



Name: _____

Teacher: _____

Mathematics Standard 2 HSC

Task 3 2024

PREPARATION TASK

Task Number:

3

Weighting:

25%

Due Date:

Tuesday 28th (Term 2 Week 5)

Submission in the HUB between 8:30am – 9:10am

Nature and description of the task:

As a result of completing this preparation activity, students should be familiar with:

- networks as a graphical representation that models situations and can be used as an approach during decision-making processes.
- the knowledge of networks enables the development of a logical sequence of tasks or a clear understanding of connections between people or items.
- the study of networks is important in developing students' ability to interpret a set of connections or sequence of tasks as a concise diagram in order to solve related problems.
- critical path analysis in the optimisation of real-life problems.
- using critical path analysis as a useful tool in project planning, management and logistics.

On Tuesday the 28th you will:

1. Hand in your Preparation Task at the HUB between 8:30am – 9:10am.
2. Complete a 50-minute (one period) in-class Validation Task on a selection of questions similar to those in this Preparation Task. PLEASE NOTE: You will **NOT** have access to your Preparation Task during this time.

The final mark for this assessment will be determined according to the following split:

Preparation Task: 50%

Validation Task: 50%

Non-Completion of Task:

If you know you are going to be away on the day the Assessment Task is due and are unable to hand in Assignment on the due day, then you must have supportive documentation. *Zero marks will apply if the Assessment Task is submitted/completed late, unless an Illness/ Misadventure or Application for Extension form has been submitted.*

Outcomes assessed:

MS2-12-8 solves problems using networks to model decision-making in practical problems

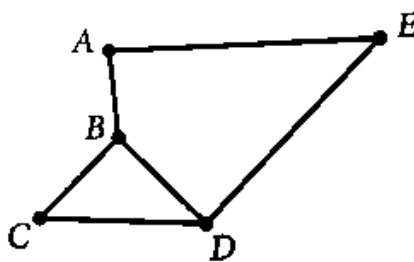
MS2-12-9 chooses and uses appropriate technology effectively in a range of contexts, and applies critical thinking to recognise appropriate times and methods for such use

MS2-12-10 uses mathematical argument and reasoning to evaluate conclusions, communicating a position clearly to others and justifying a response

Preparation Total Mark

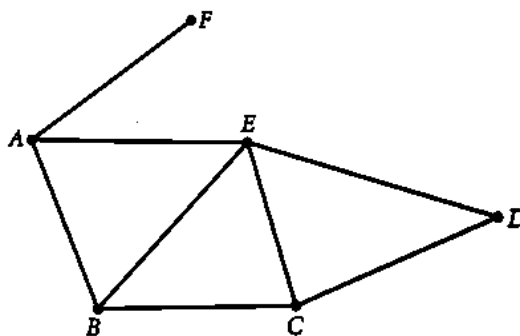
/48

1. In the network diagram below, how many vertices have an odd degree?



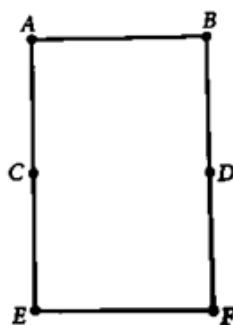
- A 2 B 3 C 4 D 5

2. Which of the following is NOT a path for the network below?



- A FAEBC B BCDEAF C DCBAEF D CDEBAF

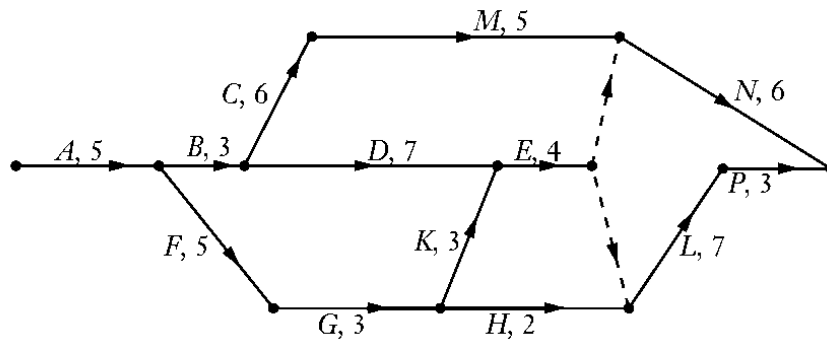
3. The network below has 6 vertices and 6 edges.



