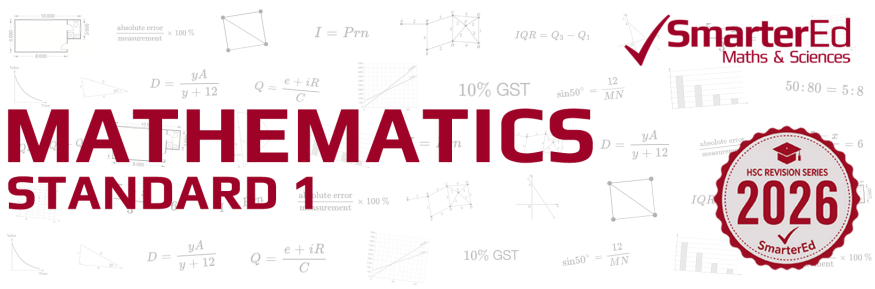



Welcome to the SmarterMaths 2026 HSC Standard 1 Revision Series.

Key features of this year's Revision Series include:

- ~12 hours of carefully selected HSC revision questions
- Targeted practice across the most important HSC question types
- Designed for students aiming for a Band 5-6 result
- Revision targeted at mid-difficulty, regularly tested question types as well as other examples that have proven more challenging
- Topic and question weightings reflect historical HSC exam allocations
- Build your own personalised revision resource by ***carefully reviewing and annotating*** these worksheets throughout Term 3.

**Philosophy: Every question has earned its place. Historical HSC trends, common question types and past areas of student difficulty have all influenced the selection process.*

**IMPORTANT**

If you've already completed some of these questions during the year, **that's a good thing.**

Many of the highest-performing students credit repeated practice with challenging past HSC questions as a key ingredient in their HSC success. This revision series focuses on the highest-value question types, helping you build confidence and critically, *speed* through the exam.

**HSC Final Study – Standard 1 Networks**

Syllabus: N1 Network Concepts

Worksheet 1 of 1 | Estimated exam weighting: 8.4%

Key Areas addressed by this worksheet:

N1 Network Concepts (8.4%)

- **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 consistently examine this topic area through multiple choice with 8 separate MC questions appearing in new syllabus exams to date. The revision set focuses on this question-type.
- **Shortest Paths:** have been examined 5 times since 2019, most recently in 2025. It has been tested as part of a more substantial minimum spanning tree question on every occasion except 2024.
- 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 (★)**: proving an examiner favourite with longer answer questions worth between 2–4 marks asked each year between 2019-24 and via multiple-choice in 2025.
- 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.

**KEY:** ★ Priority Revision – content or specific questions flagged by SM analysis as key revision.

*"When you get tired studying networks, don't quit. Change gears. A 10-minute walk can do more for your brain than another 10 minutes of staring at the page."*

~ Ruban Wiki

# STANDARD 1 2026

## HSC Revision Series

Smarter Ed

**Networks (1 of 1)**

**N1 Networks and Paths**

**Basic Concepts**

**Shortest Paths**

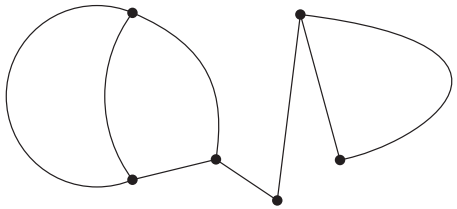
**Minimum Spanning Trees**

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

## Questions

### 1. 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

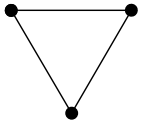
**D.** 8

---

### 2. Networks, STD1 N1 2020 HSC 1 MC

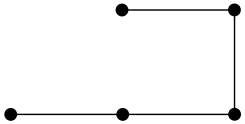
Which of the following networks has more vertices than edges?

A.

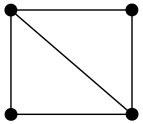


B.

C.



D.



