Name: _____

Year 12 2023 Mathematics Standard 2
Assessment Task 3

Investigative Assignment with Validation Task

Task number: 3	**Weighting: 25%**	**Due Date:** Thursday 25/05/23

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

Nature and description of the task:

Students are given a sample examination as a Preparation Activity that is to be completed. This portion of the assessment is to be turned in on the 25th of May 2023, prior to the in-class validation.

On the 25th of May 2023, you will complete in an in-class Validation Task. The final mark for this assessment will be the mark you receive in the in-class Validation task.

Non-Completion of Task:

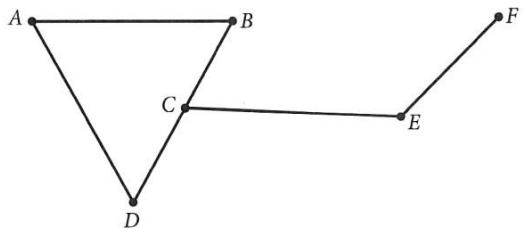
If you know you are going to be away on the day of the Validation Task and are unable to complete it on the due day, then you must have supportive documentation. *Zero marks will apply if the Assessment Task is completed late, unless an Illness/ Misadventure or Application for Extension form has been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

Section I

- Attempt Questions 1–6 **6 marks**
- Allow about 10 minutes for this section

Question 1

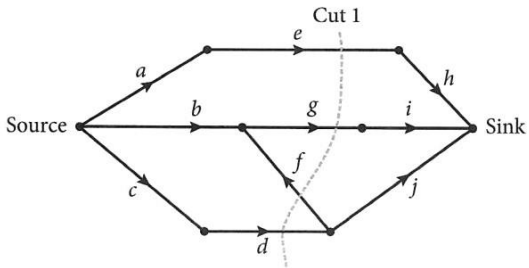
What is the sum of the degrees of all vertices in the network below?



A 10 **B** 12 **C** 14 **D** 16

Question 2

Water pipes connect 8 locations. The flow network below shows the capacities of the pipes.

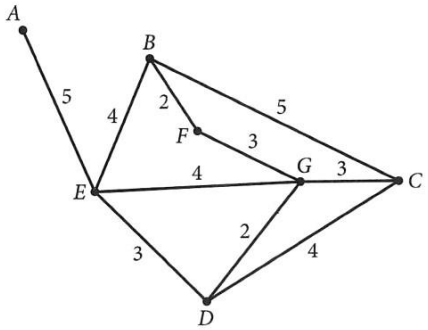


What is the capacity of cut 1?

A $e+d$ **B** $e+g+f$ **C** $e+g+d$ **D** $e+g-f+d$

Question 3

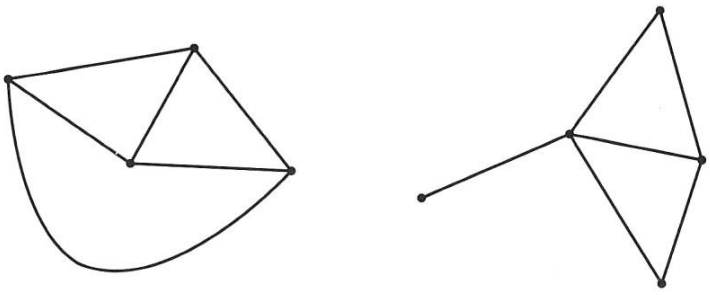
What is the weight of the minimum spanning tree in the network below?



A 17 **B** 18 **C** 19 **D** 22

Question 4

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.

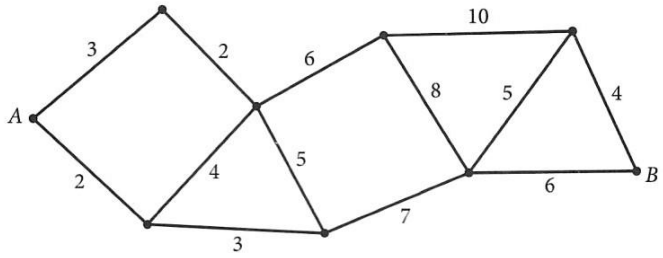
B Network B has 1 more vertex with an odd degree than Network A.

C Network B has fewer vertices than Network A.

D The sum of the degrees of Network B is the same as that of Network A.

Question 5

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 17 m

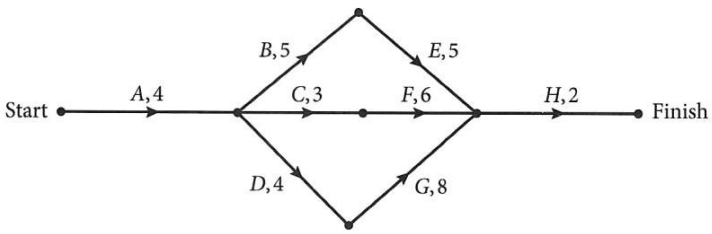
B 18 m

C 25 m

D 26 m

Question 6

Find the critical path of the network below.