Two new edges are added to the network. Each edge joins two of the existing vertices, but not the same 2. Which of the following CANNOT occur after the two edges are added?

- A 4 vertices with even degrees B 1 vertex with a degree of 4 C All vertices with even degrees D 4 vertices with odd degrees

4. Looking at the Network below, which table shows the correct relationship between activities?



A

Activity	Duration	Predecessors
A	5	–
B	3	A
C	6	B
D	7	B
E	4	D, K
F	5	A
G	3	F
H	2	G
K	3	G
L	7	H
M	5	C
N	6	M
P	3	L

B

Activity	Duration	Predecessors
A	5	–
B	3	A
C	6	B
D	7	B
E	4	D, K
F	5	A
G	3	F
H	2	G
K	3	G
L	7	H, E
M	5	C
N	6	M
P	3	L

C

Activity	Duration	Predecessors
A	5	–
B	3	A
C	6	B
D	7	D
E	4	D, K
F	5	A
G	3	F
H	2	G
K	3	G
L	7	H
M	5	C
N	6	M, E
P	3	L

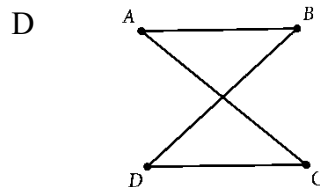
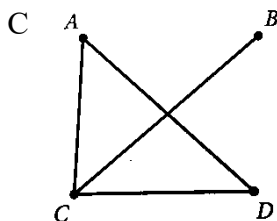
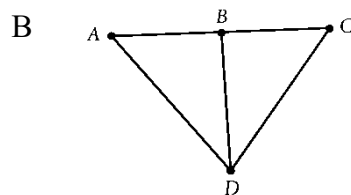
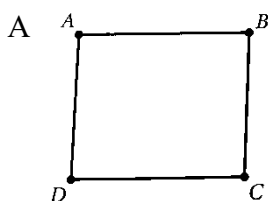
D

Activity	Duration	Predecessors
A	5	–
B	3	A
C	6	B
D	7	B
E	4	D, K
F	5	A
G	3	F
H	2	G
K	3	G
L	7	E, H
M	5	C
N	6	M, E
P	3	L

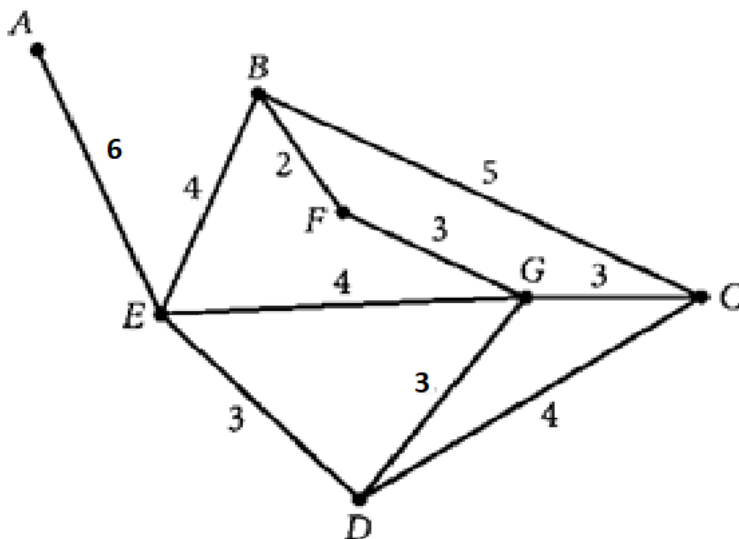
5. The grid shows the number of edges connecting 4 vertices of a network.

	A	B	C	D
A	0	0	1	1
B	0	0	1	0
C	1	1	0	1
D	1	0	1	0

Which network diagram is represented by the grid?