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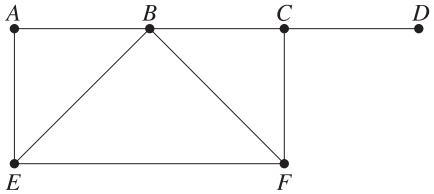
### 3. Networks, STD1 N1 2025 HSC 3 MC

Consider the network diagram.




Which vertex has degree 4?

**A.** $A$

**B.** $B$

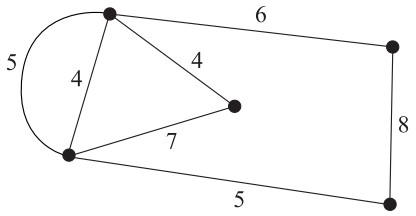
**C.** $C$

**D.** $D$

---

**4. Networks, STD2 N2 EQ-Bank 4 MC**

A weighted network diagram is shown below.




What is the weight of the minimum spanning tree?

**A.** 18

**B.** 19

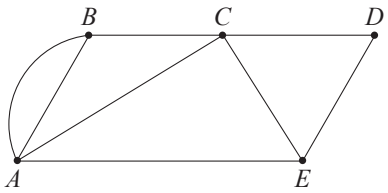
**C.** 20

**D.** 22

---

**5. 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

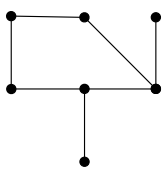
**D.** 16

---

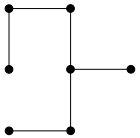
**6. Networks, STD1 N1 2020 HSC 5 MC**

Which of the following network diagrams is NOT a tree?

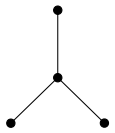
A.



B.



C.



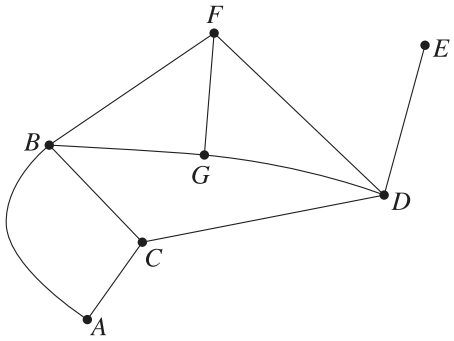
D.



---

## 7. 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

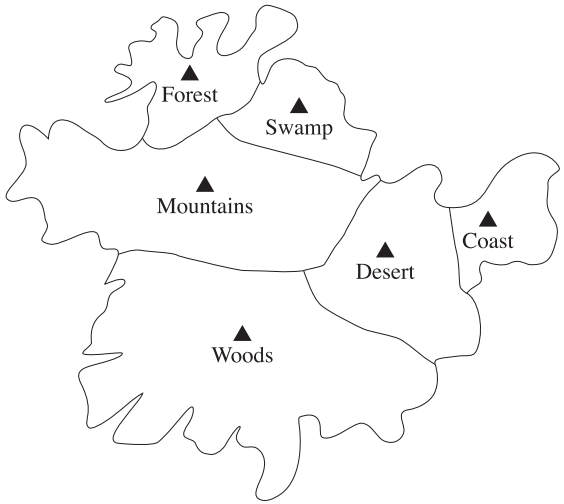
**C.** 9

**D.** 10

---

## 8. 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

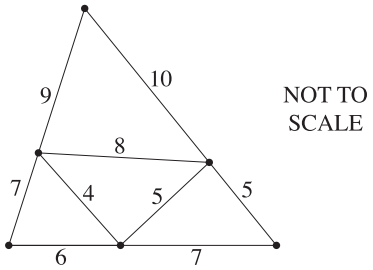
**C.** 6

**D.** 5

---

## 9. Networks, STD1 N1 2025 HSC 6 MC

The network shows the distances, in kilometres, along a series of roads that connect towns.




What is the value of the largest weighted edge included in the minimum spanning tree for this network?

