

Student Name: _____



GENERAL MATHEMATICS 2024

Unit 4

Key Topic Test 7 – Networks and Decision Mathematics: Flow Problems

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 9 pages.

Instructions

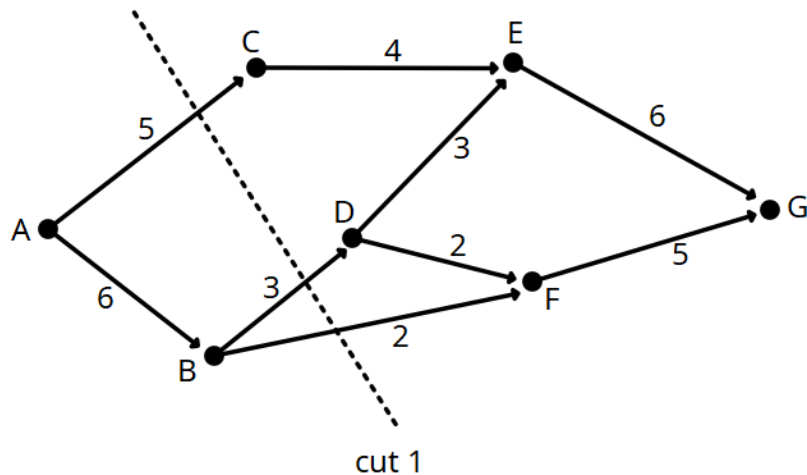
- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

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**

When considering the flow from A to G, the capacity of cut 1 is:

- A. 5 B. 8 C. 10 D. 7 E. 9

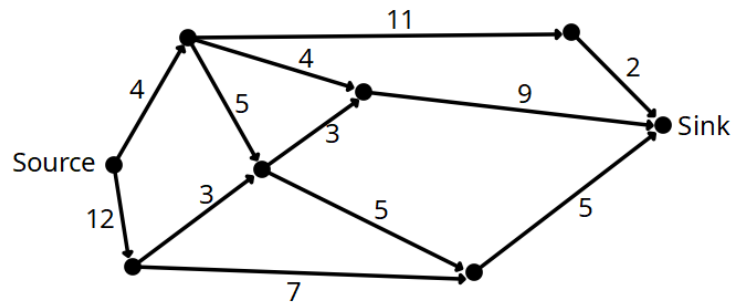
Question 2

The maximum flow from A to G is

- A. 8 B. 11 C. 10 D. 12 E. 9

Question 3

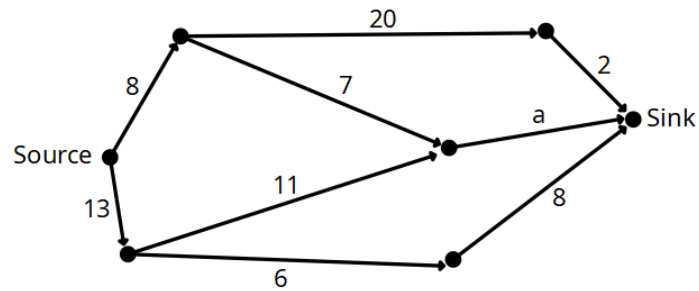
The maximum flow from source to sink in this network is



- A. 16 B. 12 C. 14 D. 25 E. 10

Question 4

If the maximum flow through the network below is 17, the value of a is

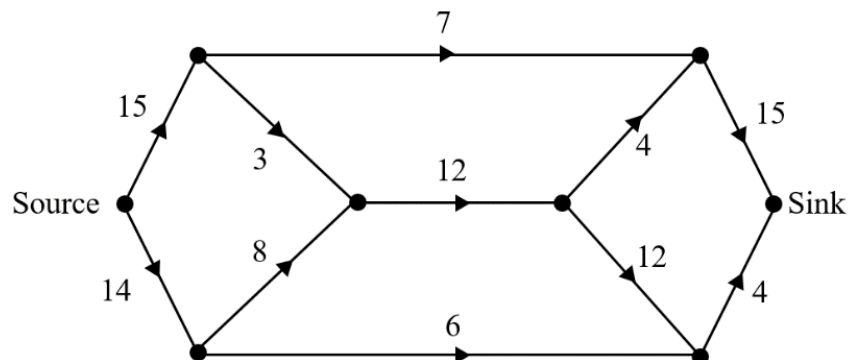


- A. 9 B. 10 C. 7 D. 5 E. 11

Question 5

The maximum flow from source to sink in this network is:

- A. 15
B. 25
C. 19
D. 24
E. 29



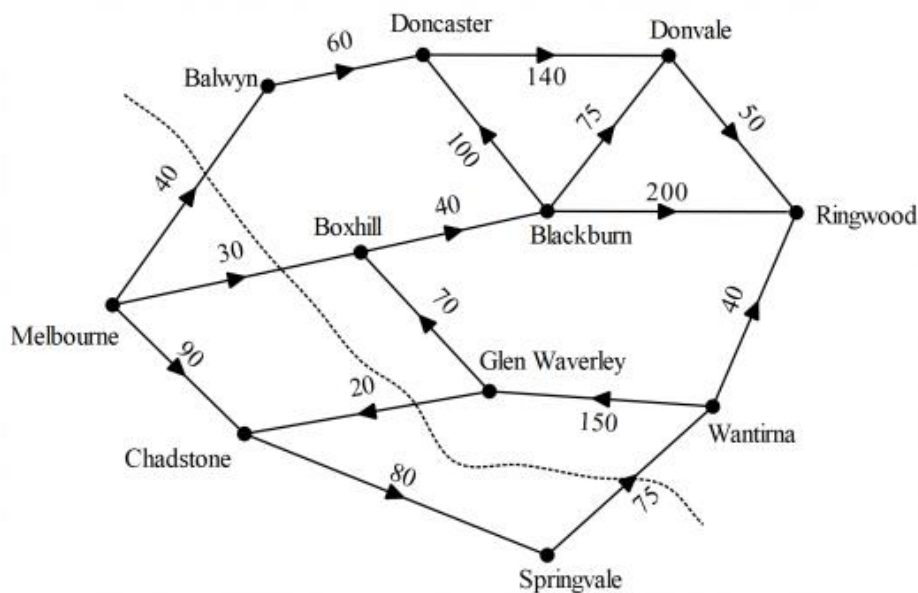
SECTION B - Short-answer questions

Instructions for Section B

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

Question 1 (9 marks)

The following network shows the roads connecting local Melbourne suburbs when travelling from Melbourne to Ringwood. The numbers on each edge represent the average number of cars per minute that can travel along each of the roads.



a. State the capacity of the cut shown

_____ 1 mark

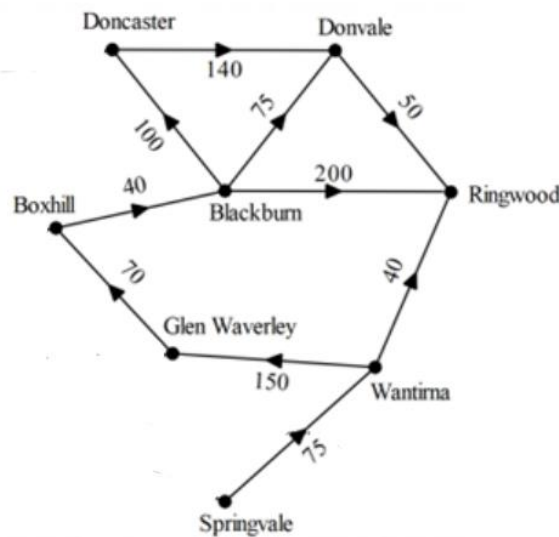
b. On the graph above, draw a cut with a capacity of 140 cars per minute.

_____ 1 mark

c. State the maximum flow for this network and mark the cut that shows this on the graph above.

_____ 2 marks

The roads connecting Springvale to Ringwood only are included in the graph below.



- d. Find the maximum flow per minute for cars travelling from Springvale to Ringwood.

1 mark

- e. If the capacity of the road from Springvale to Wantirna was to be increased, find the minimum capacity for this edge to maximise the total flow from Springvale to Ringwood.

2 marks

- f. The local council instead decides to increase the capacity of the road connecting Springvale to Wantirna to 250 cars per minute, and add a direct road from Glen Waverley to Blackburn. Find the minimum capacity of this new road, in order to maximise the flow from Springvale to Ringwood.

2 marks

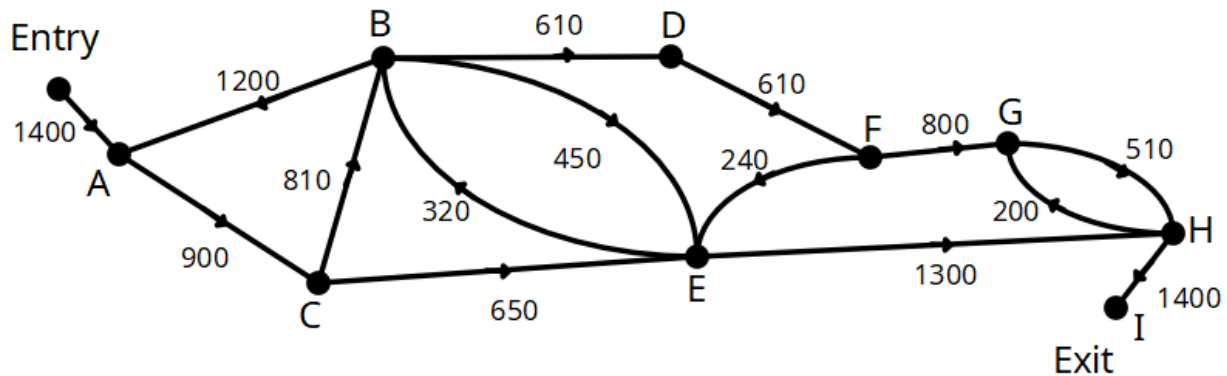
Question 2 (4 marks)

The network diagram below shows the local road network of a town.