6. What is the weight of the minimum spanning tree in the network below?



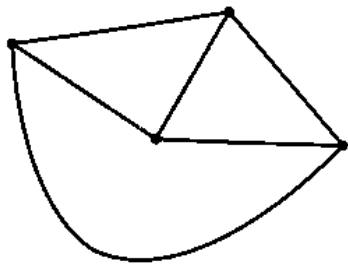
A 20

B 18

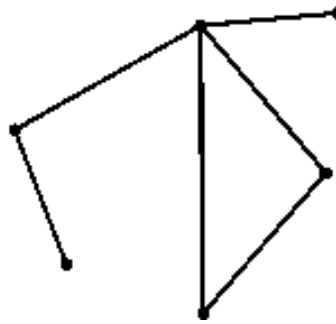
C 19

D 22

7. Which of the following statements is true regarding networks A and B?



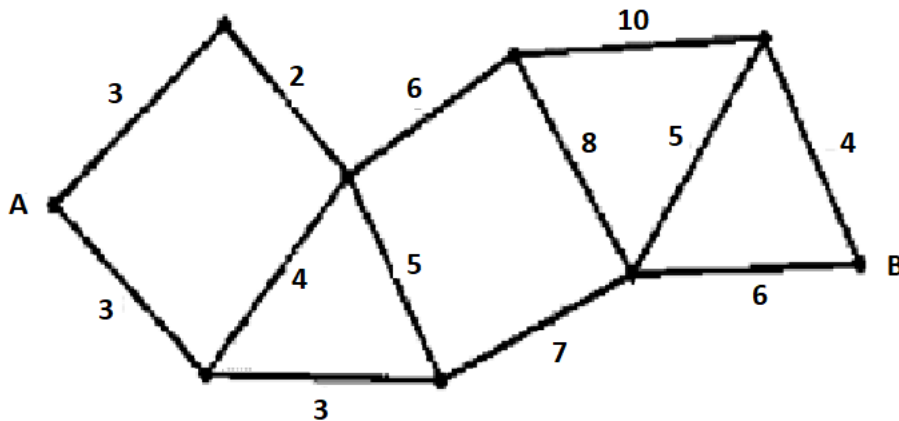
Network A



Network B

- A The sum of the degrees of Network B is greater than that of Network A.
- B Network B has half as many vertices with an odd degree than Network A.
- C Network B has fewer vertices than Network A.
- D The sum of the degrees of Network B is the less than that of Network A.

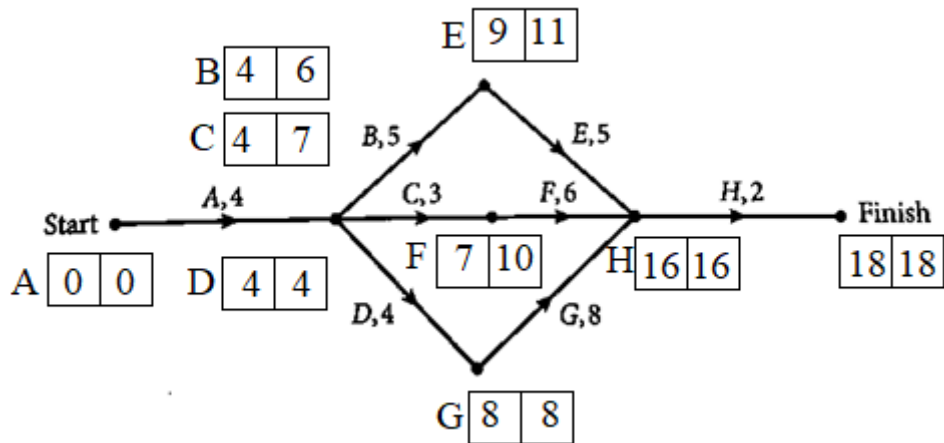
8. In the network below, points A and B are connected through a series of paths. The values on each path represent distances, in metres.



What is the shortest distance between points A and B?

- A 18 m
- B 19 m
- C 25 m
- D 26 m

Use the diagram below to answer questions 9 and 10.



9. The earliest start time for activity H is:

- A 13 B 14 C 15 D 16

10. The length of the critical path is:

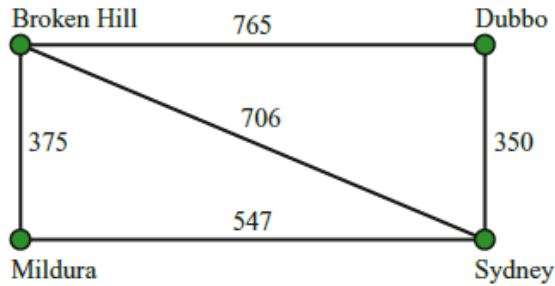
- A 15 B 16 C 18 D 20

- END OF MULTIPLE CHOICE -

Questions 11 – 24 are short-response. Show all working in the space provided.