**A.** 7

**B.** 8

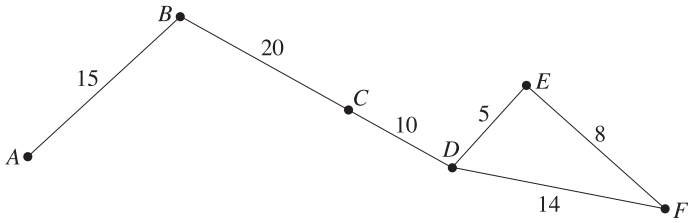
**C.** 9

**D.** 10

---

## 10. Networks, STD1 N1 2025 HSC 14

The time, in minutes, it takes to travel by road between six towns is recorded and shown in the network diagram below.



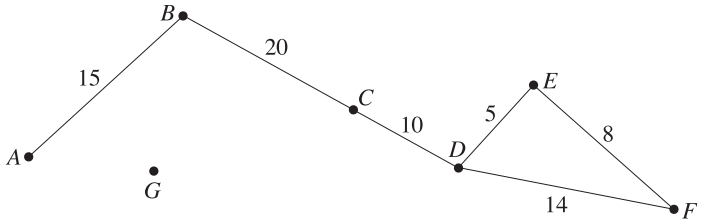

a. In this network the shortest path corresponds to the minimum travel time.

What is the minimum travel time between towns $A$ and $F$, and what is the corresponding path? ***(2 marks)***

New roads are built to connect a town $G$ to towns $A$ and $D$. The table gives the times it takes to travel by the new roads.

| *Town* | *Time*(minutes) | *Town* |
|---|---|---|
| $A$ | 8 | $G$ |
| $G$ | 22 | $D$ |

b. Add the new roads and times to the network diagram below. ***(2 marks)***

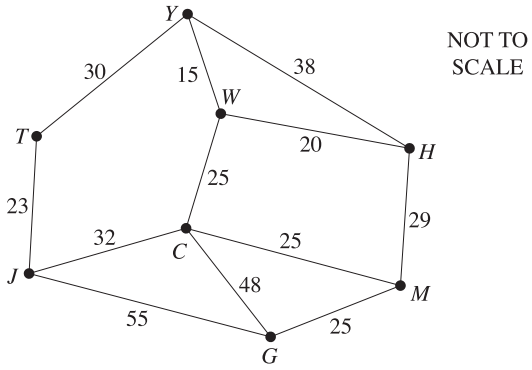



c. Explain whether the path in part (a) is still the shortest path from $A$ to $F$ after the new roads are added. ***(1 mark)***

---

## 11. 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)*

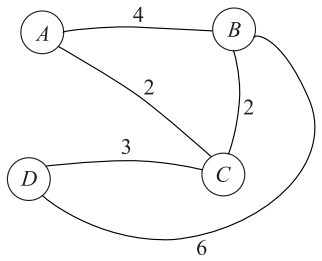
b. A truck driver needs to travel from $Y$ to $G$ but knows that the road from $C$ to $G$ is closed.

