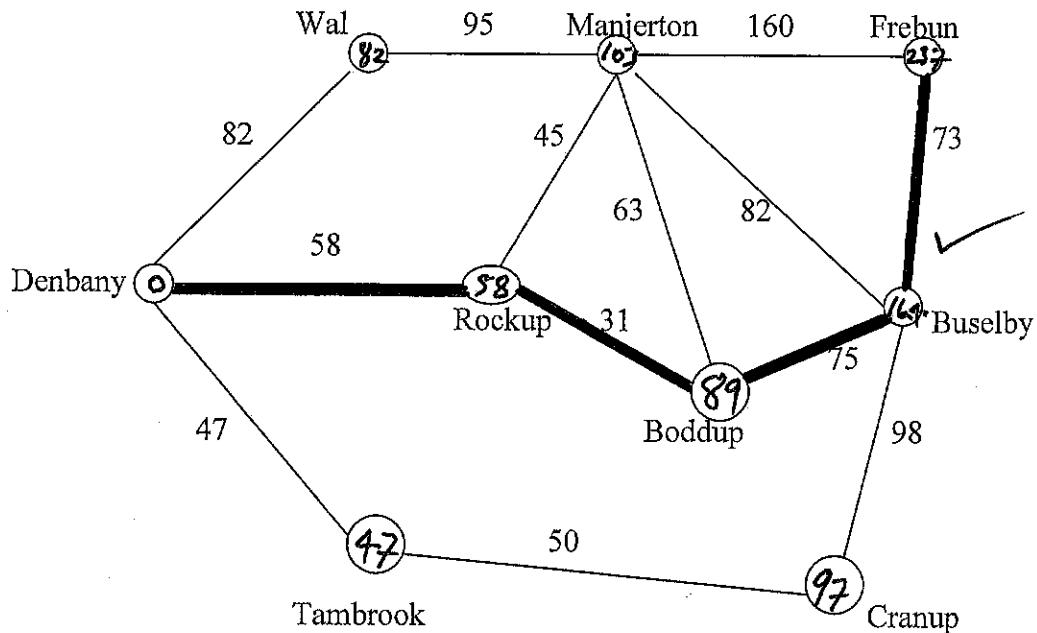


NETWORKS – REVISION QUESTIONS

1. [2, 2 = 4 marks]

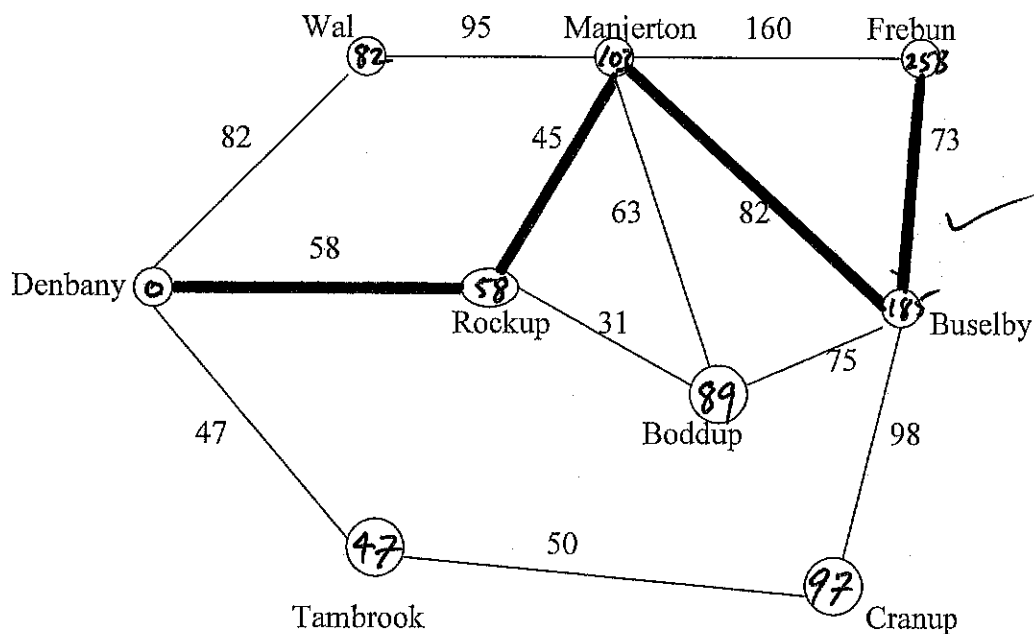
Here is a simplified map showing some possible routes (distances in kilometres) from Denbany to Frebun. **Indicate on the diagrams supplied;**

- a) the shortest route from Denbany to Frebun, and state it's length.