A *ADGH*

B *ABEH*

C *ACFH*

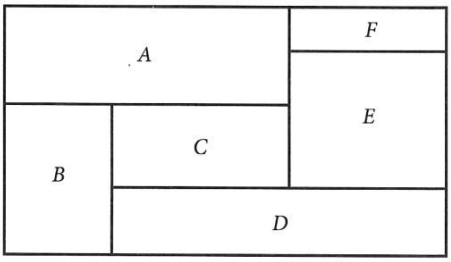
D *ACH*

Section II

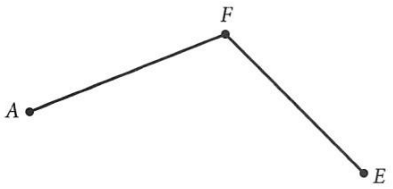
- Attempt Questions 7–17 **34 marks**
- Allow about 50 minutes for this section
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/or calculations.

Question 7 (2 marks)

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

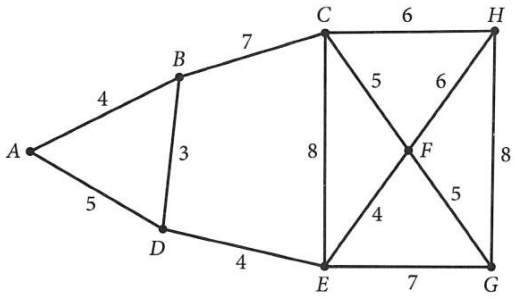


Complete the network of the field shown below, indicating the connections between fields that are in contact with each other. 2 marks



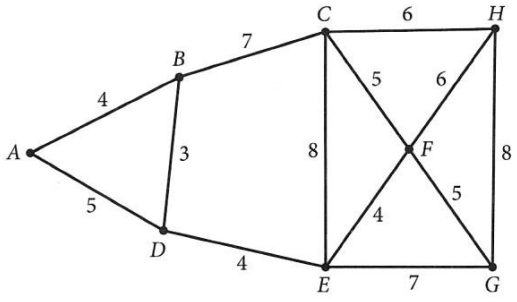
Question 8 (3 marks)

The network below shows distances, in metres, between 9 locations.



a What is the shortest distance between A and H? 1 mark

b Does the shortest path lie on the network's minimum spanning tree? 2 marks
Show your answer using the diagram below.



Question 9 (4 marks)

Towns *D*, *E*, *F* and *G* are connected by roads, and the distances, in kilometres, are shown in the grid.

	D	***E***	***F***	***G***
D	–	14	22	16
E	14	–	41	12
F	22	41	–	27
G	16	12	27	–

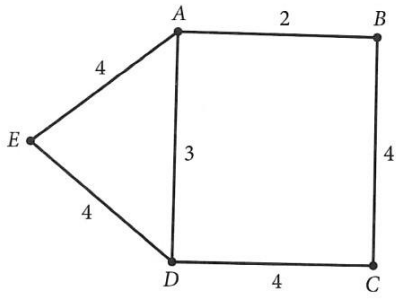
a Draw a weighted network diagram that represents the information in the grid. 2 marks

b A trucking company is based in town *F* and wants to visit each town, returning to *F* along the shortest path.

What route should the company take and what is the length of the route? 2 marks

Question 10 (3 marks)

The following network joins 5 vertices.

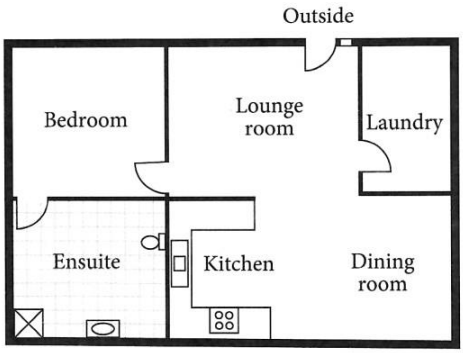


a How many minimum spanning trees are possible? 1 mark

b Draw 1 minimum spanning tree and indicate its length. 2 marks

Question 11 (2 marks)

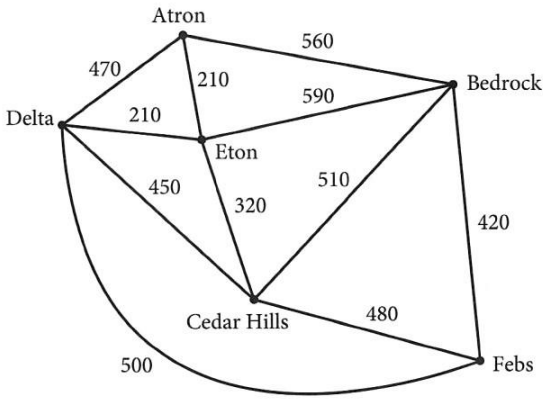
The following plan is for a small flat being built in a backyard.



Draw a network that models the house plan. Show areas as vertices, and show doorways and entrances as edges. 2 marks

Question 12 (3 marks)

A company wants to install internet cabling to connect 6 suburbs. The network below shows the length, in metres, of cabling required to connect each suburb.

