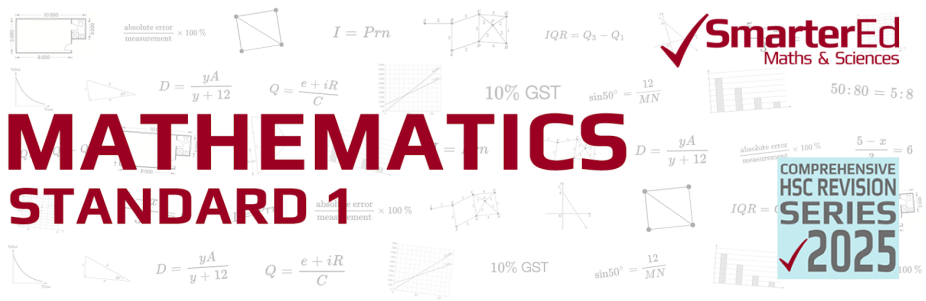


Thank you for subscribing to SmarterMaths Teacher Edition (Silver) in 2025.

Key features of the inaugural Standard 1 “2025 HSC Comprehensive Revision Series” include:

- ~12 hours of cherry-picked HSC revision questions by topic.
- Targeted at motivated students aiming for a Band 4-6 result.
- Questions are chosen to reflect their expected difficulty based on past Std1 HSC papers with a slight weighting toward more difficult examples where appropriate.
- Mark allocations given to each topic area reflect its historical (new syllabus) HSC exam allocation.
- ***Attempt, carefully review and annotate*** this revision set in Term 3.
- This question set provides the foundation of a concise and high quality revision resource for the run into the HSC exam.

Our analysis on each topic, the common question types, past areas of difficulty and recent HSC trends, all combine to create this revision set that ensures students cover a wide cross-section of the key areas.

IMPORTANT: If students have been exposed to questions in these worksheets during the year, we say great. Many top performing students attest to the benefits of doing quality questions 2-3 times before the HSC. This type of revision set is aimed at creating confidence and *speed through the exam*, with cherry picked questions that cover all important elements of revision while avoiding low percentage rabbit hole excursions.

HSC Final Study – Std1 Networks (estimated ~8.3% of exam)

Key Areas addressed by this worksheet

N1 Network Concepts (8.3%)

- *Basic Concepts* reviews a wide range of network concepts including the degree of vertices, number of edges, tree and path definitions, connected network and weighted edges.
- A revision focus area requires students to complete a table (or matrix) from a network graph and vice versa. This is a core competency that has been examined each year in the period 2022-24, predominantly via longer answer questions.
- Examiners regularly test *Basic Concepts* through multiple choice with 7 separate MC questions appearing in new syllabus exams to date. The revision set looks at a range of difficulty levels with a weighting towards some of the most challenging examples (see *2024 Std1 6 MC*, *2022 Std1 2 MC* and *2020 Std1 5 MC*).
- *Shortest Paths* have been examined 4 times in the last 6 years. With the exception of 2024, it has been tested as part of a more substantial minimum spanning tree question.
- Questions can require students to find a "shortest distance" by providing either a network diagram or a table, both of which are covered in the revision set.
- *Minimum Spanning Trees* are proving an examiner favourite with longer answer questions worth between 2–4 marks asked in every Std1 exam since it was introduced.
- This topic is a revision focus area due to its significant mark allocations and the fact it often produces sub-50% mean marks.
- *2024 Std1 20* required students to provide reasons for their *MST* selection, a novel approach and "must review" question.
- The worked solutions provide significant detail for solving problems using both Prim's and Kruskal's algorithms, reflecting the step-by-step approach outlined in the Networks Topic Guidance document.

"Students should take wandering outdoor walks when studying Networks, so that the mind might be nourished and refreshed by the open air and deep breathing."