NOTE: Answer-only responses will NOT be accepted.

11. The cost of flying from Sydney to certain regional centres is shown below.



a. What is the cheapest route to Broken Hill?

1 mark

.....

b. Assuming the cheapest route is booked out, what is the second cheapest route?

1 mark

.....

12. A certain project has 4 activities that must be completed. The table below shows the duration of each activity in days and the immediate predecessor for each activity.

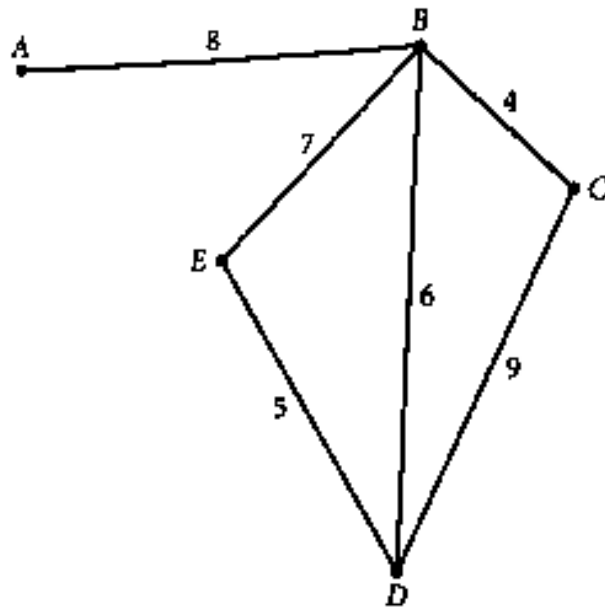
Activity	Duration (days)	Immediate predecessor
A	4	-
B	10	A
C	3	B
D	14	C

What is the latest starting time for activity D if the whole project needs to be completed in 34 days?

1 mark

.....

13.

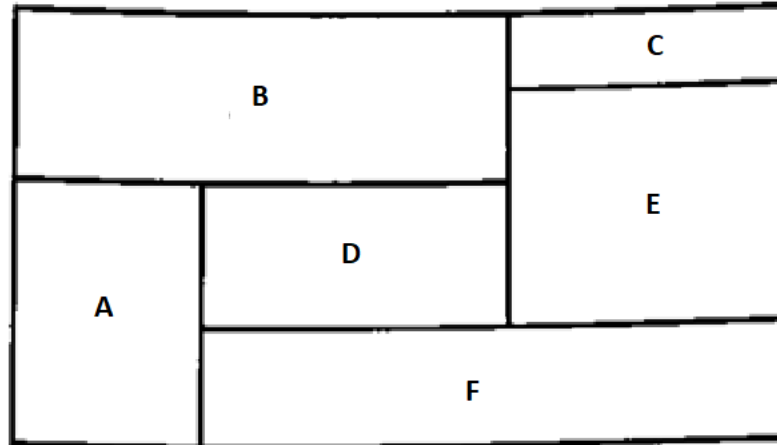


Complete the table below to represent the weighted network shown.

2 marks

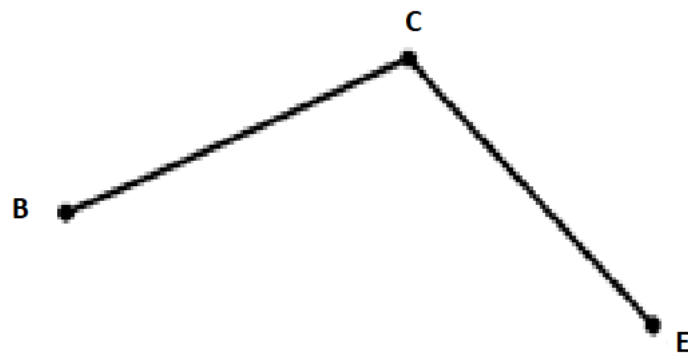
	A	B	C	D	E
A	-	8	0		0
B		-			
C			-		
D				-	5
E				5	-

14. A rectangular field is separated into 6 different areas for growing different crops.



a. Complete the network of the field shown below, indicating the connections between fields that are in contact with each other.

1 mark



b. For this diagram, prove the following statement:
 “The sum of the degrees is equal to twice the number of edges”

1 mark

.....

.....

15.

a. Draw a network that represents the following people and their friends.