The numbers on the edges represent the maximum vehicles per hour that can travel along each road in this network.

The arrows represent the permitted direction of travel.

The vertices represent the intersections of the roads.



- a. Find the maximum number of vehicles that can travel from the intersection at vertex G to the exit each hour.

1 mark

- b. Find the maximum number of vehicles that can travel from the entry to the exit each hour.

1 mark

The local council plans to increase the number of vehicles that travel from the entry to the exit each hour.

- c. Which road must have its capacity increased in order to achieve this?

1 mark

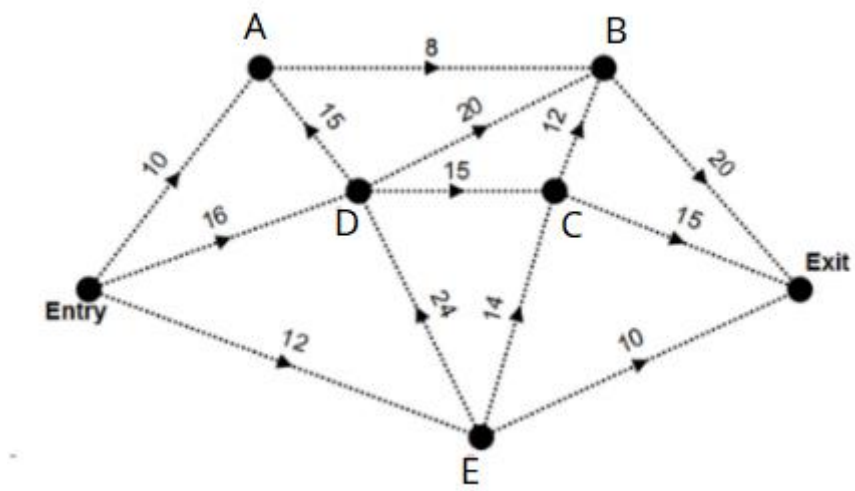
- d. What should the minimum capacity of this road be to maximise the flow of vehicles from the entry to the exit?

1 mark

Question 3 (4 marks)

A museum plans to have an interesting exhibit on show, on loan from overseas. It is hoping that this will increase ticket sales for the museum. However, there are issues with the width of the corridors and the maximum number of visitors that can walk through them.

Below is a diagram of the flow through the corridors at present. Weightings represent the number of people who can access the corridor at a given time.



- a. Find the maximum flow from entry to exit through the museum

1 mark

The museum has enough budget to widen two existing corridors, to a maximum of 20 people at a given time.

- b. Which 2 corridors should be widened in order to maximize the flow through the museum?

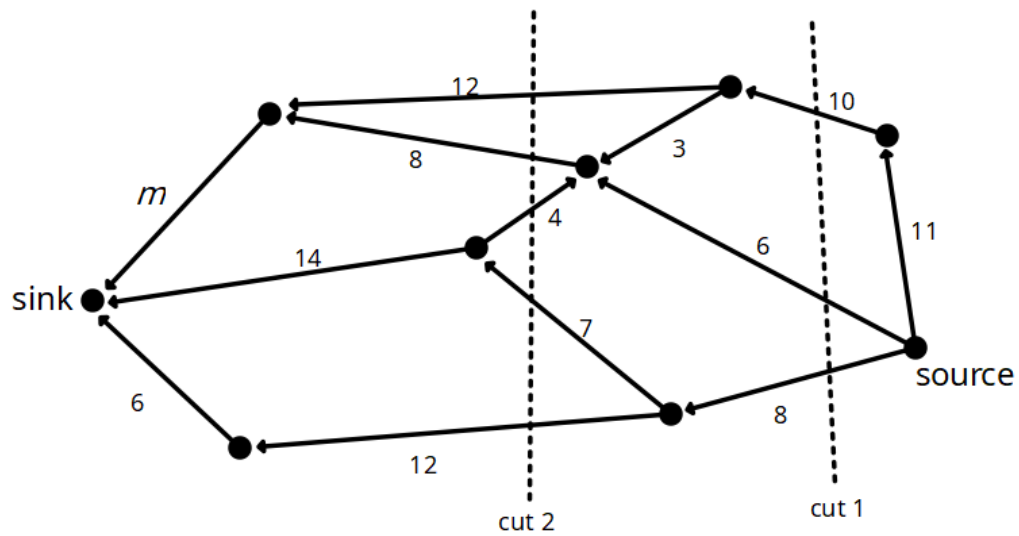
2 marks

- c. Find the new maximum flow through the museum if these corridors are widened.

1 mark

Question 4 (3 marks)

Consider the network below:



a. State the capacity of cut 1

1 mark

b. State the capacity of cut 2

1 mark

c. If the maximum flow through this network is 17, find the value of m .

1 mark

END OF KEY TOPIC TEST