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GENERAL MATHEMATICS

(MTG315115)

PART 1 – Bivariate Data Analysis

Time: 36 minutes

Pages:	12
Questions:	3
Attachments:	Information Sheet

Candidate Instructions

1. You **must** make sure that your responses to the questions in this examination paper will show your achievement in the criteria being assessed.
2. Answer **all** questions. Answers must be written in the spaces provided on the examination paper.
3. You should make sure you answer all parts within each question so that the criterion can be assessed.
4. This examination is 3 hours in length. It is recommended that you spend approximately 36 minutes in total answering the questions in this booklet.
5. The External Examination Information Sheet for General Mathematics can be used throughout the examination. No other written material is allowed into the examination.
6. All written responses must be in English.

On the basis of your performance in this examination, the examiners will provide results on each of the following criterion taken from the course statement:

Criterion 4 Demonstrate knowledge and understanding of bivariate data analysis.

Section Total:	/36
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Additional Instructions for Candidates

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You are expected to provide a calculator approved by the Office of Tasmanian Assessment, Standards and Certification.

For questions worth 1 mark, whilst no workings are required, markers may consider appropriate step(s) taken to come to an answer.

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Spare graph grids have been provided in the back of the booklet for you to use if required.

If you use any of these spare graph grids you MUST indicate you have done so in your answer to that question.

Question 1 (approximately 6 minutes)

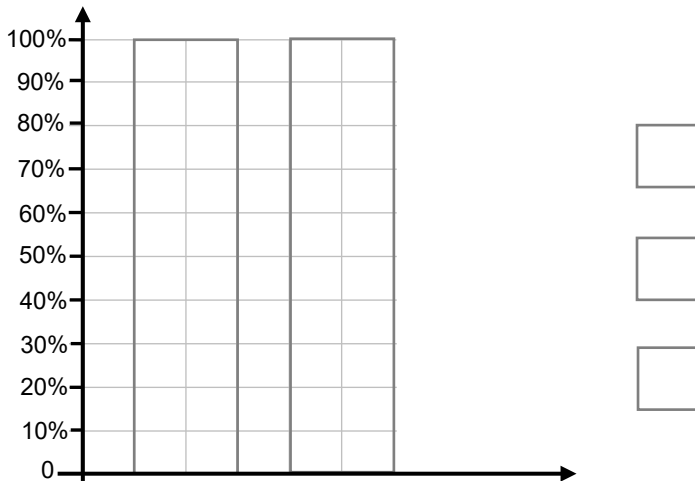
A group of students were surveyed about the type of transport that they used to get to school. A summary table showing the results of this survey is shown below.

	Males	Females
Walk	11	18
Bus	42	40
Car	14	40
Totals	67	98

- (a) Complete the table below showing the females data in percentage terms. (1 mark)

	Males %	Females %
Walk	16	
Bus	63	
Car	21	

- (b) Complete the divided bar chart below, showing the data in percentages from part (a). (2 marks)



- (c) Using the information given and your answers from parts (a) and (b), comment on any **associations** between the variables presented. (3 marks)

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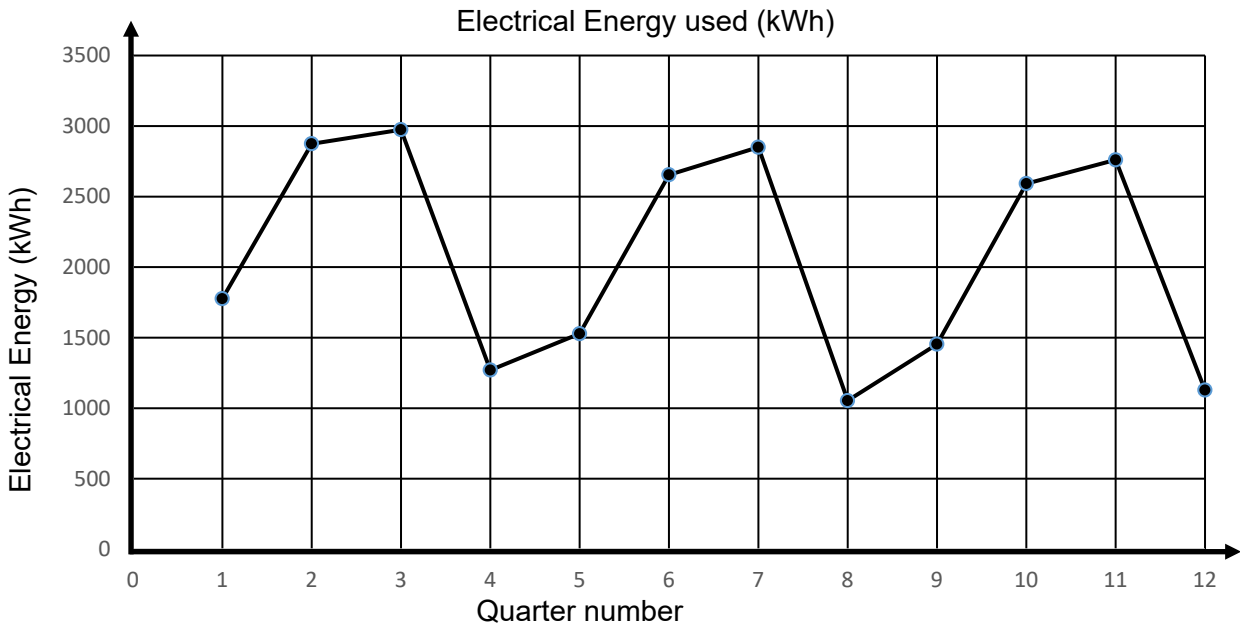
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Question 2 (approximately 10 minutes)

The time series graph below shows the amount of Electrical Energy, in kilowatt hours (kWh), that a household uses over a period of 12 consecutive quarters.