~ Seneca

STANDARD 1
2025
HSC Revision Series

Smarter Ed

Networks

N1 Networks and Paths (Y12)

Basic Concepts

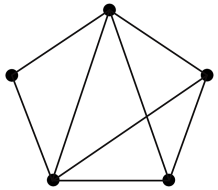
Minimum Spanning Trees

Shortest Paths

Exam Equivalent Time: 60 minutes *(based on allocation of 1.5 minutes per mark)*

Questions

1. Networks, STD2 N2 2010 FUR1 2 MC



The number of edges in the graph above is

A. 5

B. 7

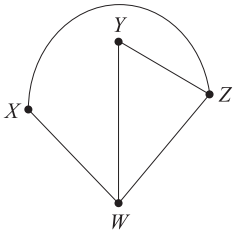
C. 8

D. 10

---

2. Networks, STD1 N1 2019 HSC 1 MC

A network diagram is given.



What is the degree of vertex W?

A. 1

B. 2

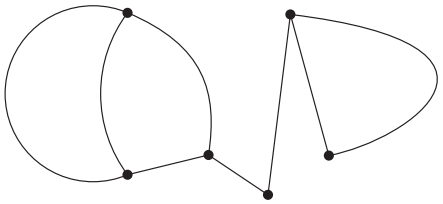
C. 3

D. 4

---

3. Networks, STD1 N1 2021 HSC 1 MC

A network diagram is shown.



How many vertices are in this network?

A. 5

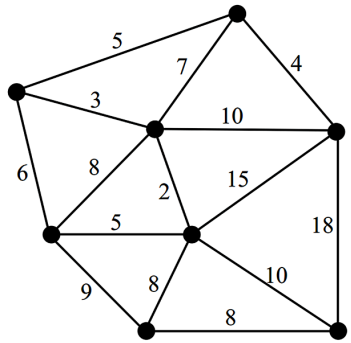
B. 6

C. 7

D. 8

---

4. Networks, STD2 N2 2010 FUR1 5 MC



For the network above, the length of the minimal spanning tree is

A. 30

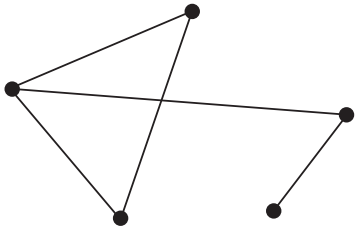
B. 31

C. 35

D. 39

---

5. Networks, STD1 N1 2024 NHT 33 MC



In the graph shown above, the number of vertices of even degree is:

A. 1

B. 2

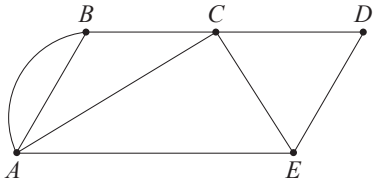
C. 3

D. 4

---

6. Networks, STD1 N1 2021 HSC 3 MC

Consider the network diagram.



What is the sum of the degrees of all the vertices in this network?

A. 5

B. 8

C. 14

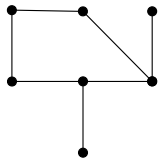
D. 16

---

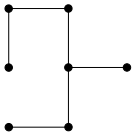
7. Networks, STD1 N1 2020 HSC 5 MC

Which of the following network diagrams is NOT a tree?

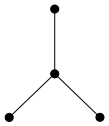
A.



B.



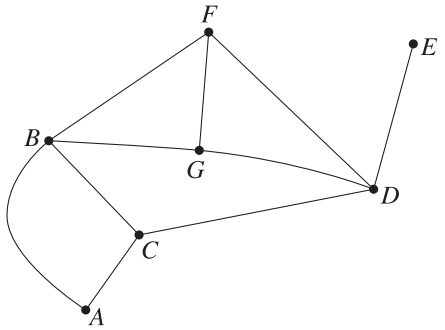
C.



D.

8. Networks, STD1 N1 2022 HSC 2 MC

A network diagram is shown.



What is the number of edges in this network?