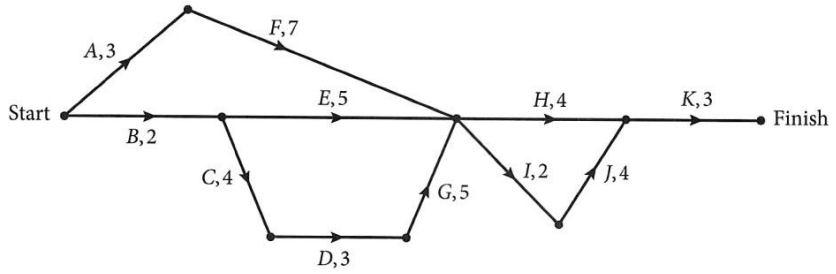


What is the minimum cost of connecting all 6 suburbs if cabling costs \$50 per metre? 3 marks

Questions 7–12 are worth 17 marks in total (Section II halfway point)

Question 13 (3 marks)

The network diagram shows tasks that must be completed to finish a project. Each edge weight represents the time taken to complete the task, in days.



a What is the estimated start time (EST) of activity *H*? 1 mark

b What is the critical path for the project? 1 mark

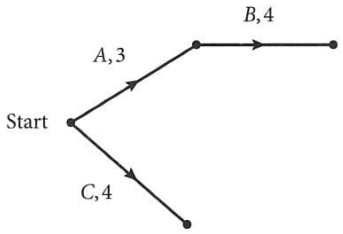
c What is the float time of activity *E*? 1 mark

Question 14 (4 marks)

The table shows the activities of a project, their durations, in days, and their immediate predecessors.

Activity	Duration (days)	Immediate predecessor(s)
A	3	–
B	4	*A*
C	4	–
D	5	*C*
E	7	*C*
F	6	*C*
G	4	*B, F*
H	4	*D*
I	7	*E, G, H*

a Using the table, complete the network below. 2 marks

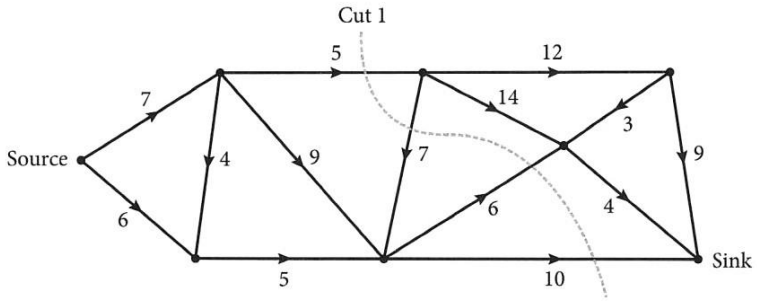


b What is the minimum completion time for the project? 1 mark

c What is the float time of activity *F*? 1 mark

Question 15 (3 marks)

The network below shows the flow of water through a series of pipes, from a source to the sink. Each number refers to the capacity of a pipe, in kilolitres per hour.

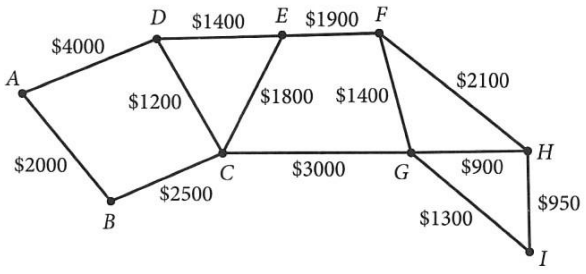


a What is the capacity of cut 1? 1 mark

b What is the maximum flow of the network, in kilolitres per hour? 2 marks

Question 16 (4 marks)

Annette wants to plan a trip to visit 8 different cities over the Christmas break. She begins her trip from A. The costs to travel from one city to another are given as edge weights.



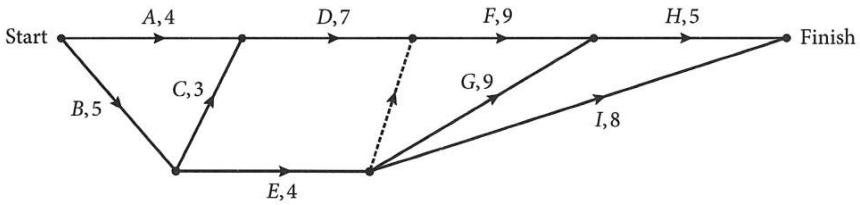
a If Annette wants to visit all 8 cities, what is the least amount of money she will need to cover her travel expenses? 1 mark

b What is the cheapest route from A to I that Annette can take, and how much will this cost? 2 marks

c Why is the cheapest route from A to I NOT the best path to take from a cost perspective if Annette still wants to visit the other 7 cities? 1 mark

Question 17 (3 marks)

A project has 9 activities, with durations measured in weeks. This is shown in the directed network below.



How many activities would need to be reduced by 2 weeks to reduce the minimum completion time of the project to 21 weeks? 3 marks

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