should change. Justify your answer. [2]

5. (7 marks)

The following table shows the lengths, in kilometres, of pipe-lines between six water-pumping stations $A - F$.

	A	B	C	D	E	F
A	×	23	17	19	18	22
B	23	×	20	24	23	21
C	17	20	×	24	19	23
D	19	24	24	×	20	24
E	18	23	19	20	×	24
F	22	21	23	24	24	×

- (a) The authorities decide to disconnect some of the pipe-lines. Use Prim's algorithm on the table above to find the minimum total length of pipe-lines which need to be kept open in order for all the pumping stations to remain linked together and state the length. [3]
- (b) Draw a minimum spanning tree showing the pipe-lines that need to remain linked together. [2]
- (c) The pipe-line from B to C is found to be faulty. So when choosing the pipe-lines to keep open the authorities must not include BC . Describe the effect this change has on the total length of pipe-lines which need to be kept open. [2]

6. (4 marks)

The table below shows the tasks required for the building of a new cafe in the city and the time required in days. The project was started on 1st September 2022.

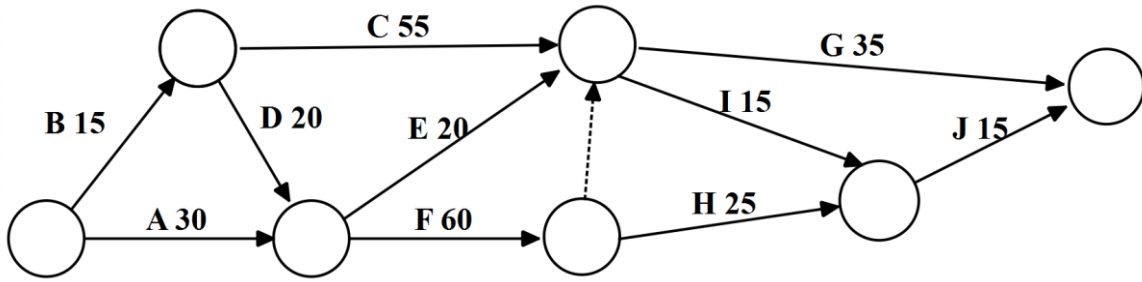
Task	Activity	Duration	Immediate Predecessor
A	Clear land	42	–
B	Lay the slab	28	A
C	Build the walls	42	B
D	Install electrics	21	C
E	Plaster the walls	21	D, H
F	Landscaping	28	B
G	Interior design	35	E
H	Roof	14	C

(a) Draw a project network to represent the above information.

[4]

7. (7 marks)

The diagram below shows the project network for the completion of tasks A, B, C, D, E, F, G and H with times to complete the task given in hours.



- (a) Determine the minimum completion time and the state the critical path. [3]
- (b) The network shows a dummy activity. What is the purpose of the dummy activity? [1]
- (c) How long can Task E be delayed without affecting the critical path? [1]
- (d) If the time taken for Task C increased by 15 hours what affect does this have on the minimum completion time and the critical path. [2]