A. 6

B. 7

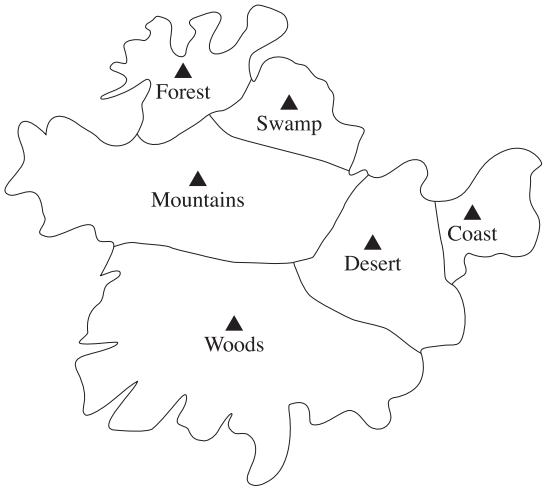
C. 9

D. 10

---

9. Networks, STD1 N1 2024 HSC 6 MC

The map shows regions within a country.



A network diagram is to be drawn to represent this map. Vertices will be used to indicate each region and edges will be used to represent a border shared between two regions.

How many edges will there be in the network diagram?

A. 8

B. 7

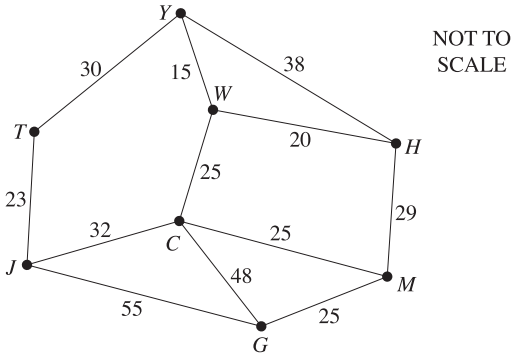
C. 6

D. 5

---

10. Networks, STD1 N1 2024 HSC 15

A network of towns and the distances between them in kilometres is shown.



NOT TO SCALE

a. What is the shortest path from T to H? *(2 marks)*

.....

.....

b. A truck driver needs to travel from Y to G but knows that the road from C to G is closed.

What is the length of the shortest path the truck driver can take from Y to G after the road closure? *(2 marks)*

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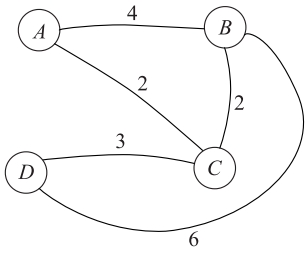
11. Networks, STD2 N2 SM-Bank 20

A table is constructed to represent the network diagram below.



Complete the table. *(2 marks)*

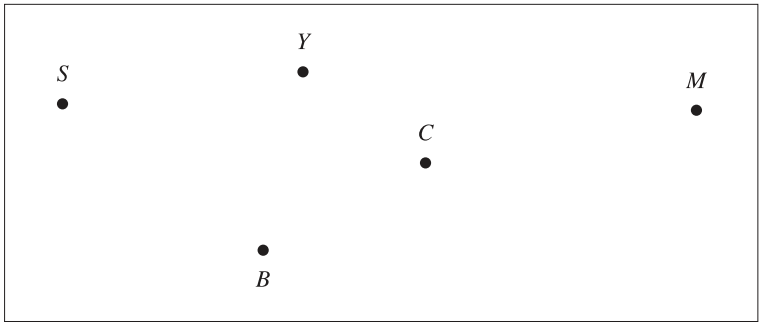
	A	B	C	D
A	0	4		-
B	4	0		
C			0	3
D		6		0

12. Networks, STD1 N1 2022 HSC 20

The table below shows the distances, in kilometres, between a number of towns.

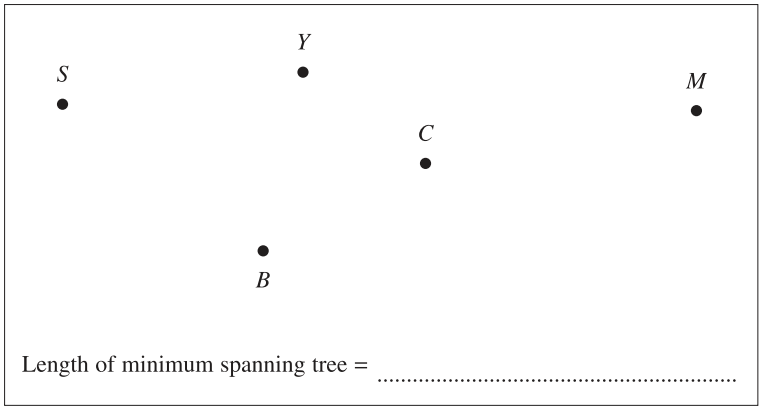
Towns	Snowtown (*S*)	Clairville (*C*)	Yuma (*Y*)	Bosten (*B*)	Morrella (*M*)
(*S*)	–	–	280	275	–
(*C*)	–	–	60	150	–
(*Y*)	280	60	–	–	530
(*B*)	275	150	–	–	790
(*M*)	–	–	530	790	–