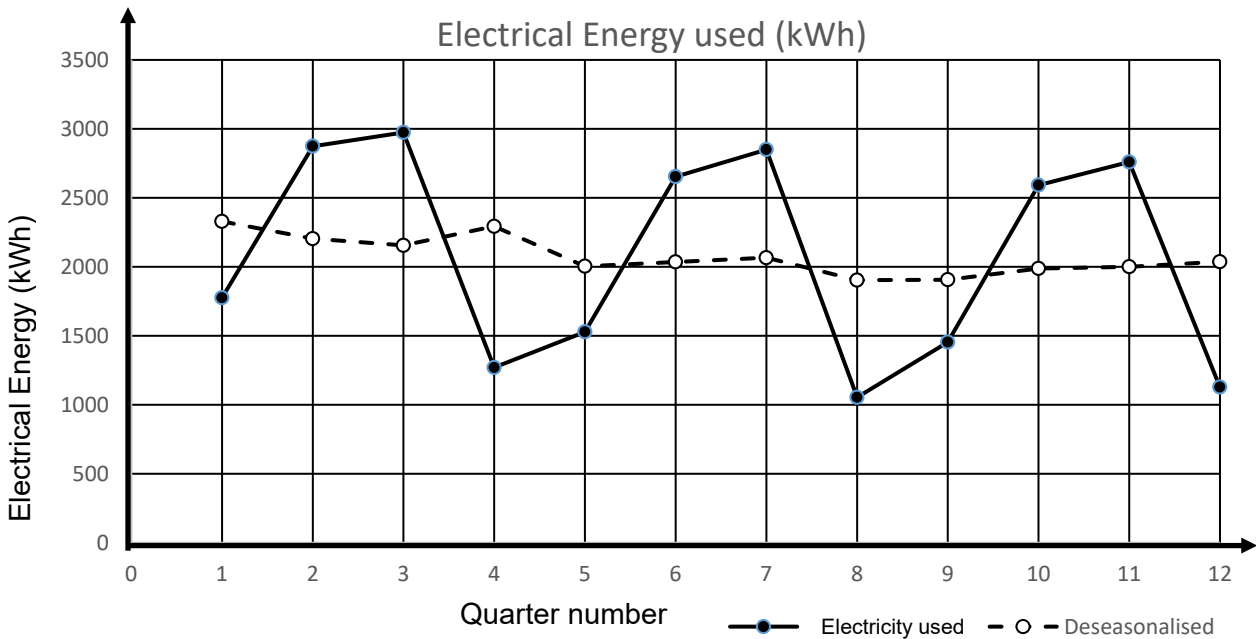


(a) Describe the **trend** and the **secular** (long term) **trend** indicated in this graph. (1 mark)

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The graph below shows the times series graph and the **deseasonalised** electrical energy data on the same axes.



Question 2 continues.

Question 2 (continued)

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- (b) Describe the purpose of deseasonalising the data. (2 marks)

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- (c) Using data from the second graph opposite, calculate the (approximate) **seasonal index** for quarter 1. (Give your answer to two decimal places.) (2 marks)

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- (d) The **seasonal index** for quarter 3 is 1.38. Explain the meaning of this seasonal index figure. (2 marks)

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The equation to the line of best fit for the deseasonalised data was found to be:

$$E = -29.45Q + 2268$$

$$\text{Correlation coefficient } (r) = -0.7605$$

Where E is the deseasonalised amount of electrical energy used (in kWh) and Q is the quarter number.

- (e) Use this equation and the seasonal index for quarter 3, 1.38, to determine the **actual** amount of electricity used in **quarter 11**. (Give your answer to the nearest kWh.) (3 marks)

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Question 3 (approximately 20 minutes)

Sue adds different amounts of fertiliser, **F**, in grams, to eight tomato plants, A to H. Later, she measures the mass of tomatoes, **T**, in kilograms, that the tomato plants produce.

Plant	Fertiliser (F) (g)	Tomatoes (T) (kg)
A	1.0	3.8
B	1.5	4.5
C	2.0	5.8
D	2.5	6.6
E	3.0	7.0
F	3.5	7.1
G	4.0	7.3
H	4.5	7.6



- (a) Determine the **linear model** that could be used to predict the mass of tomatoes based on the amount of fertiliser added. Give all values to two decimal places. (2 marks)

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- (b) Determine the **correlation coefficient, r**. Write a conclusion based on this with respect to the information presented. (2 marks)

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- (c) Sue states that '*adding more fertiliser causes a greater mass of tomatoes to be produced*'. Comment on this statement, considering the information presented in the question. (3 marks)

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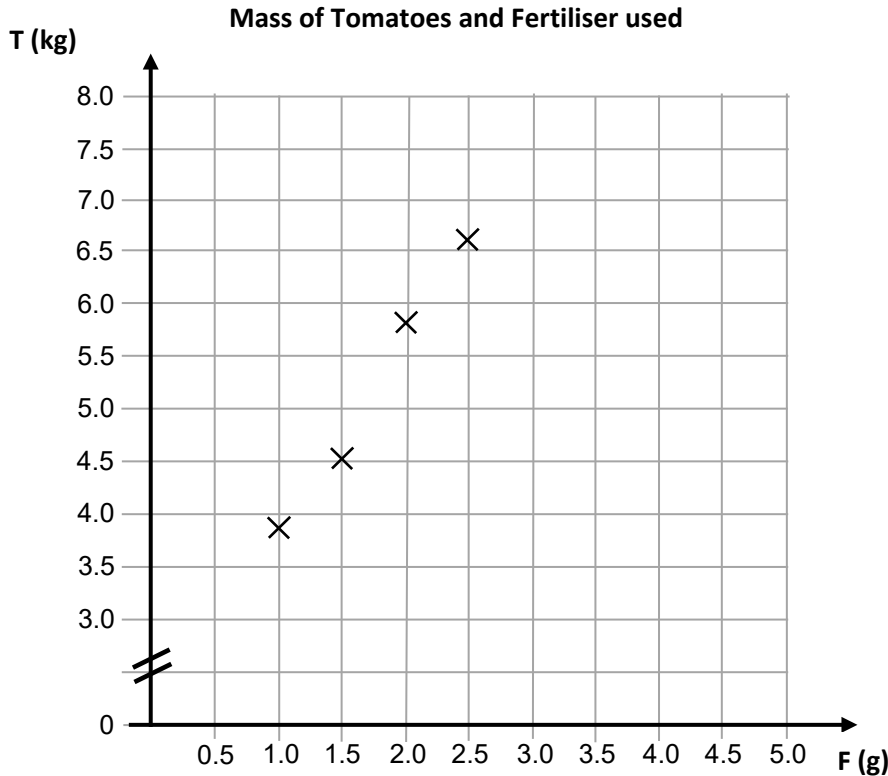
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Question 3 continues.

Question 3 (continued)

(d) Enter the missing **data points** from the table opposite onto the scatter graph below.

Sketch the linear model onto the scatter graph, indicating the **two points** you used. (2 marks)



(e) Use the linear model to predict: (3 marks)

(i) The mass of tomatoes that would be produced using 3.3 g of fertiliser.

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(ii) The amount of fertiliser required to produce 9.0 kg of tomatoes.