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

---

## 12. Networks, STD2 N2 EQ-Bank 17

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 |

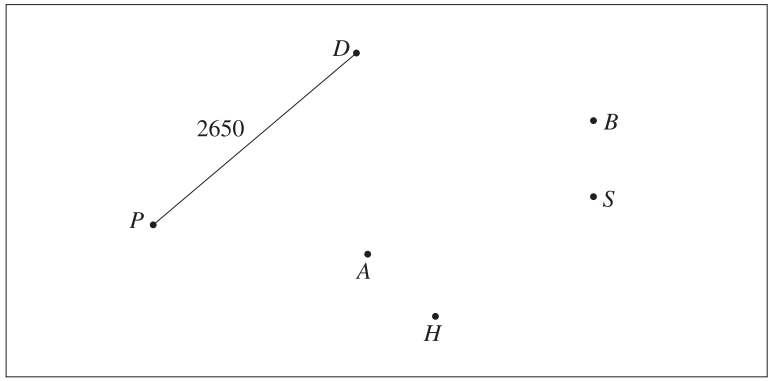
---

## 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

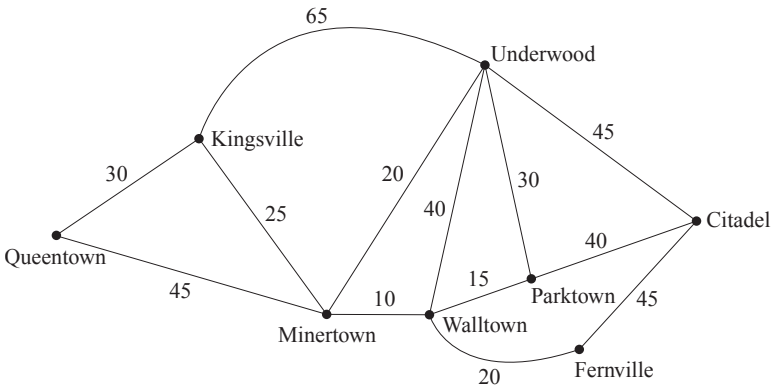
A regional airline operates flights in Queensland. Flight times between connected towns are shown in the table.

| | *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)***

## 15. Networks, STD1 N1 2021 HSC 17

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

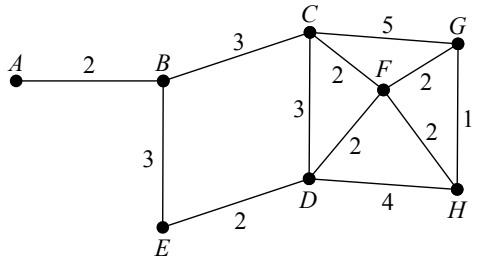



a. Draw a minimum spanning tree for this network and determine its length. ***(3 marks)***

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

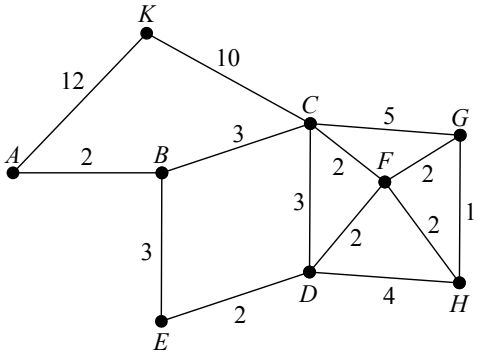
## 16. Networks, STD1 N1 2020 HSC 21

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.

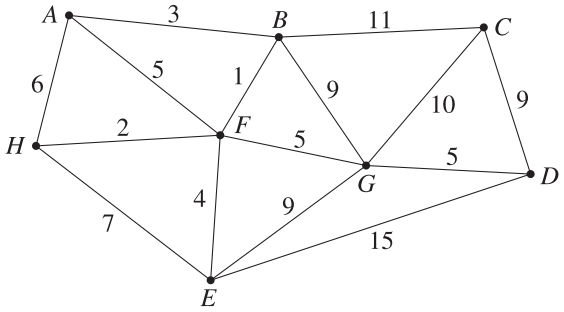



What is the length of the minimum spanning tree for this revised network? *(1 mark)*