a. Using the vertices given, draw a weighted network diagram to represent the information shown in the table. ***(2 marks)***



b. A tourist wishes to visit each town.

Draw the minimum spanning tree which will allow for this AND determine its length. ***(3 marks)***



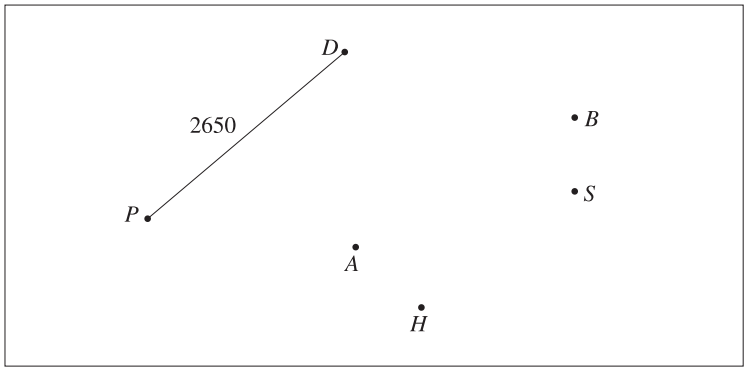
Length of minimum spanning tree = ...

13. Networks, STD1 N1 2023 HSC 15

The table shows some of the flight distances (rounded to the nearest 10 km between various Australian cities.

City	Adelaide (*A*)	Brisbane (*B*)	Darwin (*D*)	Hobart (*H*)	Perth (*P*)	Sydney (*S*)
Adelaide		–	–	1170	2120	–
Brisbane	–		2850	–	–	750
Darwin	–	2850		–	2650	3150
Hobart	1170	–	–		–	1040
Perth	2120	–	2650	–		3270
Sydney	–	750	3150	1040	3270	

a. Use the information in the table to complete the network diagram where the edges are labelled with distances. ***(2 marks)***



b. Mahsa wants to travel from Hobart to Darwin. She wants to change planes only once.

Using the network diagram, calculate how many kilometres she will travel by plane. ***(1 mark)***

.....

14. Networks, STD1 N1 2019 HSC 17

A regional airline operates flights in Queensland. Flight times between connected towns are shown in the table.

	Cairns	*Kowanyama*	*Mt Isa*	*Pormpuraaw*	*Townsville*
Cairns	–	1 h 50 min	2 h 5 min	–	55 min
Kowanyama	1 h 50 min	–	–	20 min	–
Mt Isa	2 h 5 min	–	–	–	1 h 40 min
Pormpuraaw	–	20 min	–	–	–
Townsville	55 min	–	1 h 40 min	–	–

Draw a network diagram to show how the towns are connected, with weights on the edges showing the flight times. ***(2 marks)***

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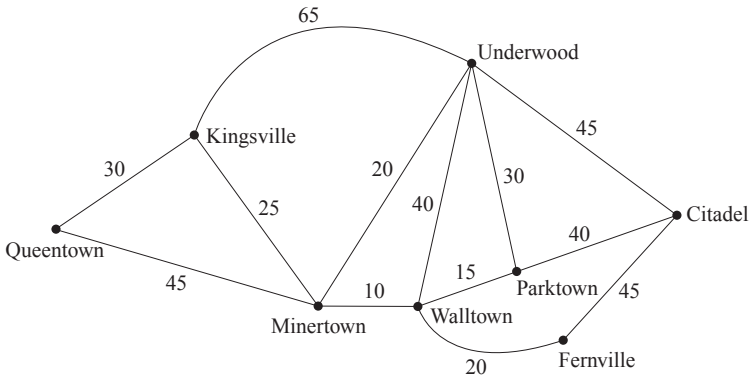
15. Networks, STD1 N1 2021 HSC 17