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(f) Which of your predictions in part (e) can be considered **reliable**? Explain. (2 marks)

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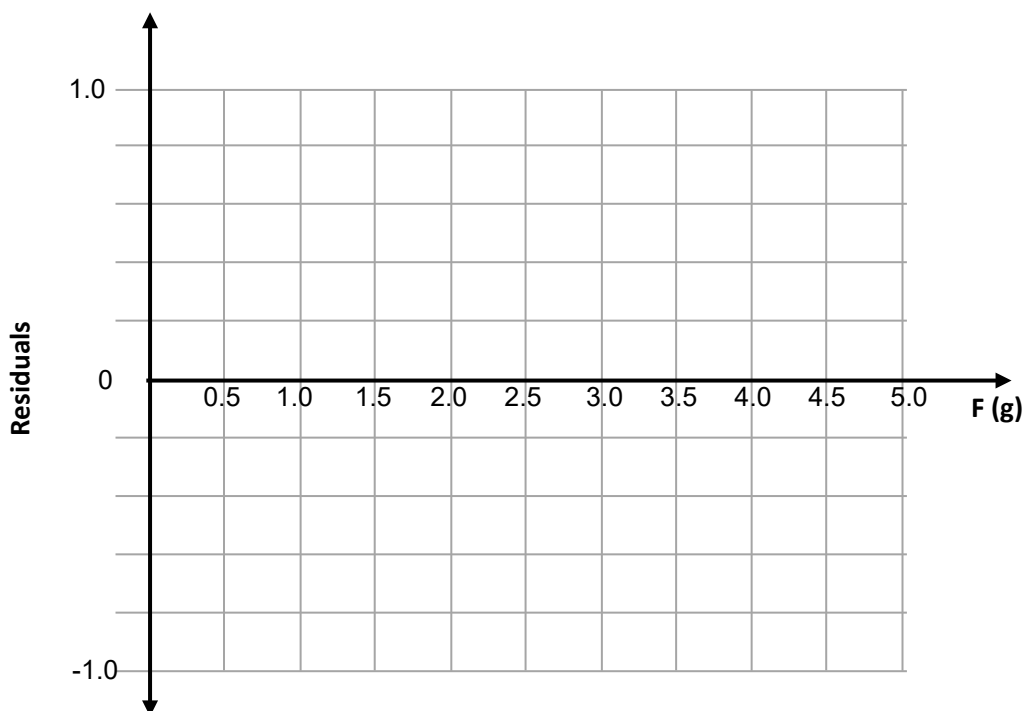
Question 3 continues.

Question 3 (continued)

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- (g) Prepare a scaled **residual plot** for the linear model you found in part (a) on the grid below.

(3 marks)



- (h) On the basis of your previous answers to this question, state whether or not the linear equation you determined in part (a) models this data well or otherwise. Give reasons for your choice. (3 marks)

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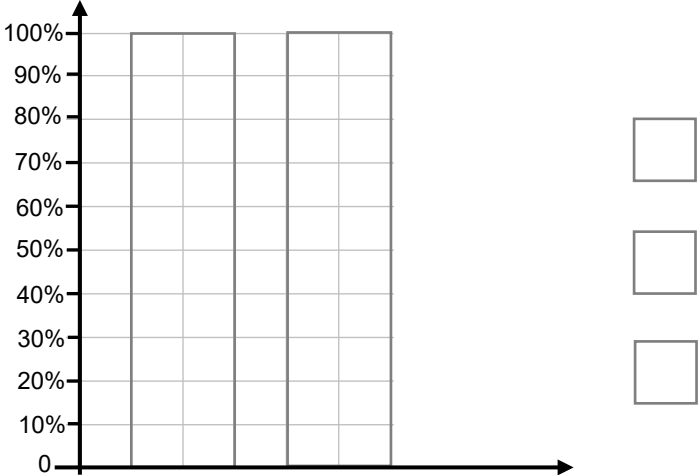
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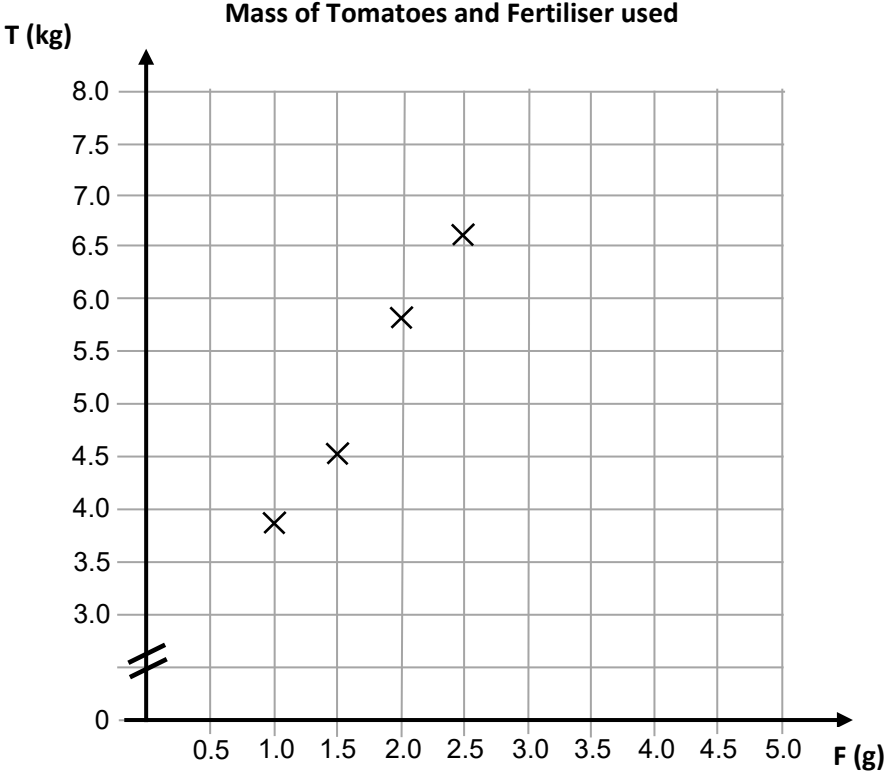
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SPARE DIAGRAMS