---

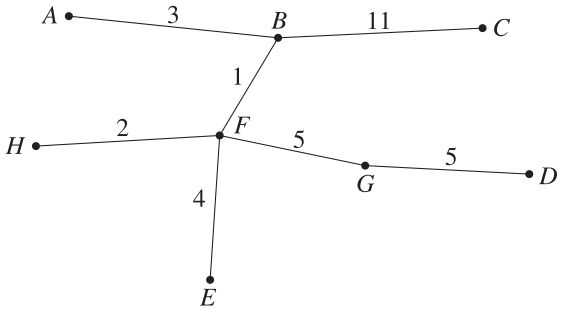
## 17. Networks, STD1 N1 2023 HSC 18

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)*

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

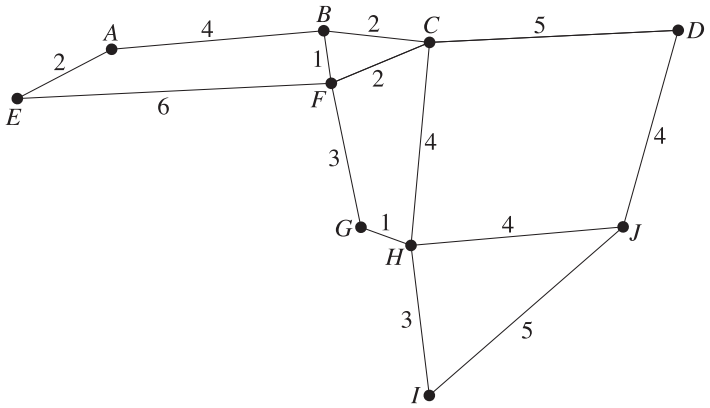



Is it a minimum spanning tree? Give a reason for your answer. *(2 marks)*

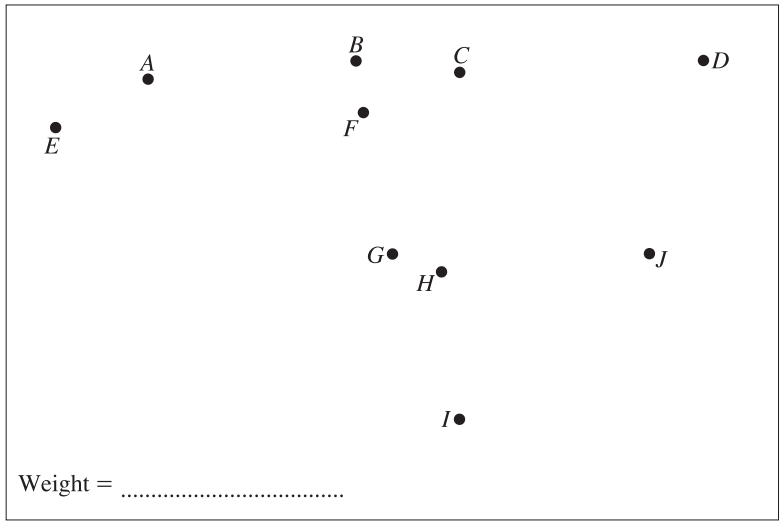
---

## 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)*



# Worked Solutions

## 1. Networks, STD1 N1 2021 HSC 1 MC

Vertices $= 6$

$\Rightarrow B$

## 2. Networks, STD1 N1 2020 HSC 1 MC

Consider C: Graph has 5 vertices and 4 edges.

$\Rightarrow C$

## 3. Networks, STD1 N1 2025 HSC 3 MC

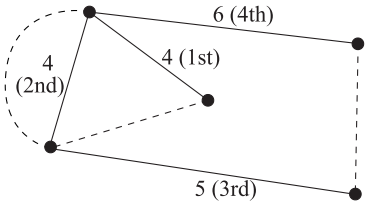
Vertex $B$ has 4 edges leading from it so has degree 4.

$\Rightarrow B$

## 4. Networks, STD2 N2 EQ-Bank 4 MC

One Strategy – Using Kruskal's Algorithm:

There are 5 vertices, so we need 4 edges.




$\therefore$ Weight $= 4 + 4 + 5 + 6 = 19$

$\Rightarrow B$

## 5. Networks, STD1 N1 2021 HSC 3 MC

Sum of degrees $= 4 + 3 + 4 + 2 + 3 = 16$

$\Rightarrow D$

♦♦ *Mean mark 31%.*

---

## 6. Networks, STD1 N1 2020 HSC 5 MC

A tree cannot have a loop.

$\Rightarrow A$

♦ *Mean mark 45%.*

---

## 7. Networks, STD1 N1 2022 HSC 2 MC

There are 10 connection points (lines)

between the nodes in the diagram.