2 marks

Person	Kate	Lucy	Megan	Nicole	Olivia	Penelope
Friends	Lucy Penelope	Megan Kate	Lucy Penelope Olivia Nicole	Megan Olivia	Megan Nicole	Kate Megan

b. Complete the table of vertex degrees.

1 mark

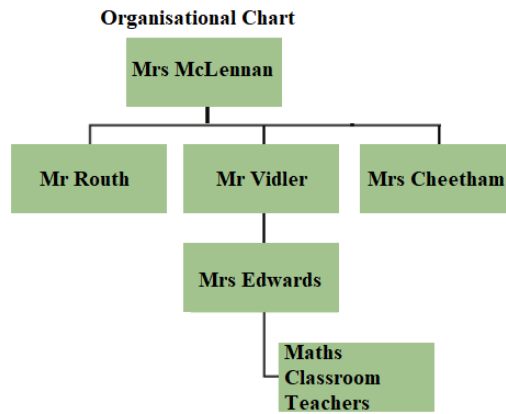
Vertex	Kate	Lucy	Megan	Nicole	Olivia	Penelope
Degree						

c. Kate is telling Lucy a story about what happened to a friend of a friend of hers. Who is the story about?

1 mark

.....
.....

16. The following organisational chart shows the hierarchy within Orange High School.



a. Draw the organisational chart as a network.

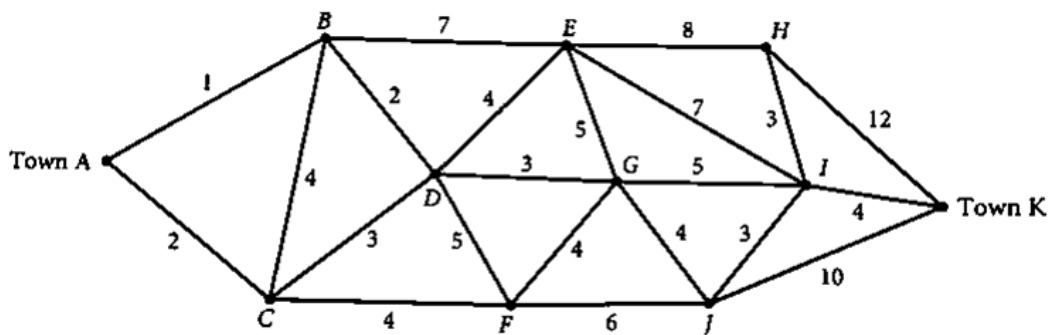
1 mark

b. A Maths Classroom teacher reports a serious incident to Mrs Edwards. How many steps will it take for this report to travel from the classroom teacher to Mrs McLennan?

1 mark

.....

17. The following network shows Town A and Town K connected by a series of roads. The edge weights represent distances, in kilometres.

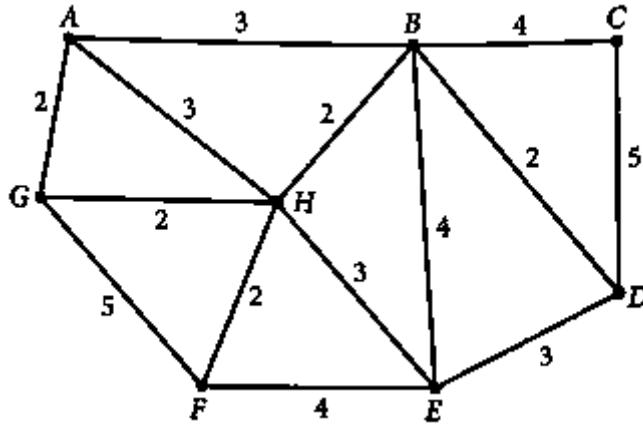


What is the shortest distance between Town A and Town K?
List the vertices of the shortest path from Town A to Town K.

2 marks

.....
.....

18. The weighted network below shows the connections between 8 areas.



a. Draw the 2 minimum spanning trees from the network.