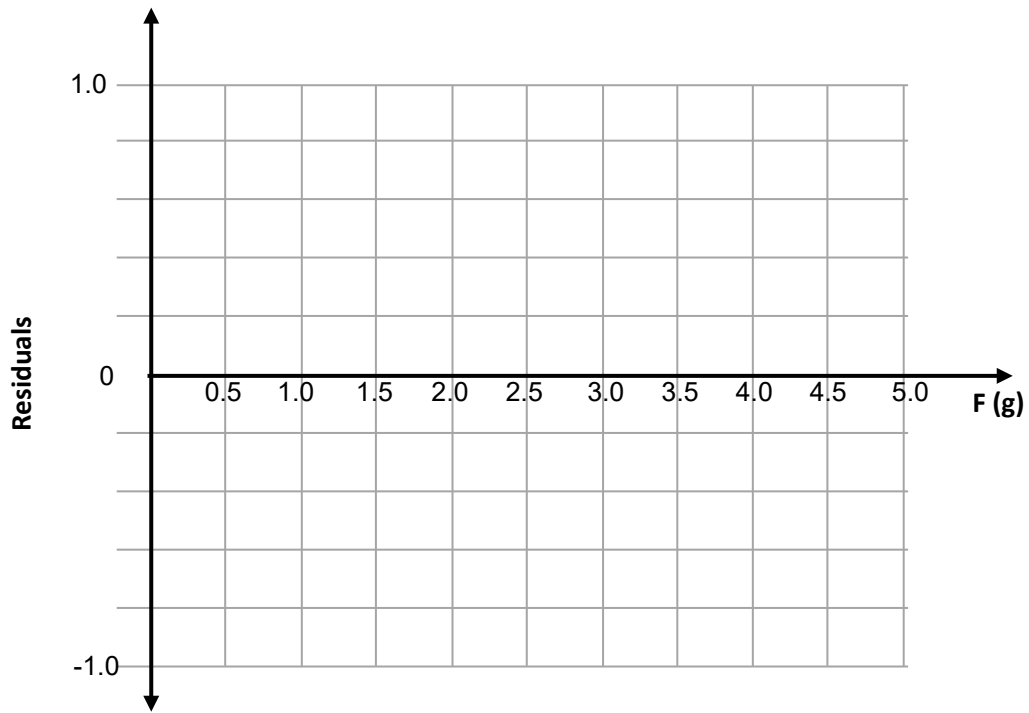
Question 1



Question 3



Question 3



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GENERAL MATHEMATICS

(MTG315115)

PART 2 – Growth and Decay in Sequences

Time: 36 minutes

Pages:	12
Questions:	4
Attachments:	Information Sheet

Candidate Instructions

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5. The External Examination Information Sheet for General Mathematics can be used throughout the examination. No other written material is allowed into the examination.
6. All written responses must be in English.

On the basis of your performance in this examination, the examiners will provide results on each of the following criterion taken from the course statement:

Criterion 5 Demonstrate knowledge and understanding of growth and decay in sequences.

Section Total:	/36
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Additional Instructions for Candidates

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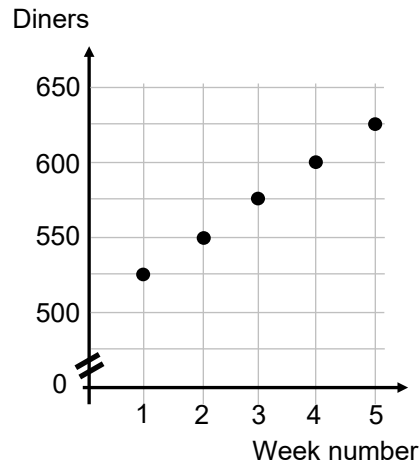
A spare graph has been provided in the back of the booklet for you to use if required.

If you use this spare graph you MUST indicate you have done so in your answer to that question.

Question 4 (approximately 9 minutes)

Amer and Yasmin open a new restaurant.

The graph opposite shows the number of diners served each week over the first five weeks that their restaurant was open.



- (a) Write down the rule for the **arithmetic sequence** that describes the number of diners that they serve each week. (2 marks)

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- (b) Assuming that the arithmetic sequence rule continues to apply, **algebraically** determine during which week they first served at least 715 diners. (3 marks)

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- (c) Determine the **total** number of diners that they serve over the first ten weeks that they are open. (2 marks)

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- (d) Rewrite the arithmetic sequence from part (a) as a **recurrence (difference)** equation. (2 marks)

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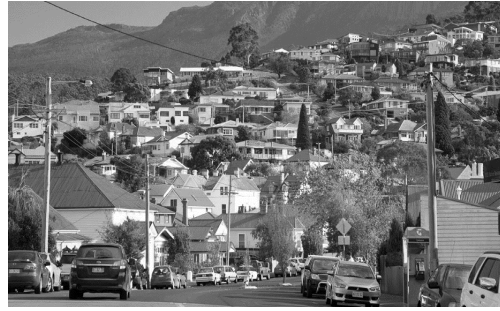
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Question 5 (approximately 7 minutes)

In 2011 the median house price in a Tasmanian suburb was \$315 000.

Over the years 2011 to 2018, inclusive, the median house price in this suburb **increased** by 4.42% each year.



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- (a) Give the **geometric sequence rule** for the median price of houses in this suburb for this time period. Explain the values of the first term 'a' and the common ratio 'r' in terms of the information presented. (2 marks)

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- (b) Use the geometric sequence rule to predict the median house price in this suburb in the year 2018. (2 marks)

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- (c) Determine the year during which the median house price in this suburb first **exceeds** \$500 000. Discuss the reliability of your answer. (3 marks)

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Question 6 (approximately 9 minutes)

The population of a new suburb in Melbourne was recorded at the end of the first three years after people moved in.

Year	1991	1992	1993
Year number	1	2	3
Population	1 000	1 220	1 422

- (a) Using relevant calculations, explain why this data follows **neither** an arithmetic nor a geometric sequence. (3 marks)

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A **difference (recurrence) equation** models this data.

$$P_{n+1} = 0.92 P_n + 300 \quad \text{where } P_1 = 1\,000 \text{ people}$$

- (b) Use this difference equation to find the population of this suburb at the end of: (2 marks)

1994:

1995:

- (c) At the end of which **year** would the population first exceed 3 000 people? (1 mark)

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- (d) According to the difference equation, what will be the maximum population of this suburb? Explain using **mathematical terms** why this long term trend occurs. (3 marks)

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Question 7 (approximately 11 minutes)

Sophie and James run a deer farm.

At the beginning of year 1 of farming they have 1 000 deer.

The rate of **increase** in the deer numbers is expected to be 8.0% per year. They sell 140 deer at the end of each year.

