Student Name: _____

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GENERAL MATHEMATICS 2024

Unit 4
Key Topic Test 6 – Networks and Decision Mathematics: Weighted Graphs and Trees

Recommended writing time*: 45 minutes
Total number of marks available: 25 marks

QUESTION BOOK

* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions

- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners and rulers, approved CAS calculator and one bound reference book.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.

Materials supplied

- Question and answer book of 8 pages.

Instructions

- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

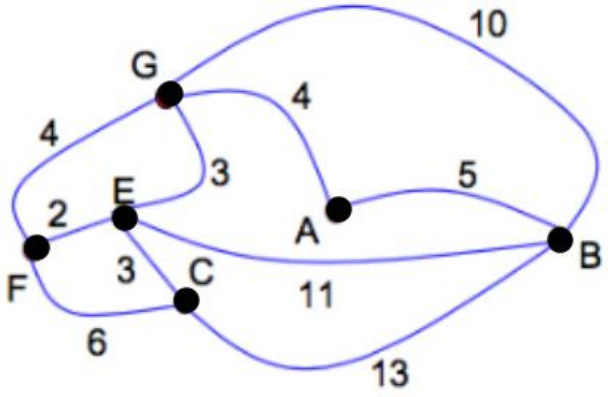
Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

SECTION A – Multiple-choice questions

Instructions for Section A

- All questions are worth one mark.
- Answer all questions by circling the correct response.
- Marks are not deducted for incorrect answers.
- No marks will be awarded if more than one answer is completed for any question

Use the following information to answer Questions 1 and 2



Question 1

The length of the shortest path from F to B is:

A. 12 **B.** 13 **C.** 14 **D.** 15 **E.** 16

Question 2

The length of the minimum spanning tree for this graph is:

A. 16

B. 17

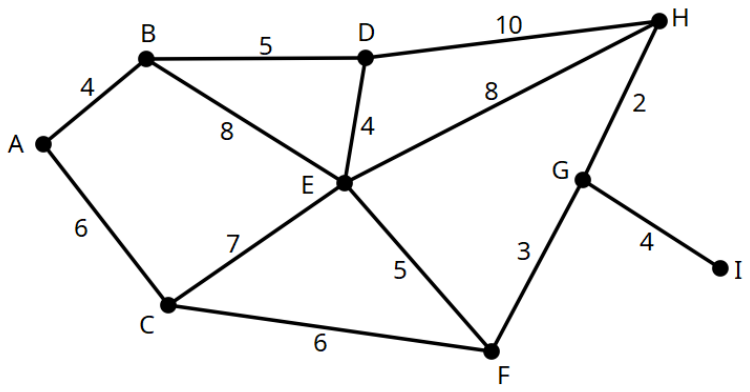
C. 18

D. 19

E. 20

Use the following information to answer Questions 3, 4 and 5

Consider the network graph



Question 3

The number of edges for a spanning tree for this graph is:

A. 7 **B.** 8 **C.** 9 **D.** 10 **E.** 11

Question 4

The weight of the minimum spanning tree is:

A. 27 **B.** 30 **C.** 33 **D.** 28 **E.** 31

Question 5

The shortest path from A to I is:

A. A – B – D – H – G – I
B. A – B – E – F – G – I
C. A – C – F – G – I
D. A – C – E – F – G – I
E. A – B – D – E – F – G - I

SECTION B - Short-answer questions

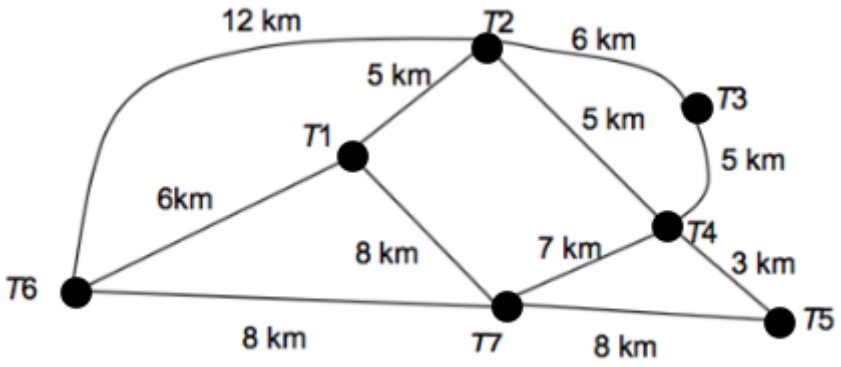
Instructions for Section B

- Answer each question in the space provided.
- Please provide appropriate workings and use exact answers unless otherwise specified.