Length: $58 + 31 + 75 + 73 = 237 \text{ km}$ ✓

- b) the shortest route from Denbany to Frebun that passes through Manjerton, and state it's length.



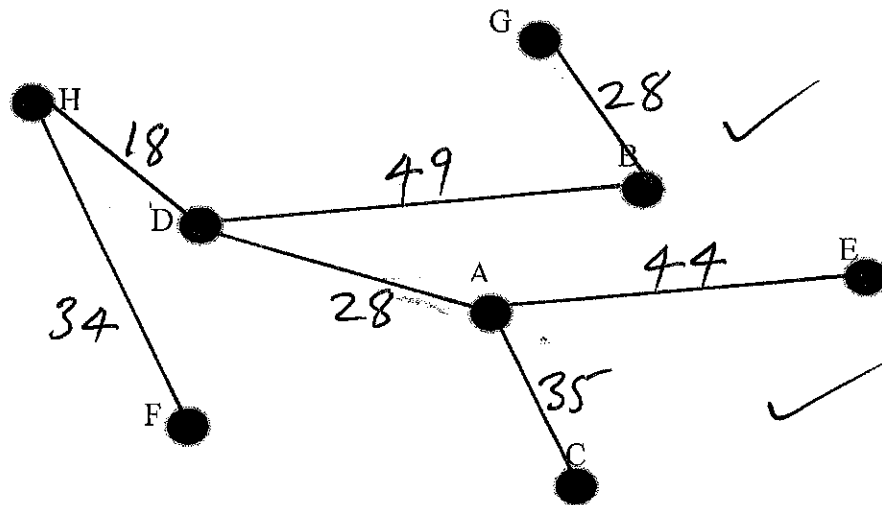
Length: $58 + 45 + 82 + 73 = 258 \text{ km}$ ✓

2. [3, 2, 2 = 7 marks]

A cable TV company is planning the installation of a series of cables connecting 8 country towns (A, B, C, D, E, F, G, H). The table below gives the cost (in thousands of dollars) of establishing connections between the various towns.

	A	B	C	D	E	F	G	H
A		64	35	28	44	68	-	-
B	64			49	90		28	
C	35					72		
D	28	49						18
E	44	90					88	
F	68		72					34
G		28			88			56
H				18		34	56	

- a) On the basis of the costing done, draw the minimal spanning tree below, clearly marking the lengths of each cable.



- b) What is the minimum cost of connecting the 8 towns?

$$35 + 28 + 44 + 28 + 49 + 18 + 34 = 236$$

$$\therefore \$236,000 \checkmark$$

- c) Engineers working on this project advised that the proposed connection between Towns A and D is not possible because of the rough terrain. However, the company now needs to find an alternative connection which will provide services to all towns with minimum cost. What is the appropriate suggestion? What effect will your suggestion have upon the cost?