2 marks

<p style="text-align: center;">A B C</p> <p style="text-align: center;">● ● ●</p> <p style="margin-top: 60px;">G ● ● H</p> <p style="text-align: right; margin-right: 50px;">● D</p> <p style="margin-top: 60px;">● ●</p> <p style="text-align: center;">F E</p>	<p style="text-align: center;">A B C</p> <p style="text-align: center;">● ● ●</p> <p style="margin-top: 60px;">G ● ● H</p> <p style="text-align: right; margin-right: 50px;">● D</p> <p style="margin-top: 60px;">● ●</p> <p style="text-align: center;">F E</p>
--	--

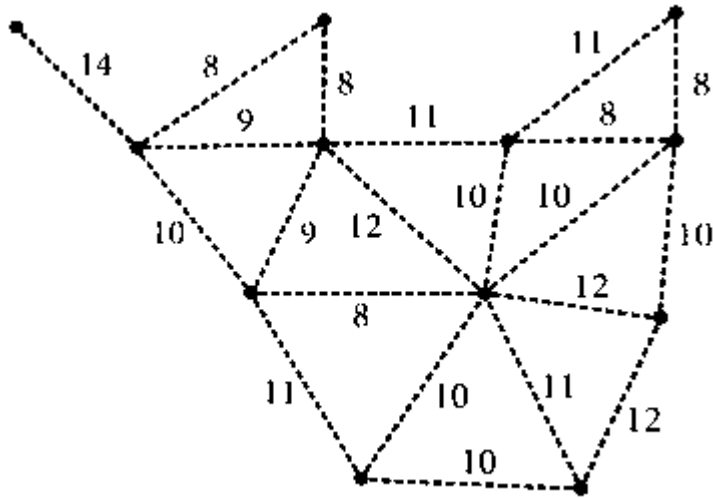
b. What is the length of the minimum spanning tree?

1 mark

.....

.....

19. At the local showground, 12 stalls need to be connected to electricity. Each edge represents the length of cabling, in metres, needed to connect each stall. All of the sites are to be connected with the smallest length of electrical cable possible.



a. On the diagram, draw or highlight where the cables need to be installed so that the stalls are connected with the smallest length of cable. **1 mark**

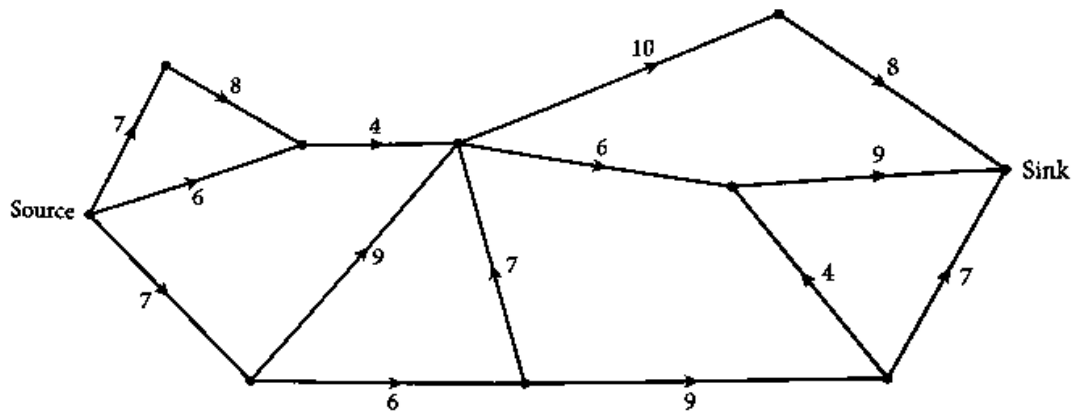
b. If the cost to install the cable is \$30 per linear metre, how much will this cost the showground organisers? **1 mark**

.....

.....

.....

20. The network below shows water pipes connecting various locations around a city. The water flows from the source to the sink and the number represents the capacities of the pipes, in kilolitres per hour.



a. What is the maximum capacity of this network?

1 mark

.....

.....

.....

b. If all the pipes with a capacity of 4 were upgraded to a capacity of 14, will a new cut be needed? If so, draw this cut on the diagram above and calculate by how much the new maximum flow will increase.