Question 1 (7 marks)

The network diagram below shows the existing roads between 7 towns.

A telecommunications company wants to connect all the towns (T1 – T7) in the network below by cable. The company wishes to join the towns using the shortest amount of cable possible. The cable is to be laid under the existing roads. Not all of the roads will be used.



a. Highlight on the diagram above how this would be possible.

2 marks

b. State the mathematical algorithm used to ensure the minimum length of cable required.

_____

1 mark

c. Determine the minimum length of cable required.

_____

1 mark

d. State which towns can be directly accessed from T2.

_____

1 mark

e. When installing the cable, the technician is required to travel from T6 to T4 for an emergency service call. Find the shortest route available. State both the route and distance.

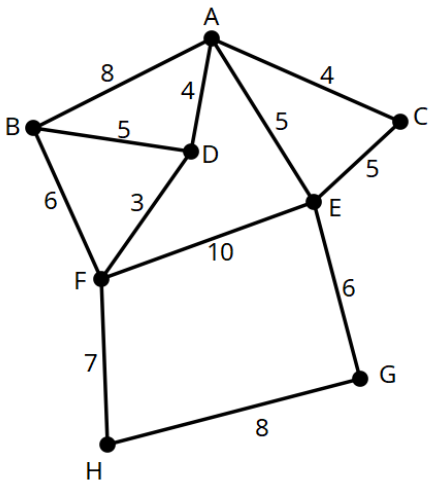
_____

_____

2 marks

Question 2 (8 marks)

The following graph shows significant landmarks in a town (vertices) and the roads (edges) connecting them. Distances on each edge are in kms.



a. Use Euler's formula to show that this is a connected planar graph.

_____

1 mark

b. If somebody runs the circuit A – B – D – F – H – G – E – A, find the distance that they ran.

_____

1 mark

c. Find the number of even degree vertices.

_____

1 mark

d. A Eulerian trail for this graph begins at vertex B, state the vertex that it will finish at.

_____

1 mark

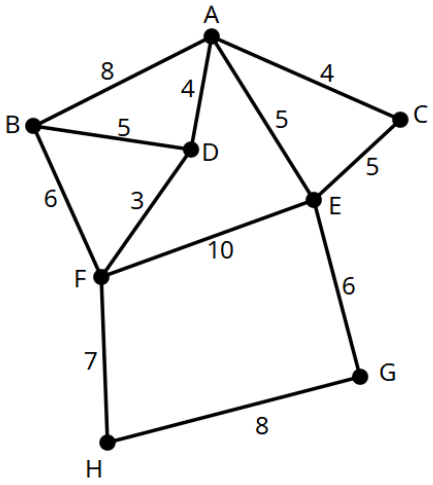
e. Explain why a Eulerian circuit is not possible.

_____

_____

1 mark

f. On the graph below, highlight the minimum spanning tree for this network.



2 marks

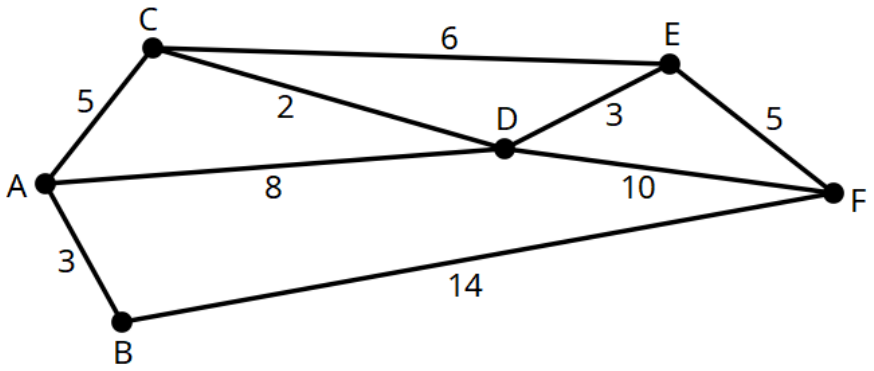
g. State the length of the minimum spanning tree.

_____

1 mark

Question 3 (5 marks)

Consider the graph below:



Djikstra's algorithm is used to find the shortest path from A to F, and has been started in the table below.

From A	B	C	D	E	F
A	3	5	8	∞	∞
B	3				

a. Use Djikstra's algorithm to complete the table above.

4 marks

b. State the shortest path from A to F and it's distance

_____

_____

1 mark

END OF KEY TOPIC TEST