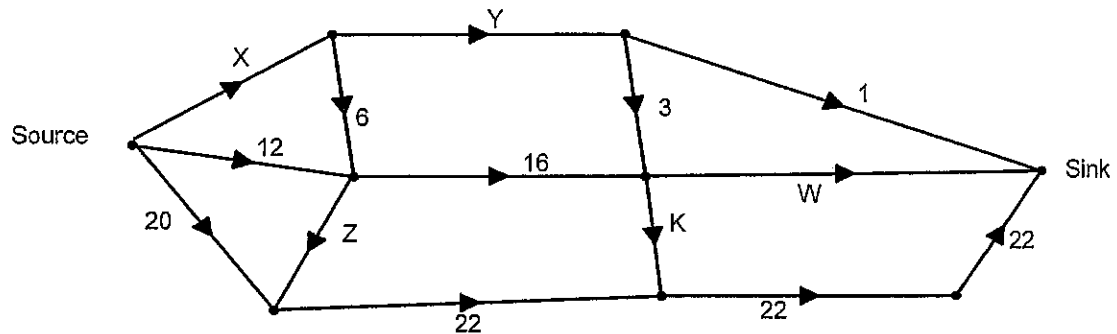
Connect AB instead of AD ✓

$$35 + 44 + 64 + 28 + 49 + 18 + 34 = 272$$

$$\therefore \text{Extra } \$36,000 \checkmark$$

3. [5, 1, 2 = 8 marks]

The following perfect system, where flow from the source equals flow to the sink, represents the network of oil pipelines in a country. The numbers indicate the flow through the pipes in 1000s of Litres per hour.



- a) Find X, Y, Z, K, and W.

$$Y = 3 + 1, \therefore Y = 4 \checkmark$$

$$X = 6 + Y, \therefore X = 10 \checkmark$$

$$Z + 16 = 12 + 6, \therefore Z = 2 \checkmark$$

$$22 + K = 22, \therefore K = 0 \checkmark$$

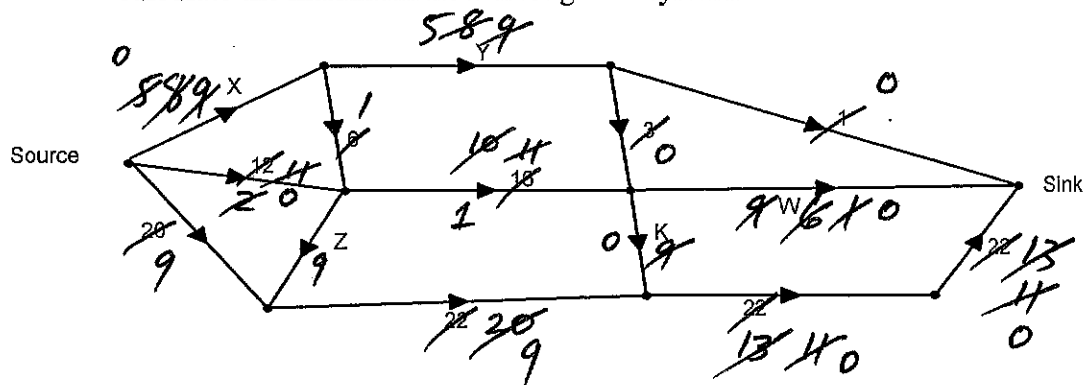
$$16 + 3 = K + W, \therefore W = 19 \checkmark$$

- b) State the flow through the system.

$$\text{Flow from source} = \text{flow to sink} = 42$$

$$\therefore 42,000 \text{ L/h} \checkmark$$

- c) If X, Y, Z, W and K are each replaced with pipes taking 9 000 Litres per hour, calculate the maximum flow through the system.



$$\begin{array}{r} 1 \\ 3 \\ 5 \\ 1 \\ 9 \\ 2 \\ 11 \end{array} \left. \vphantom{\begin{array}{r} 1 \\ 3 \\ 5 \\ 1 \\ 9 \\ 2 \\ 11 \end{array}} \right\} 32$$

$$\therefore 32,000 \text{ L/h} \checkmark$$

4. [4, 2, 1, 3, 2, 2, 1, 1 = 16 marks]