The network diagram shows the travel times in minutes along roads connecting a number of different towns.



a. Draw a minimum spanning tree for this network and determine its length. ***(3 marks)***

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b. How long does it take to travel from Queentown to Underwood using the fastest route? ***(1 mark)***

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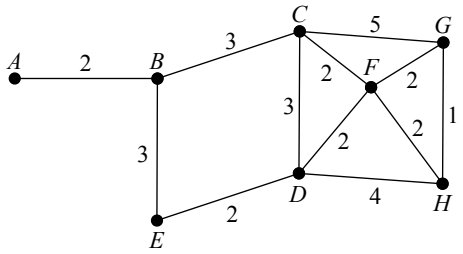
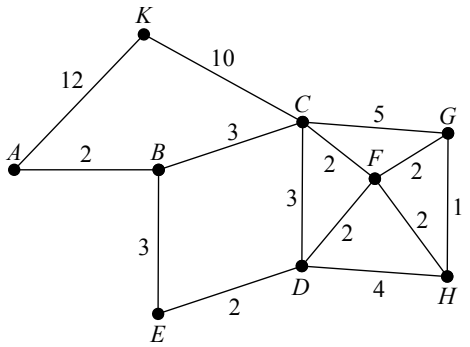
16. Networks, STD1 N1 2020 HSC 21

The diagram represents a network with weighted edges.



a. Draw a minimum spanning tree for this network and determine its length. *(3 marks)*

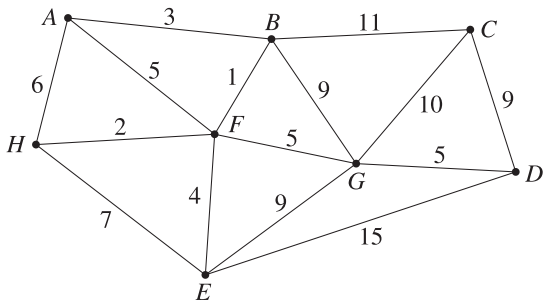
b. The network is revised by adding another vertex, K. Edges AK and CK have weights of 12 and 10 respectively, as shown.



What is the length of the minimum spanning tree for this revised network? *(1 mark)*

17. Networks, STD1 N1 2023 HSC 18

A network of running tracks connects the points A, B, C, D, E, F, G, H, as shown. The number on each edge represents the time, in minutes, that a typical runner should take to run along each track.



a. Which path could a typical runner take to run from point A to point D in the shortest time? *(2 marks)*

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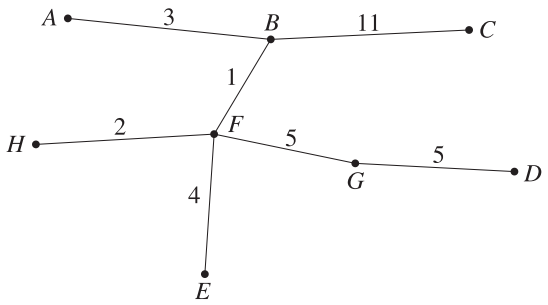
b. A spanning tree of the network above is shown.