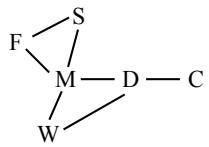
$\Rightarrow D$

♦ Mean mark 48%.

---

## 8. Networks, STD1 N1 2024 HSC 6 MC

Network diagram:




Network has 7 edges.

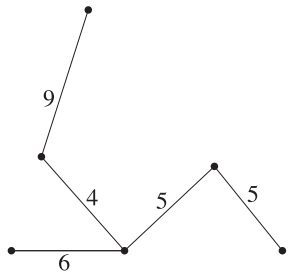
$\Rightarrow B$

♦♦ Mean mark 30%.

---

## 9. Networks, STD1 N1 2025 HSC 6 MC

Minimum spanning tree:




Using Kruskal's algorithm:

Edge $1 = 4$, Edge $2/3 = 5$, Edge $4 = 6$, Edge $5 = 9$

$\therefore$ The largest weighted edge in the MST $= 9$.

$\Rightarrow C$

♦♦ Mean mark 33%.

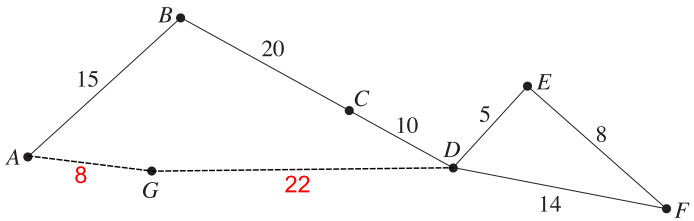
---

## 10. Networks, STD1 N1 2025 HSC 14

**a.** Minimum travel time $= 15 + 20 + 10 + 5 + 8 = 58$ minutes

Path: $A \to B \to C \to D \to E \to F$

**b.** New roads $A \to G$ and $G \to D$




**c.** Using the new roads $A \to G$ and $G \to D$:

Minimum travel time $= 8 + 22 + 5 + 8 = 43$ minutes.

Therefore the original path is no longer the shortest path.

## 11. 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

---

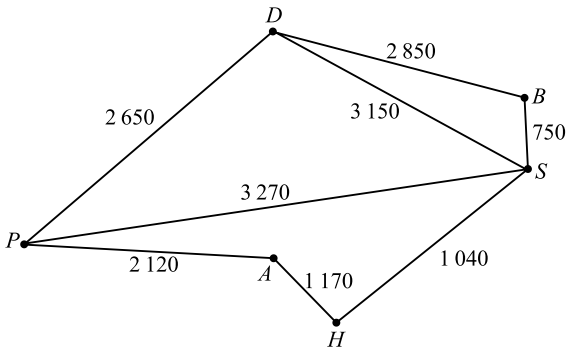
## 12. Networks, STD2 N2 EQ-Bank 17

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

---

## 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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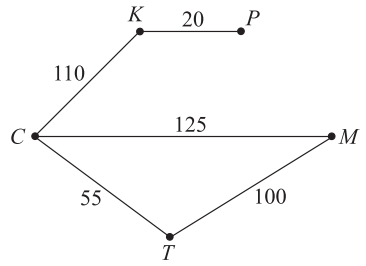
## 14. Networks, STD1 N1 2019 HSC 17