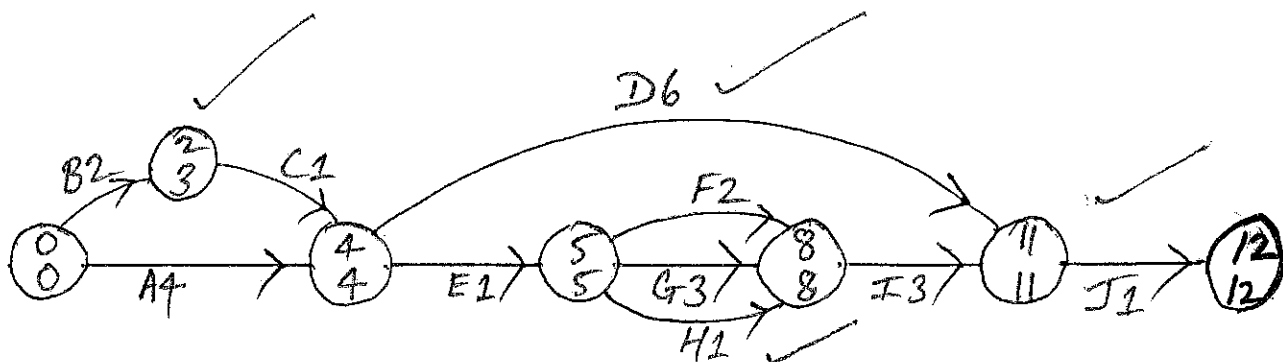
a) The activities in selecting a site to mine gold and the times to complete the activities are given below:

TASK	ACTIVITY	TIME (weeks)
A	Prepare preliminary goals	4
B	Solicit proposals	2
C	Review proposals	1
D	Refine objectives	6
E	Identify appropriate sites	1
F	Gather financial data	2
G	Gather managerial data	3
H	Gather managerial inputs	1
I	Evaluate alternate sites	3
J	Select mining site	1

The order in which the activities should be completed is given below:

- Activities A and B start together
- Activity C must be after Activity B
- Activities D and E must be after both A and C
- Activities F, G, and H must be after Activity E
- Activity I must be after Activities F, G and H
- Activity J must be after Activities D and I.

(i) Construct a project network to represent the above information.



(ii) What is the minimum time required to complete the project?

12 weeks ✓

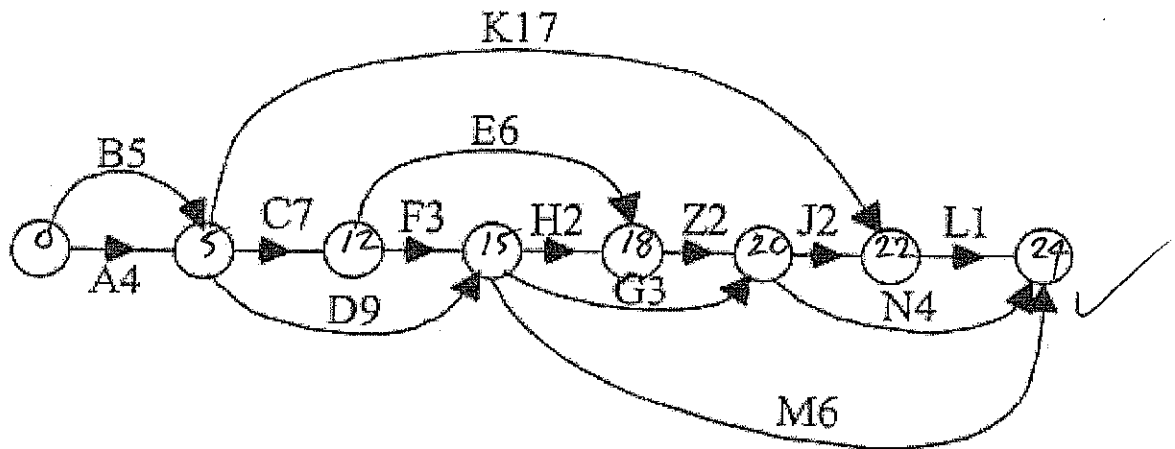
(iii) What is the critical path?

A-E-G-I-J ✓

(iv) Due to a secretarial strike, the time for Activity H is increased by 3 weeks. Does this affect the completion time of the project and the critical path? Describe all changes.

If activity H becomes 4 weeks then it will affect the minimum completion time.
 • It will increase by 1 week to 13 weeks.
 • The new critical path is A-E-H-I-J ✓

- b) The canteen at St Stephen's School is to be redeveloped and extended. The project can be broken down into several stages. The project network, with stages A, B, ..., Z with the number of weeks needed for each stage is shown below.