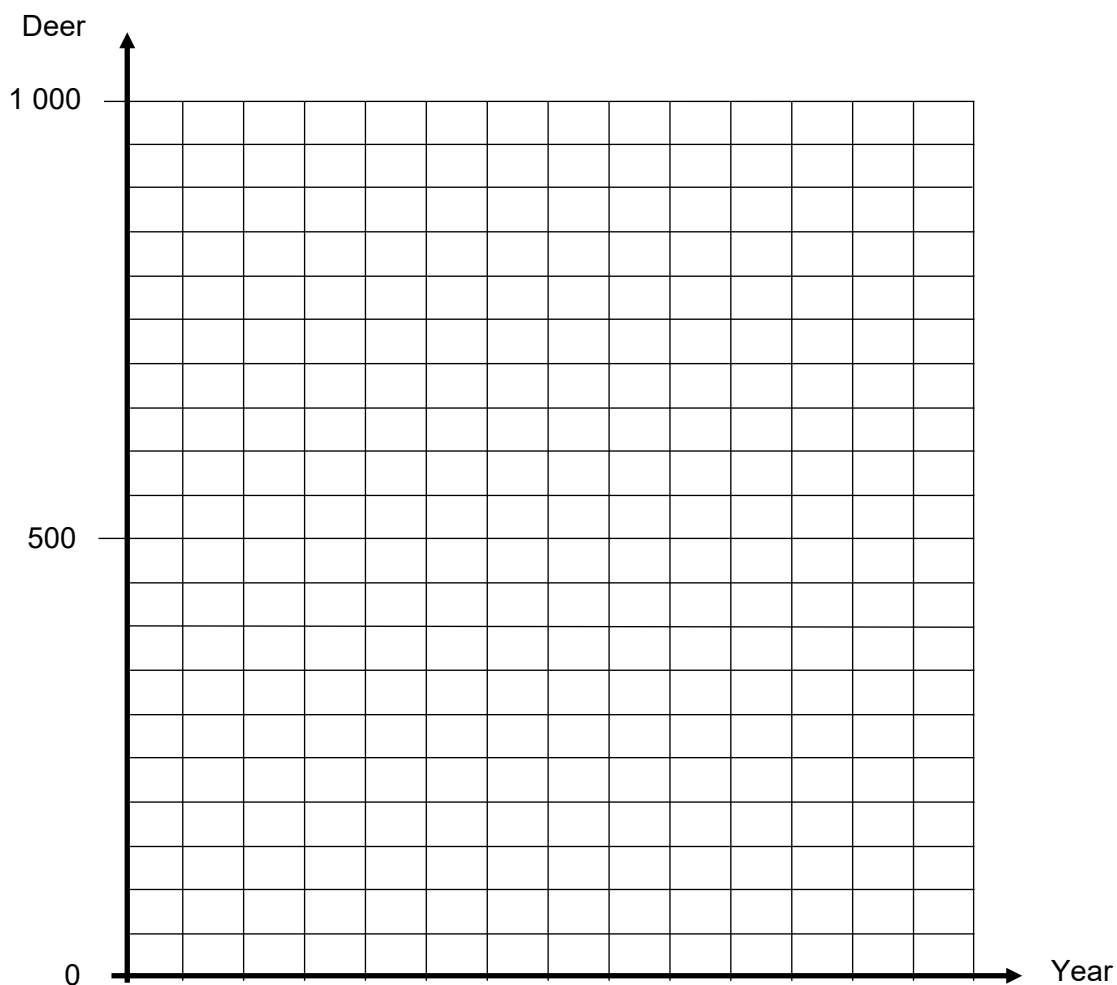


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The **difference (recurrence)** equation for the number of deer that they have at the beginning of each year, D_{n+1} , can be written as:

$$D_{n+1} = 1.080 D_n - 140 \quad \text{where } D_1 = 1\,000 \text{ deer at the start of year 1}$$

- (a) Use the graph grid below to **sketch** a graph showing the number of deer that Sophie and James have at the beginning of years 1 to 7. (3 marks)



Question 7 continues.

Question 7 (continued)

- (b) Use your calculator and your graph from part (a) to explain why their plan to sell 140 deer **would not be viable** for their farm operation. (2 marks)

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Sophie and James consider selling only 50 deer each year. (The starting population remains at 1000 and the rate of increase remains at 8.0%.)

- (c) Write the new **difference (recurrence)** equation for this scenario. (1 mark)

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- (d) Explain, using numbers to assist, the effect of this change. (2 marks)

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After running the deer farm for a few years, Sophie and James find that the deer population actually increases a rate of 11.0%. After purchasing some more deer, they decide to keep their deer herd at a constant 1 200 at the start of each year.

- (e) Under these new conditions determine the **maximum** number of deer that they can sell at the end of the year and keep the numbers at a constant 1 200.

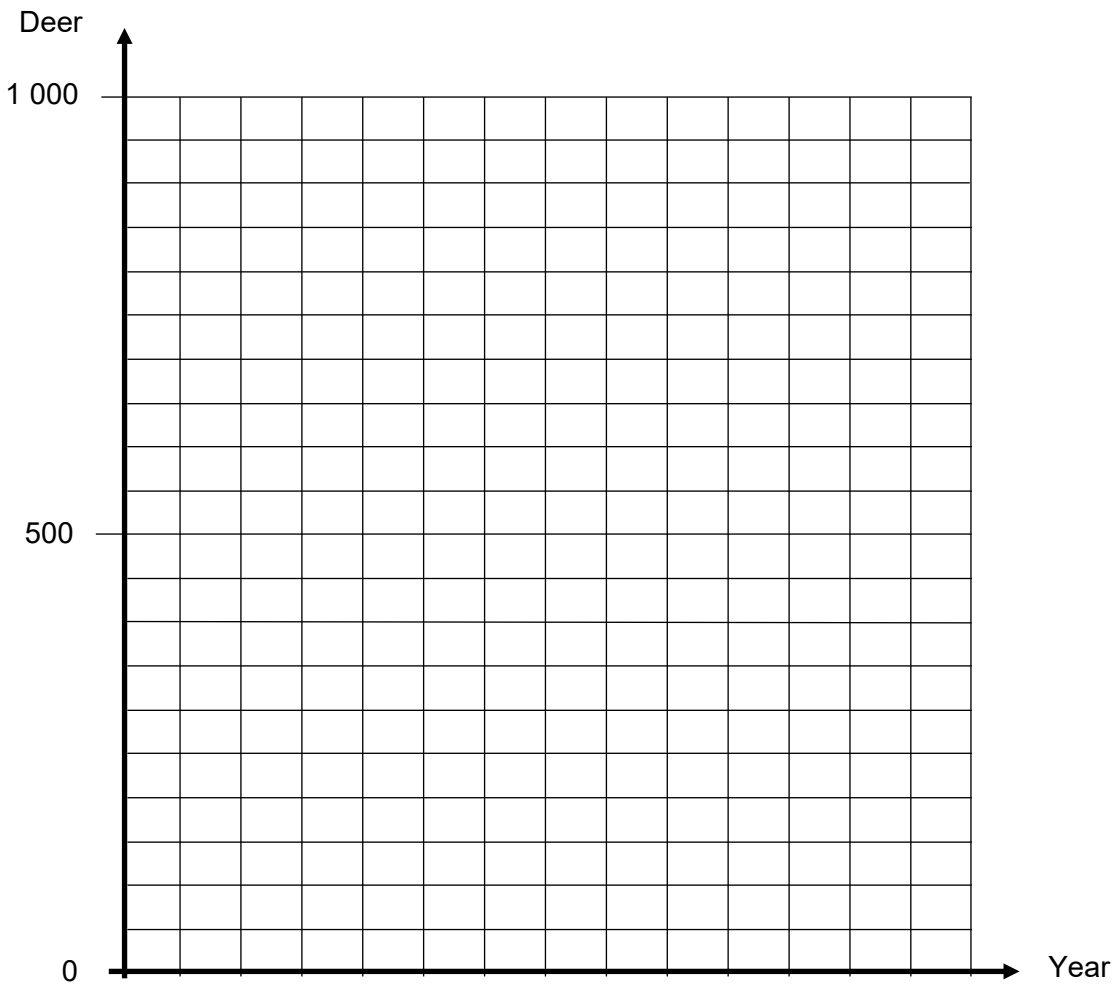
Show appropriate working to find the new **difference (recurrence)** equation. (3 marks)

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New **difference (recurrence)** equation:

SPARE GRAPH

Question 7



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GENERAL MATHEMATICS

(MTG315115)

PART 3 – Finance

Time: 36 minutes

Pages:	12
Questions:	4
Attachments:	Information Sheet

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On the basis of your performance in this examination, the examiners will provide results on each of the following criterion taken from the course statement:

Criterion 6 Demonstrate knowledge and understanding of standard financial models.