2 marks

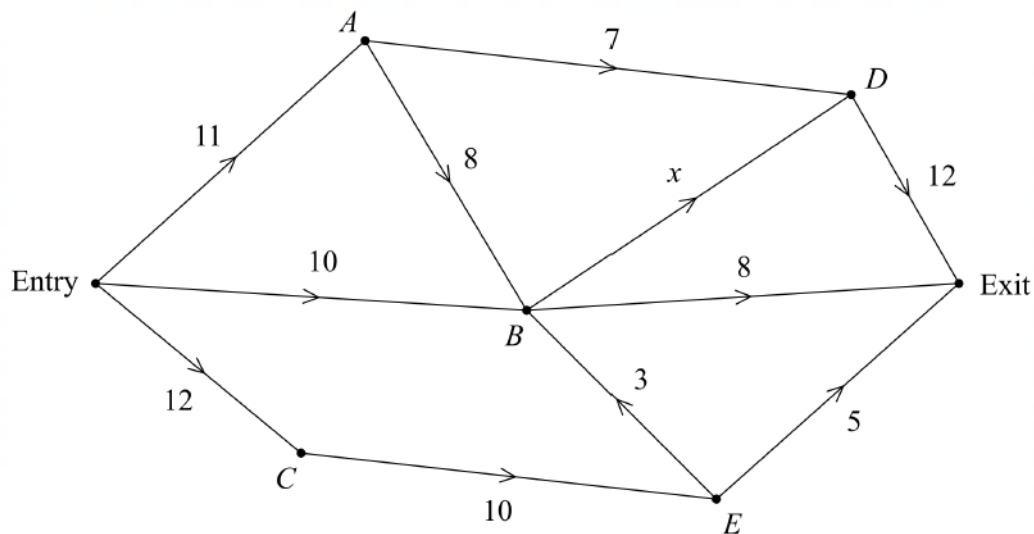
.....

.....

.....

.....

21. A warehouse has five main areas, represented by the vertices A, B, C, D and E. The numbers on the edges represent the maximum number of forklifts per minute that can pass between each area. The path BD allows x number of forklifts through per minute.



a. If the maximum flow of forklifts through the warehouse is 23 per minute, find the value of x .

2 marks

.....

.....

.....

b. For the warehouse to be profitable, the maximum flow of forklifts through the warehouse needs to be increased to 30 per minute. The warehouse staff can increase the flow along two edges of the network. Provide two edges whose flow can be increased, and by how much, in order to increase the flow capacity to 30 forklifts per minute.

2 marks

.....

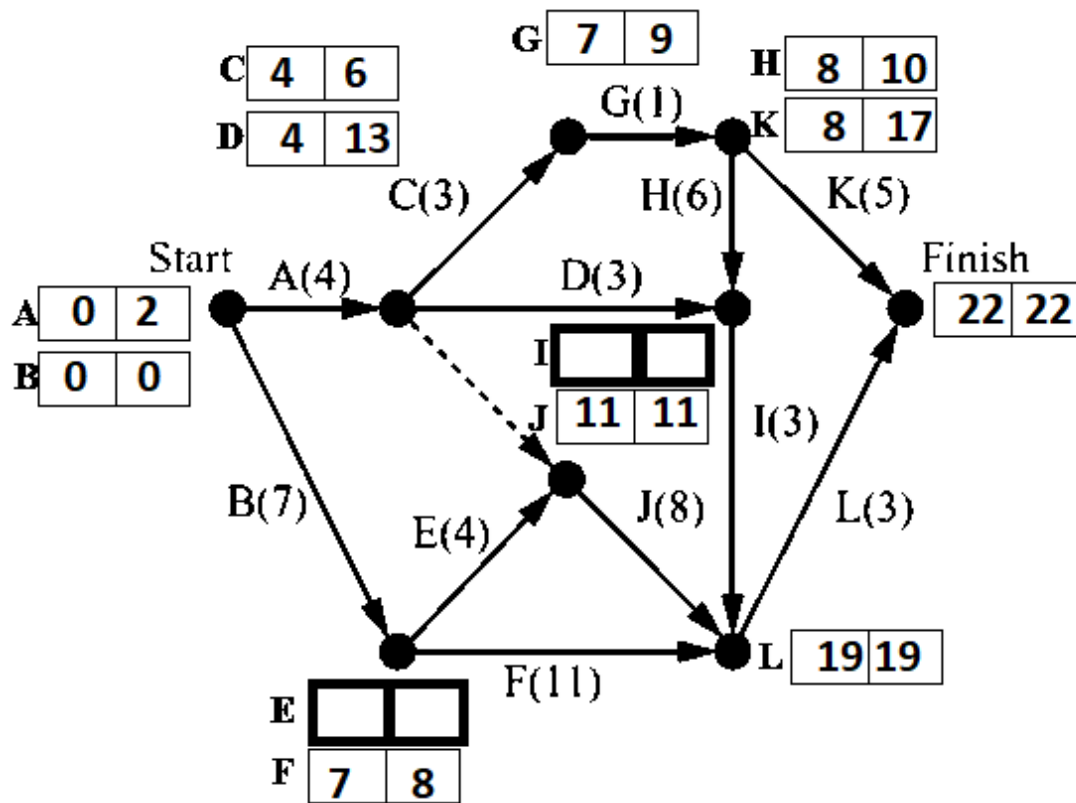
.....