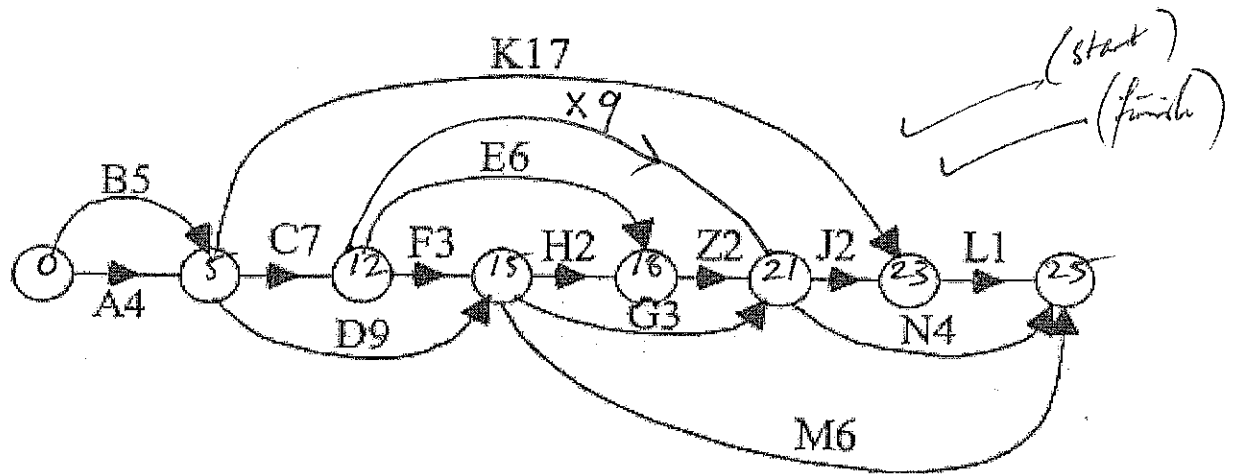


- (i) Find the minimum number of weeks needed to complete the redevelopment.

24 Weeks ✓

- (ii) Mr Adeline suggests a new cool room be built but it involves an extra Activity X. Activity X will take 9 weeks and must start immediately after Activity C and finish immediately before Activity J.

Draw the appropriate link for Activity X on the network below.



Find how the new Activity X affects

- a) the completion time

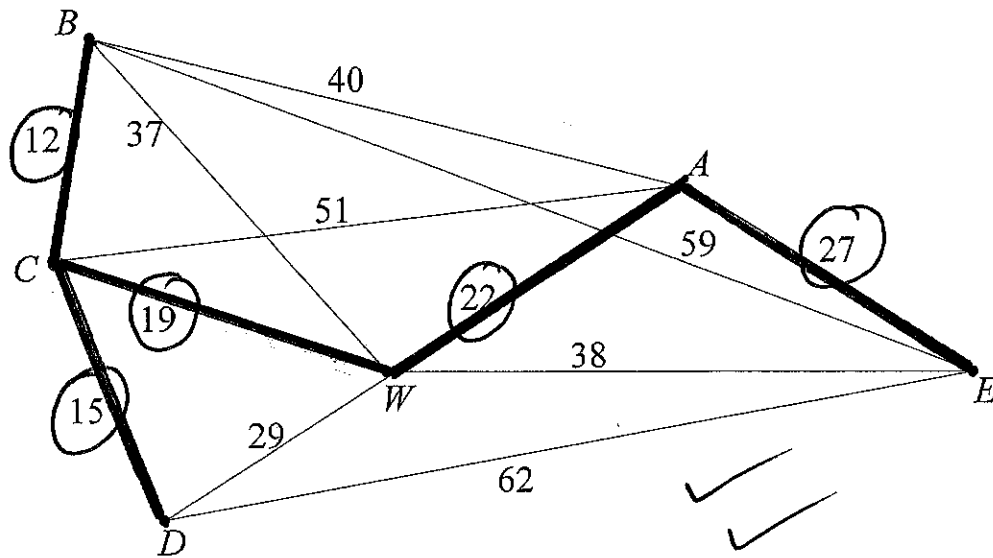
Increases it by 1 to 25 weeks ✓

- b) the critical path

It changes from BCEZN to BCXN ✓

5. [4 marks]

Reticulation piping is required to connect the water source W to 5 points for watering A, B, C, D & E. The following network represents the distances, in metres, for possible connections of these points to each other:

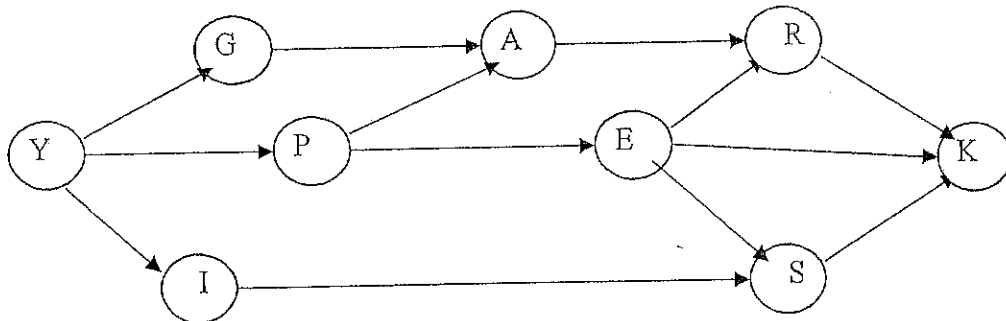


Find the minimum length of piping required.

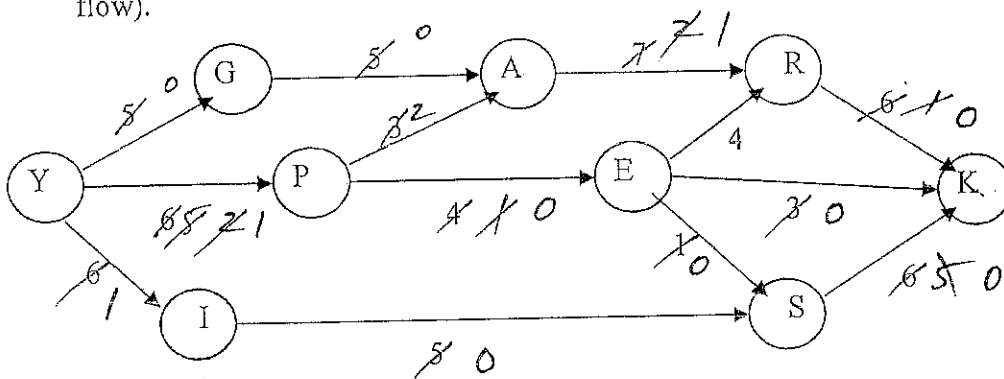
$$\begin{aligned} \text{Length of pipe} &= 19 + 12 + 15 + 22 + 27 \\ &= 95\text{m} \end{aligned}$$

6. ¹2, ³4, 1, ~~2~~ = 9 marks]

a) How many different ways exist of travelling from Y to K? 6 ✓



b) Calculate the maximum flow from Y to K. (List each path used and the corresponding flow).



Y G A R K → 5 ✓
 Y P A R K → 1 ✓
 Y P E R K → 0 ✓
 Y P E K → 3 ✓
 Y P E S K → 1 ✓
 Y I S K → 5 ✓

Max. flow from Y to K is 15 ✓

c) Identify the connection (arc) that could be deleted without affecting the maximum flow.

ER because it is not used. ✓

* d) Pathway RK is to be increased. To what value could it be increased to give an increase in the maximum flow. State the new maximum flow.

	RK=11	RK=8	RK=7
Y G A R K	5	5	5
Y P A R K	2	2	2
Y P E R K	4	1	0
Y P E K	0	3	3
Y P E S K	0	0	1
Y I S K	5/16	5/16	5/16

workbook
 $RK = 5 + 2 + 4 = 11$
 $\therefore RK = 11$ or 8 or 7 ✓
 to increase maximum flow to 16 ✓

7. ⁴/₃, ⁶/₂ = 5 marks

The table below represents the distances between towns (A to J) in the South West of Western Australia. Telstra are planning to connect the towns together with a network of optic fibre cables, with the values in the table giving the required lengths of the cable in kilometres between towns.