Section Total:	/36
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Question 8 (approximately 5 minutes)

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John started up a new savings account on 1 June by depositing \$3 000.

- (a) If interest of 2.85% p.a. was paid on a **daily balance**, determine the amount of interest John received on 31 August. (2 marks)

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- (b) **Algebraically** determine how many days it would take for John to first earn \$50.00 in interest. (3 marks)

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Question 9 (approximately 7 minutes)

Fatima invests \$15 000 at 5.04% p.a. interest, compounded monthly, for three years.

- (a) Using an **appropriate formula**, show that Fatima will earn \$2 443 in interest, to the nearest dollar, after three years. (3 marks)

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Fatima considered investing the \$15 000 into another account with interest compounded monthly. This account, which charges a \$2.00 monthly fee, can be modelled as the **difference (recurrence)** equation:

$$T_{n+1} = 1.00425T_n - 2.00 \qquad T_0 = \$15\,000$$

- (b) Determine the interest rate for this account. (2 marks)

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- (c) Which compound interest account, part (a) or part (b), will earn Fatima **more interest** over three years? Use numbers to support your answer. (2 marks)

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Question 10 (approximately 11 minutes)

Emma is given two investment choices in order to save up enough money to purchase a new car in four years time.

Choice 1: Monthly deposits of \$600 at an interest rate of 3.00% p.a. **compounded monthly**.

Choice 2: Fortnightly deposits of \$300 at interest rate of 3.00% p.a. **compounded monthly**.

- (a) Determine the amount of money each choice would give Emma after four years. (4 marks)

Choice 1:

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Choice 2:

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- (b) Which of these choices gives Emma greater savings after 4 years? Briefly explain why this is the case. (2 marks)

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Question 10 continues.

The new car Emma wishes to buy currently costs \$35 000.

- (c) If the purchase cost of a new car **decreases** by 3.40% **each year**, show that the new car will cost \$31 550 in three years time. (2 marks)

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- (d) Using investment **Choice 2** from part (a), determine how long it will take Emma to save up at least \$31 550. (3 marks)

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Question 11 (approximately 13 minutes)

Ramon and Javier take out a home loan of \$450 000, at a rate of 4.03% p.a. compounded **monthly** with monthly repayments made over 25 years.

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- (a) Determine the **monthly repayment** amount. (3 marks)

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- (b) Determine the amount of **interest** that Ramon and Javier will pay over the term of their loan. (2 marks)

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- (c) Use an **appropriate formula** to show that they will owe \$392 180 (to the nearest ten dollars) after 5 years. (3 marks)

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Question 11 continues.

After 5 years of repayments, Ramon receives an inheritance of \$100 000. Ramon uses this to pay off some of the balance of the home loan.

- (d) Using the monthly repayment amount from part (a), determine **how long** it will now take them to pay off the home loan. (3 marks)

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- (e) Determine the amount of **money** they have saved. (2 marks)

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GENERAL MATHEMATICS

(MTG315115)

PART 4 – Trigonometry

Time: 36 minutes

Pages:	12
Questions:	4
Attachments:	Information Sheet

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On the basis of your performance in this examination, the examiners will provide results on each of the following criterion taken from the course statement:

Criterion 7 Demonstrate knowledge and understanding of applications of trigonometry.

Section Total:	/36
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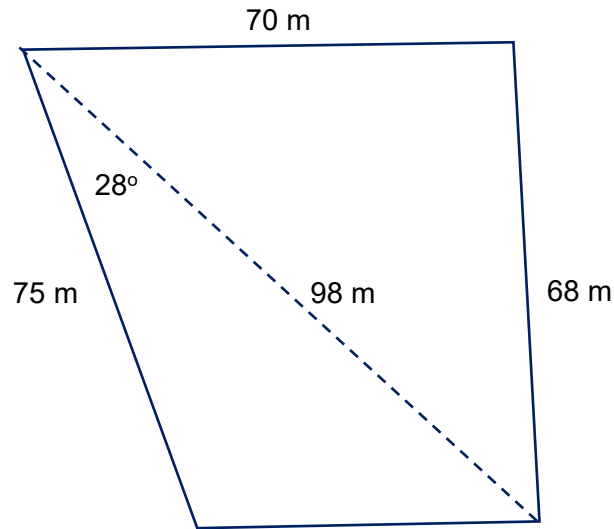
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Spare diagrams have been provided in the back of the booklet for you to use if required.

If you use either of these spare diagrams you MUST indicate you have done so in your answer to that question.

Question 12 (approximately 5 minutes)

A diagram of a block of land is shown below.



- (a) Use this information to determine the **area** of each of the triangles shown above. Give your answers to the nearest m². (4 marks)

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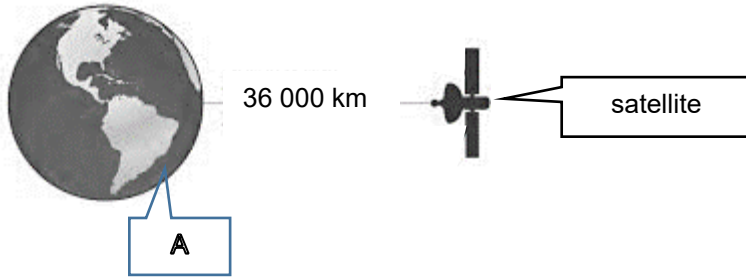
- (b) Determine the total area of the block of land. (1 mark)

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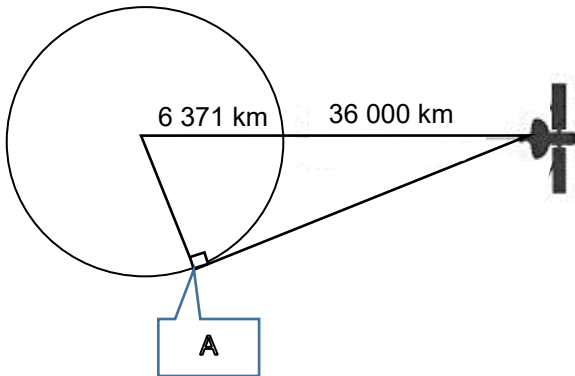
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Question 13 (approximately 4 minutes)

A satellite is located 36 000 km **above the equator** and above the 60°W meridian of longitude. Signals to and from such satellites travel in straight lines.