Is it a minimum spanning tree? Give a reason for your answer. *(2 marks)*

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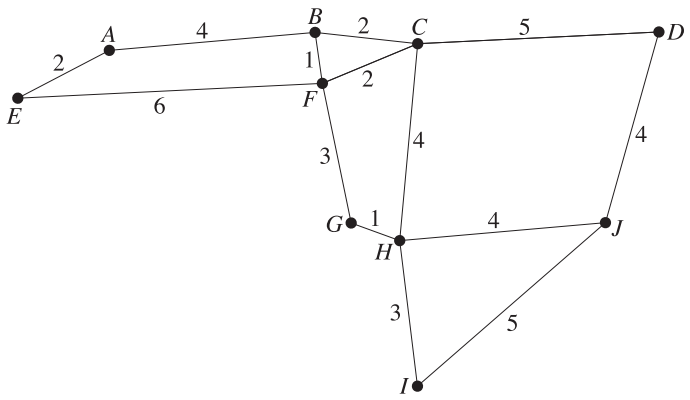
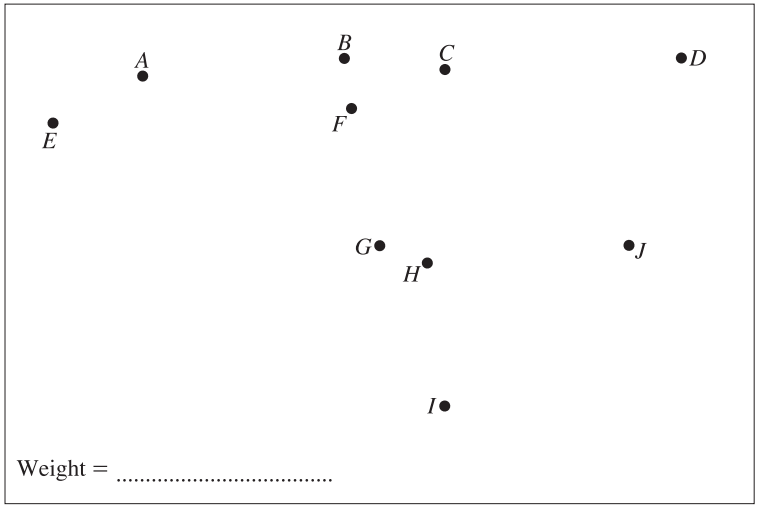
18. Networks, STD1 N1 2024 HSC 20

The diagram shows a network with weighted edges.



a. Draw a minimum spanning tree for this network and determine its weight. *(2 marks)*



b. Is it possible to find another spanning tree with the same weight? Give a reason for your answer. *(1 mark)*

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Worked Solutions

1. Networks, STD2 N2 2010 FUR1 2 MC

Edges are represented by lines between vertices.

$\Rightarrow C$

---

2. Networks, STD1 N1 2019 HSC 1 MC

Vertex W has 3 edges connected and is therefore degree 3.

$\Rightarrow C$

---

3. Networks, STD1 N1 2021 HSC 1 MC

Vertices $= 6$

$\Rightarrow B$

Worked Solutions

4. Networks, STD2 N2 2010 FUR1 5 MC

Using Kruskal's algorithm:

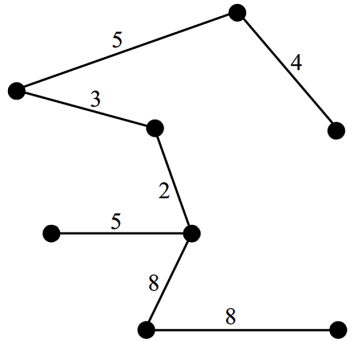
Edge 1: 2 (least weight)

Edge 2: 3

Edge 3: 4

Edge 4-5: 5

Edges 6-7: 8 (unused edges with weights <8 create circuits and are ignored)



$\therefore$ Minimal spanning tree

$= 2 + 3 + 4 + 5 + 5 + 8 + 8$

$= 35$

$\Rightarrow C$

---

5. Networks, STD1 N1 2024 NHT 33 MC

$\Rightarrow C$

---

6. Networks, STD1 N1 2021 HSC 3 MC

Sum of degrees $= 4 + 3 + 4 + 2 + 3$

$= 16$

$\Rightarrow D$

♦♦ *Mean mark 31%.*

---

7. Networks, STD1 N1 2020 HSC 5 MC

A tree cannot have a loop.

♦ *Mean mark 45%.*

$\Rightarrow A$

---

8. Networks, STD1 N1 2022 HSC 2 MC

There are 10 connection points (lines) between the nodes in the diagram.

♦ Mean mark 48%.

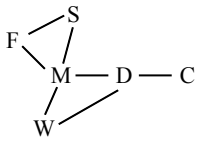
$\Rightarrow D$

---

9. Networks, STD1 N1 2024 HSC 6 MC

Network diagram:

♦♦ Mean mark 30%.



Network has 7 edges.