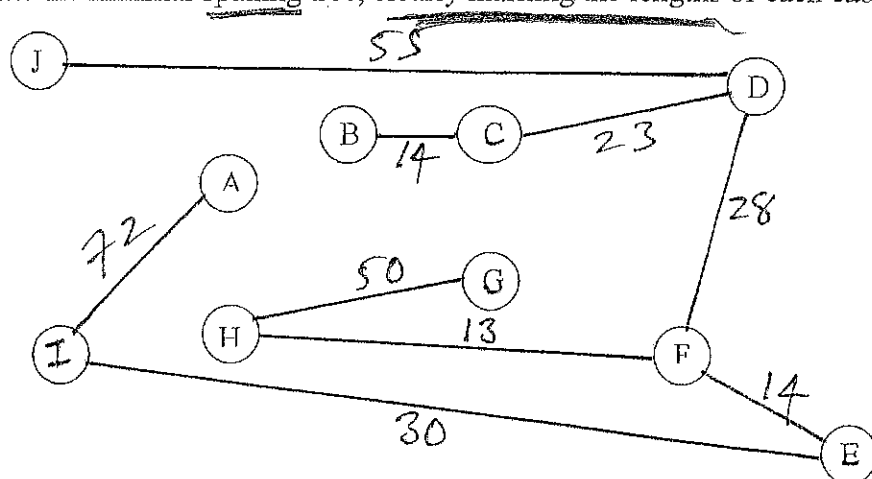
	A	B	C	D	E	F	G	H	I	J
A	-	85	-	-	-	-	-	-	72	-
B	85	-	(14)	-	-	-	-	-	43	-
C	-	14	-	(23)	-	-	-	-	-	105
D	-	-	23	-	32	(28)	-	-	35	55
E	-	-	-	32	-	14	-	-	(30)	-
F	-	-	-	28	(14)	-	-	13	-	75
G	-	-	-	-	-	-	-	(50)	-	70
H	-	-	-	-	-	(13)	50	-	-	63
I	(72)	43	-	35	30	-	-	-	-	-
J	-	-	105	(55)	-	75	70	63	-	-

- a) Use Prim's algorithm to find the minimum length of cable needed to connect all towns to the system.

$$72 + 14 + 23 + 55 + 14 + 28 + 13 + 50 + 30 = 299 \text{ km}$$

Working

- *b) Draw the minimal spanning tree, clearly marking the lengths of each cable.