- (a) Using the diagram below to assist and assuming that the radius of the Earth is 6 371 km, determine the **distance** that signal travels from the satellite to **point A**. Give your answer to the nearest km. (Note that a right angle is formed at point A.) (2 marks)



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- (b) Determine the **location** of point A. (2 marks)

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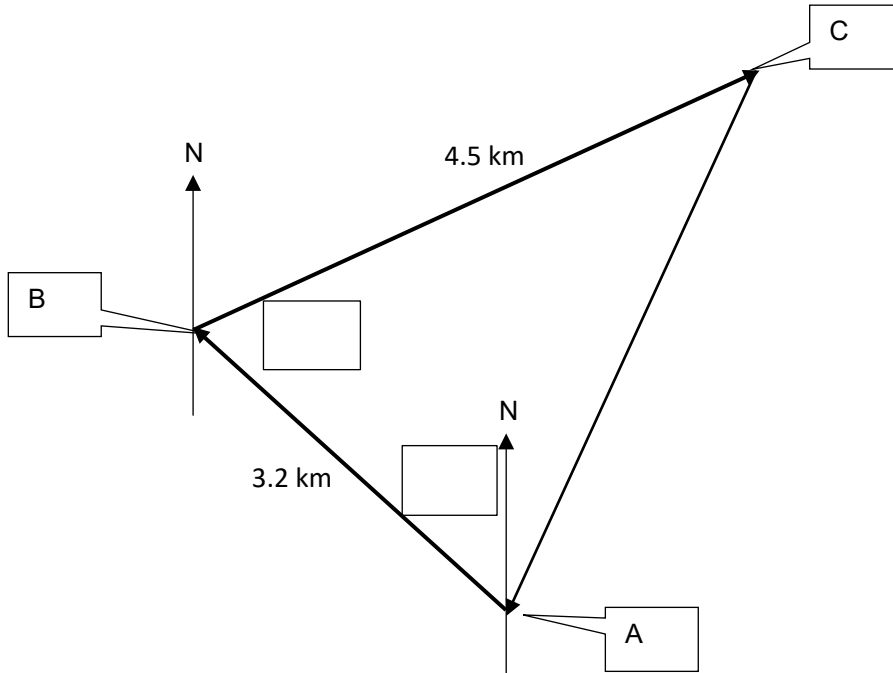
Question 14 (approximately 11 minutes)

A diagram of a cross country running course is shown below.

The first section, from point A to point B, is 3.2 km long and follows a bearing of 320° . The second section, from point B to point C, is 4.5 km long and follows a bearing of 078° . Runners return from point C to point A to complete the race.

- (a) Use the information above to determine the **two angles** required in the diagram below. Write your answers in the two boxes provided.

(2 marks)



- (b) Determine the distance from point C to point A. Give your answer to one decimal place. (3 marks)

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Question 14 continues.

Question 14 (continued)

- (c) If a runner completes this race, from point A to point B to point C, in 53 minutes and 10 seconds, determine their **average speed** in km/h. Give your answer to one decimal place. (2 marks)

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- (d) Determine the **true bearing** from point C to point A. (4 marks)

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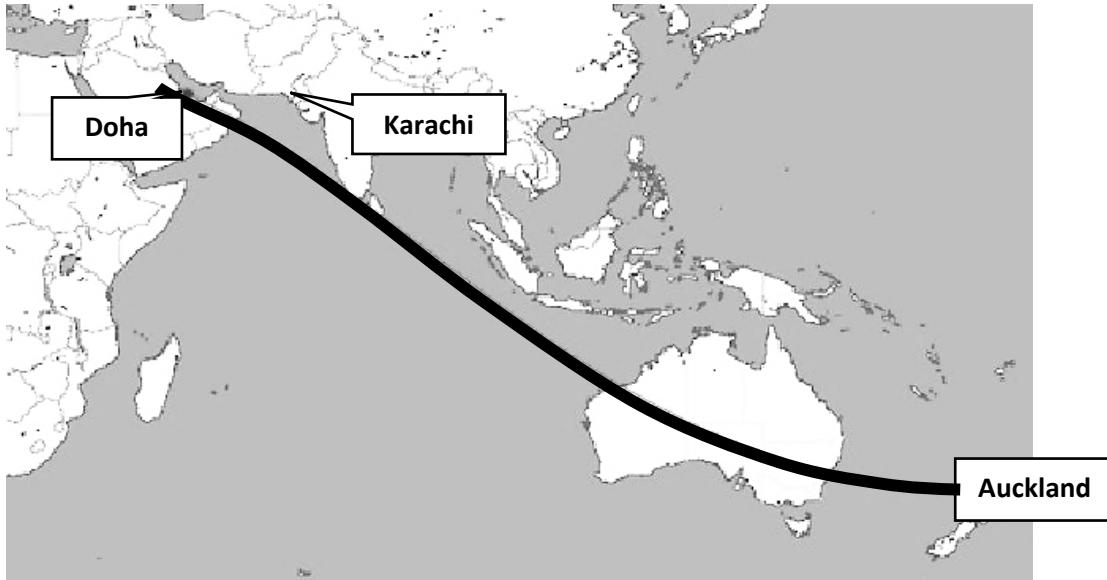
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Question 15 (approximately 16 minutes)

Sally flew from Auckland, New Zealand (37°S, 175°E) to Doha, Qatar (25°N, 52°E).

A map of her flight is shown below.



- (a) What is the standard time difference between Auckland and Doha? (3 marks)

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- (b) Sally makes a phone call to her friend in Doha, Qatar at 10:45 pm, Qatar time. At what New Zealand (Auckland) time, does she make her phone call? (2 marks)

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Question 15 continues.

Question 15 (continued)

- (c) Using appropriate formulae, determine the shortest **distance** between Auckland and Doha. Give your answer to the nearest km. (4 marks)

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Sally's plane departed from Auckland at 11:30 pm, New Zealand time, on 23 May. The plane flew at an average speed of 825 km/h.

- (d) Determine Sally's **arrival time** and **date** in Doha. (4 marks)

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From Doha, Qatar (25°N, 52°E), Sally flew **due East** to Karachi, Pakistan (25°N, 67°E). The plane flew at an **average speed** of 430 **knots**.