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: $WP$

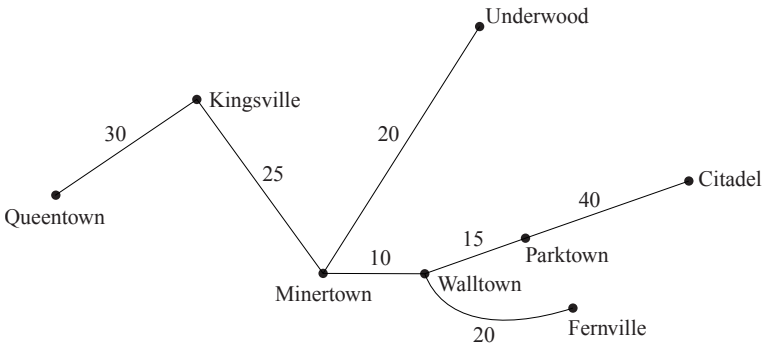
3rd/4th edges: $MU$ and $WF$

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

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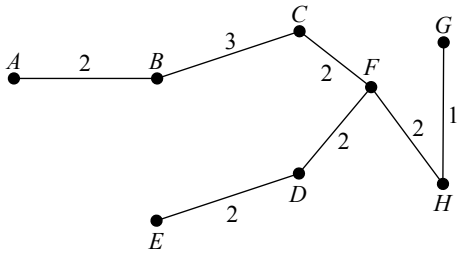
## 16. Networks, STD1 N1 2020 HSC 21

**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 $= 1 + 2 + 2 + 2 + 2 + 3 + 2 = 14$

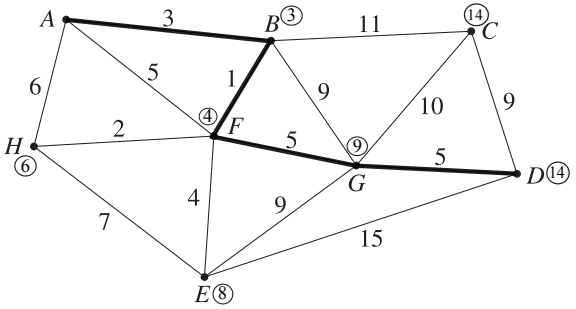
**b.** Add $CK$ to the minimum spanning tree in (a).

$\therefore$ Revised length $= 14 + 10 = 24$

♦ *Mean mark part (b) 45%.*

## 17. Networks, STD1 N1 2023 HSC 18

**a.** Using Djikstra's Algorithm:



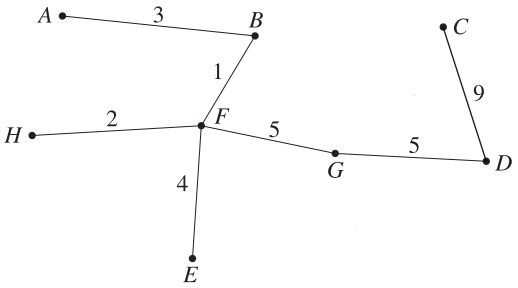

Shortest route $= ABFGD = 3 + 1 + 5 + 5 = 14$

**b.** Total time of given spanning tree

$= 3 + 11 + 1 + 2 + 4 + 5 + 5 = 31$

♦♦ Mean mark (b) 21%.

Consider the MST below:



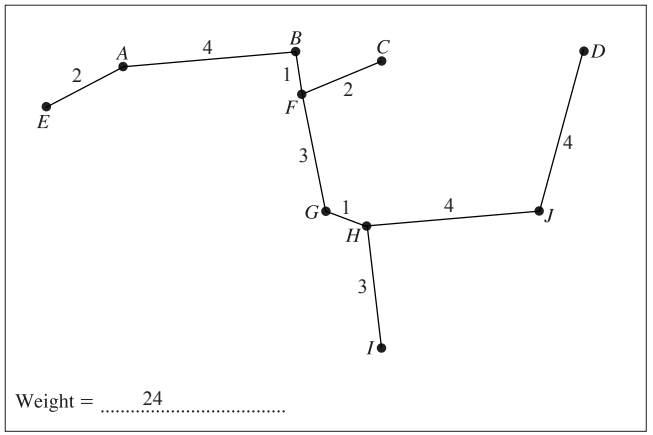

Total time (MST) $= 3 + 1 + 2 + 4 + 5 + 5 + 9 = 29$

$\therefore$ Given tree is NOT a MST.

## 18. Networks, STD1 N1 2024 HSC 20

**a.**

♦ Mean mark 53%.




Weight = 24

**b.** Yes.

♦♦♦ Mean mark 16%.

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

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