.....

.....

.....

22. The network below shows the required time to complete activities in a project.



a. Which activities cannot start until activity G is completed? 1 mark

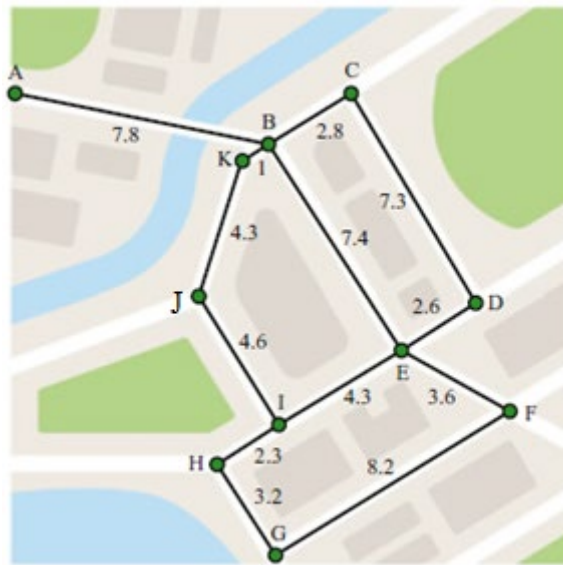
.....

b. Some of the ESTs and LSTs are missing. Fill in the missing boxes by forward scanning and backward scanning. 2 marks

c. What is the float time for activity I? 1 mark

.....

23. The network below shows the location of fibre optic nodes that form part of a national high-speed internet network. The possible location of the fibre optic cable is given as edges and the length of the cable (in kilometres) is specified as the edge weight.



a. Design the most cost-effective way of connecting each node with fibre optic cable.

2 marks

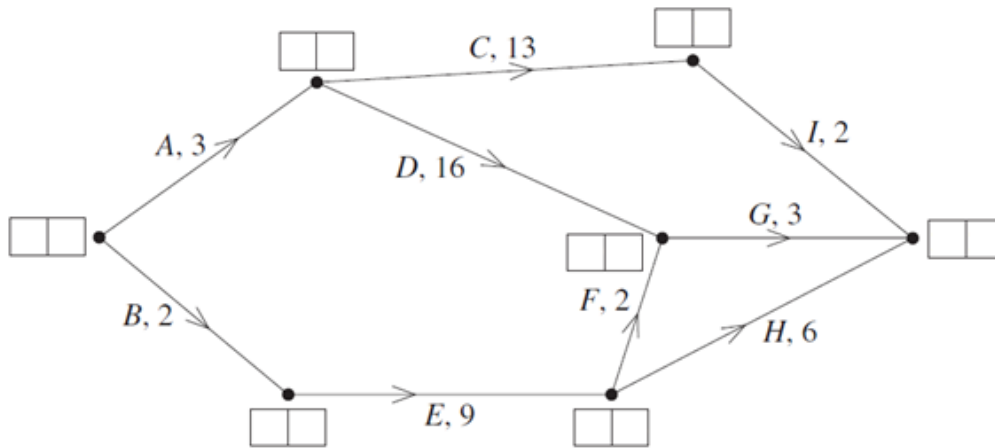
b. How many kilometres does your network require?

1 mark

.....

.....

24. The network below shows the time needed, in weeks, for each activity required to complete a building project on a construction site.



a. Forward and backward scan the network given above to determine the critical path.

2 marks

.....

.....

b. A project manager has been promised an additional \$3000 to complete the project early. The project manager has decided to channel all this money into hiring additional labourers to work on activity D. Each additional labourer will cost \$800 per week. It is expected that for every labourer added to the team, the time frame for activity D will be reduced by 1 week.

2 marks

With this new change, how long will it take for the project to be completed?

.....

.....

.....

.....

.....

- End of Preparation Task -