$\Rightarrow B$

---

10. Networks, STD1 N1 2024 HSC 15

a. $TYH = 30 + 38 = 68, \quad TYWH = 30 + 15 + 20 = 65$

$\therefore$ Shortest Path is $TYWH$.

b. $YWCMG = 15 + 25 + 25 + 25 = 90$

$YWHMG = 15 + 20 + 29 + 25 = 89$

$\Rightarrow$ All other paths are longer.

$\therefore$ Length of shortest path $= 89$ km

---

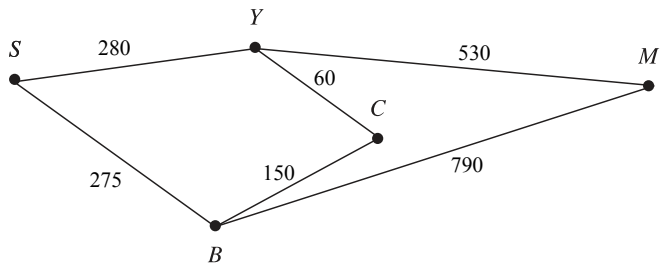
11. Networks, STD2 N2 SM-Bank 20

	A	B	C	D
A	0	4	**2**	-
B	4	0	**2**	**6**
C	**2**	**2**	0	3
D	-	6	**3**	0

---

12. Networks, STD1 N1 2022 HSC 20

a.



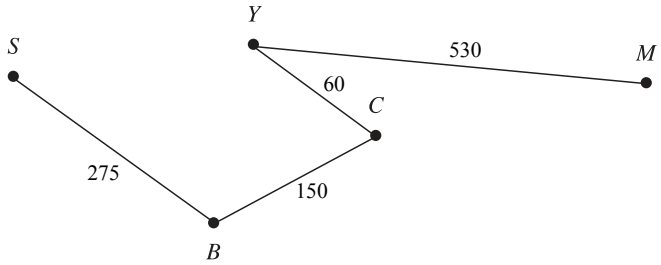
b. Using Prim's algorithm (starting at Y):

1st edge: YC

2nd edge: CB

3rd edge: SB

4th edge: YM



Length of minimum spanning tree

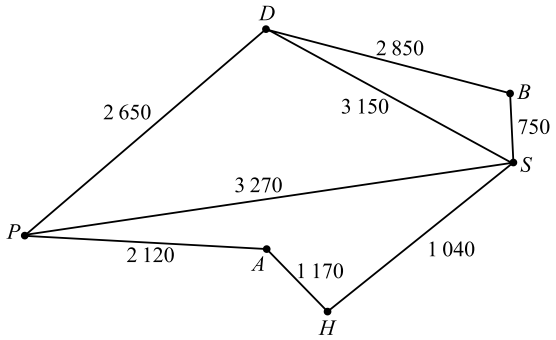
$= 275 + 150 + 60 + 530$

$= 1015$ km

---

13. Networks, STD1 N1 2023 HSC 15

a.



b. Changing planes only once $\Rightarrow H \to S \to D$

Kilometres travelled $= 1040 + 3150 = 4190$ km

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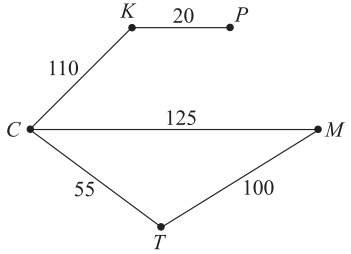
14. Networks, STD1 N1 2019 HSC 17



Edge weights are in minutes duration.

---

15. Networks, STD1 N1 2021 HSC 17

a. Using Prim's algorithm (starting at W):