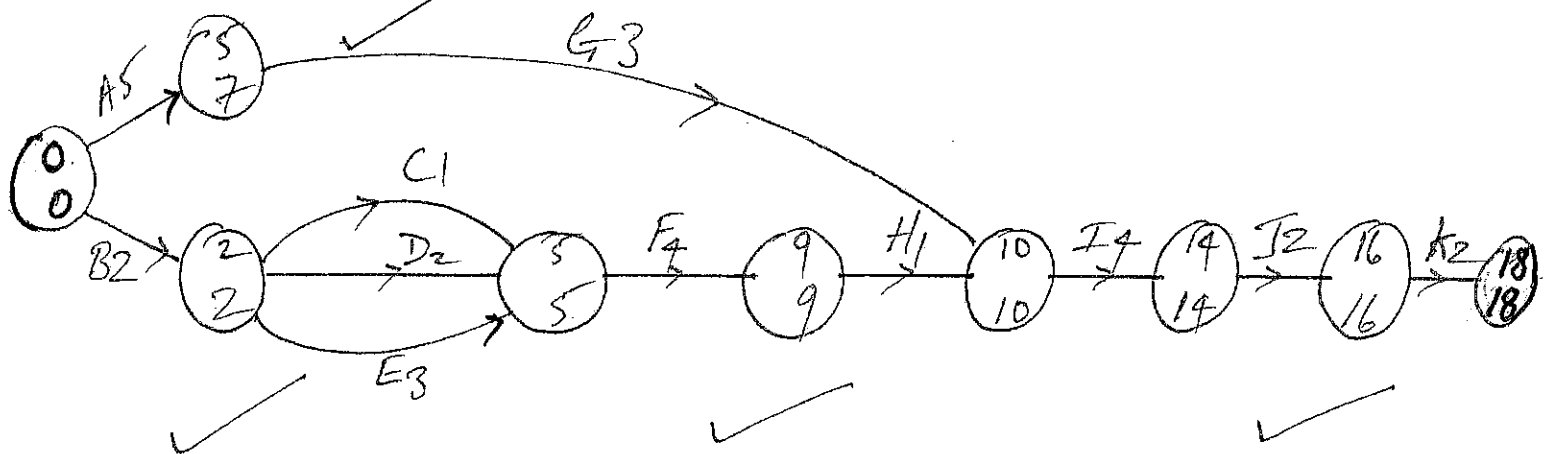
✓ correct lengths
✓ lengths marked

8. [4, 2, 1 = 7 marks]

CALM is responsible for land management in state forests. Below is a set of tasks that must be completed in a particular order to develop their land management project.

	Planting program	Immediate Predecessors	Time (days)
A	Prepare ripping program	-	5
B	Landing program	-	2
C	Confirm seedling requirements	B	1
D	Burn preparation requirements	B	2
E	Pre-burn seed tree viability testing	B	3
F	Regeneration burn	C,D,E	4
G	Ripping	A	3
H	Seed tree removal	F	1
I	Planting	G,H	4
J	Regeneration Assessment	I	2
K	Report	J	2

a) Construct the project network to represent the information given in the table.



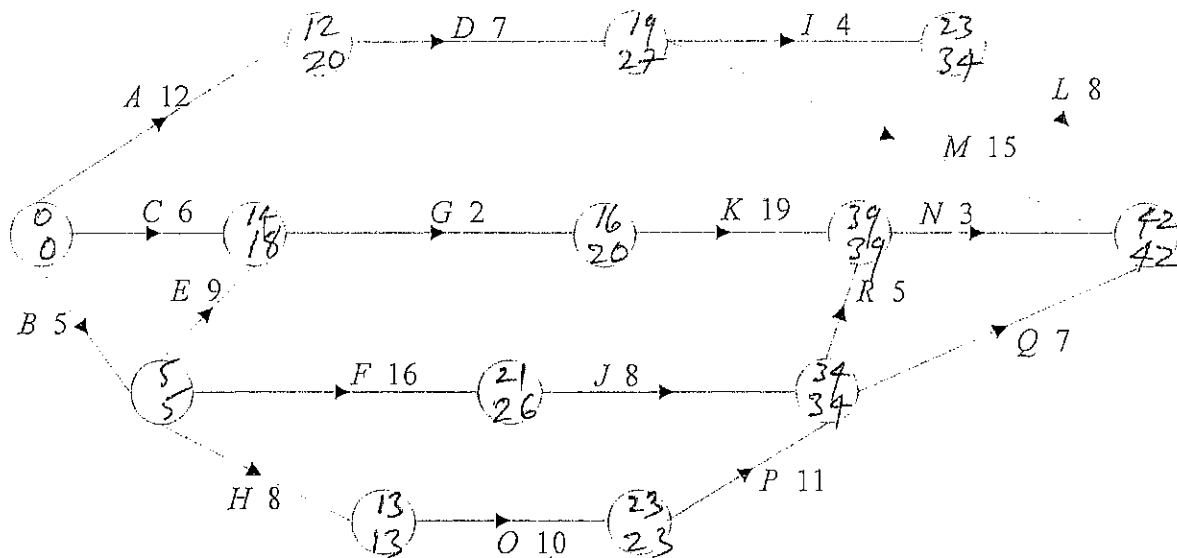
b) State the minimum completion time required for the project.

18 days

c) State the critical path.

B-E-F-H-I-J-K

9. [2, 1, 1, 2, 2 = 8 marks]



The network above shows the time (in hours) required to complete the tasks of a certain project.

- a) State the minimum time to complete all tasks.

42 hours ✓

- b) What are the tasks on the critical path?

B-H-O-P-R-N ✓

- c) What are the immediate predecessors of Task N?

K and R ✓

- d) By how much time could Task I be delayed without affecting the completion time?

$34 - 23 = 11$ hours ✓

- e) What is the effect on the minimum completion time if Task Q is increased by 3 hours?

minimum completion time increases by 2 hours to 44 hours. ✓