1st edge: WM

2nd edge: WP

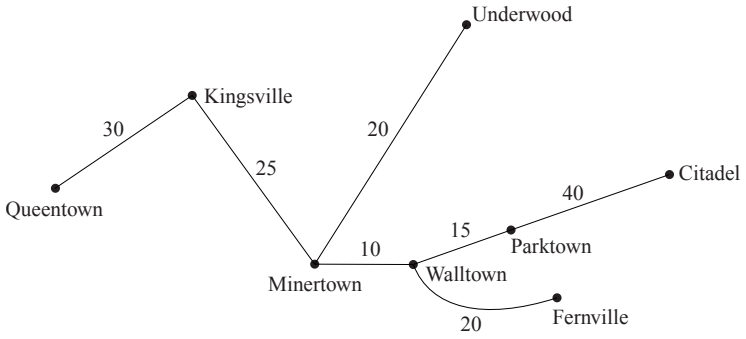
3rd/4th edges: MU and WF

5th edge: MK

6th edge: KQ

7th edge: PC

♦ *Mean mark part (a) 40%.*



Length of minimum spanning tree $= 160$

b. Fastest route $(Q$ to $U) = 45 + 20$

$= 65$ minutes

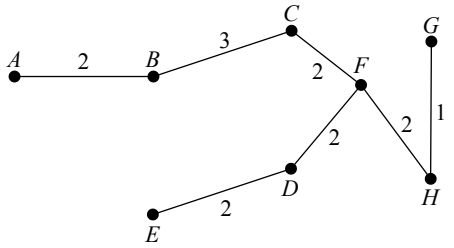
---

16. Networks, STD1 N1 2020 HSC 21

a. Using Kruskal's Algorithm (one of many possibilities):

Edge 1 : GH (1)
Edge 2 : FH (2)
Edge 3 : CF (2)
Edge 4 : FD (2)
Edge 5 : DE (2)
Edge 6 : BC (3)
Edge 7 : AB (2)

♦♦ *Mean mark part (a) 32%.*



Minimum length of spanning tree $= 1 + 2 + 2 + 2 + 2 + 3 + 2$

$= 14$

♦ *Mean mark part (b) 45%.*

b. Add CK to the minimum spanning tree in (a).

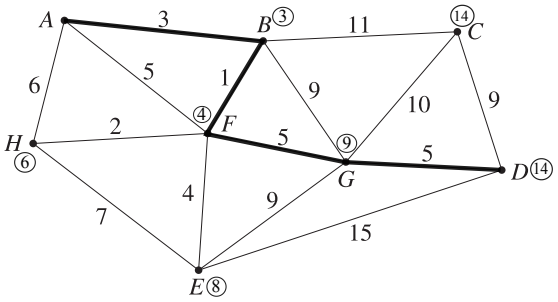
$\therefore$ Revised length $= 14 + 10$

$= 24$

---

17. Networks, STD1 N1 2023 HSC 18

a. Using Djikstra's Algorithm:



Shortest route $= ABFGD$

$= 3 + 1 + 5 + 5$

$= 14$

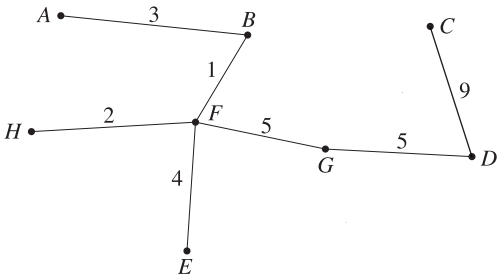
♦♦ Mean mark (b) 21%.

b. Total time of given spanning tree

$= 3 + 11 + 1 + 2 + 4 + 5 + 5$

$= 31$

Consider the MST below:



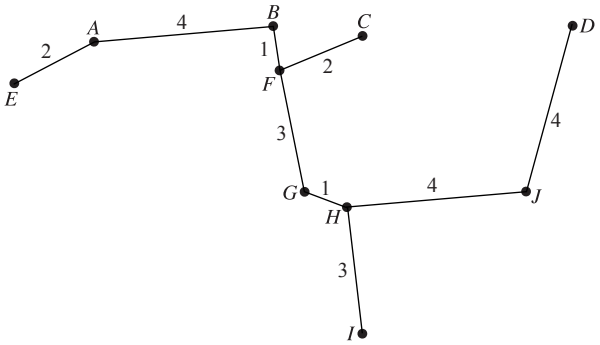
Total time (MST) $= 3 + 1 + 2 + 4 + 5 + 5 + 9 = 29$

$\therefore$ Given tree is NOT a MST.

18. Networks, STD1 N1 2024 HSC 20

a.

♦ Mean mark 53%.



Weight = 24

♦♦♦ Mean mark 16%.

b. Yes.

$\rightarrow$ The edge FC on the MST above could be replaced by the edge BC

to create a second MST (with equivalent weight $= 24$)