- (e) Determine Sally's travel time from Doha to Karachi. (3 marks)

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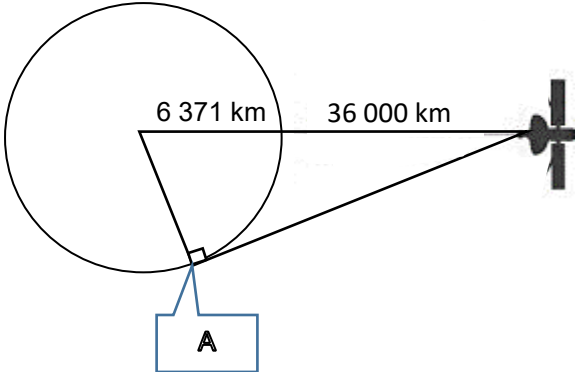
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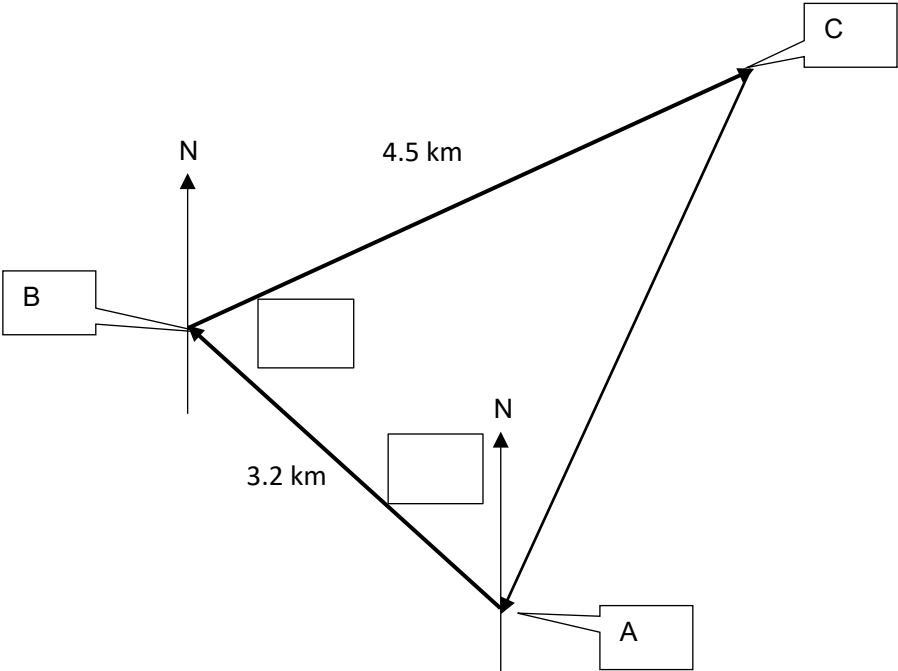
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SPARE DIAGRAMS

Question 13



Question 14



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Tasmanian Certificate of Education
External Assessment 2018

PLACE YOUR CANDIDATE
LABEL HERE

GENERAL MATHEMATICS

(MTG315115)

PART 5 – Graphs and Networks

Time: 36 minutes

Pages:	12
Questions:	4
Attachments:	Information Sheet

Candidate Instructions

1. You **must** make sure that your responses to the questions in this examination paper will show your achievement in the criteria being assessed.
2. Answer **all** questions. Answers must be written in the spaces provided on the examination paper.
3. You should make sure you answer all parts within each question so that the criterion can be assessed.
4. This examination is 3 hours in length. It is recommended that you spend approximately 36 minutes in total answering the questions in this booklet.
5. The External Examination Information Sheet for General Mathematics can be used throughout the examination. No other written material is allowed into the examination.
6. All written responses must be in English.

On the basis of your performance in this examination, the examiners will provide results on each of the following criterion taken from the course statement:

Criterion 8 Demonstrate knowledge and understanding of graphs and networks.

Section Total:	/36
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Additional Instructions for Candidates

Logical and mathematical presentation of answers and the statement of the arguments leading to your answer will be considered when assessing this part.

You are expected to provide a calculator approved by the Office of Tasmanian Assessment, Standards and Certification.

For questions worth 1 mark, whilst no workings are required, markers may consider appropriate step(s) taken to come to an answer.

For questions worth 2 or more marks, markers will look at the presentation of answer(s) and at the argument(s) leading to the answer(s).

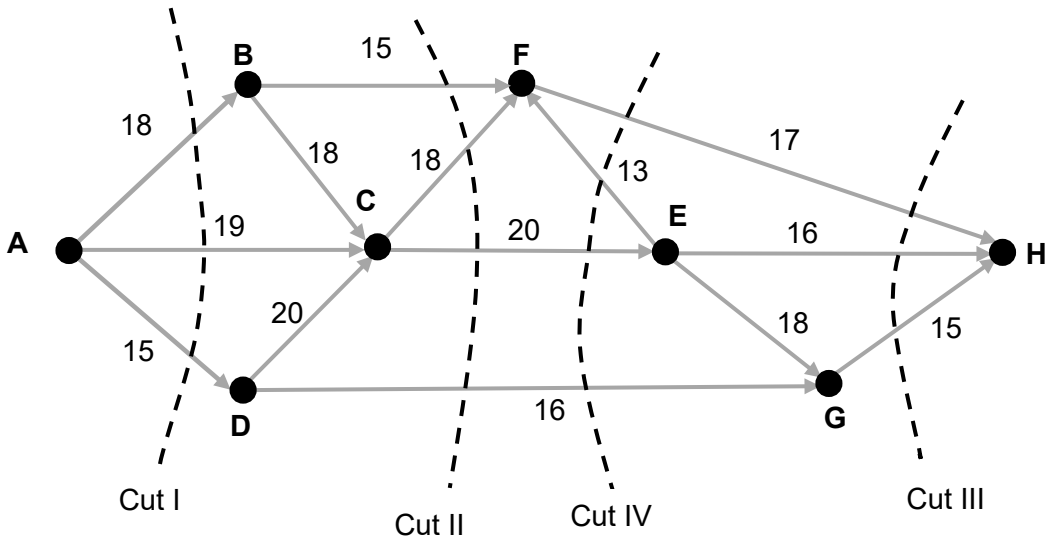
For questions worth 3 or more marks, you are **required to show** relevant working.

Spare diagrams and grids have been provided in the back of the booklet for you to use if required.

If you use any of these spare diagrams and/or grids you MUST indicate you have done so in your answer to that question.

Question 16 (approximately 7 minutes)

The network shown below represents a series of water pipes connected to a water source at point A. The numbers represent the maximum capacity of each pipe in litres per minute.



- (a) Determine the **capacities** of cuts I, II and III. Hence determine the **maximum** water flow in this system of water pipes. (2 marks)

Cut I:

Cut II:

Cut III:

Maximum water flow:

- (b) A student says that Cut IV, shown on the diagram above, is 66 litres per minute. Giving reasons, comment as to whether this is **correct** or **incorrect**. (2 marks)

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- (c) **One** of the pipes, AD, BF or GH, is to be upgraded to a larger capacity. Which of the pipes would be the best to upgrade and by how much? Justify your choice. (3 marks)

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Question 17 (approximately 8 minutes)

Four people, Adam, Bai, Chen and Daria, complete tasks 1 to 4. The times they took, in minutes, are shown below.

	Task 1	Task 2	Task 3	Task 4
Adam	16	15	16	18
Bai	16	22	20	17
Chen	18	17	14	18
Daria	18	13	21	20

- (a) Use the **Hungarian algorithm** in order to make an assignment that will result in each of these tasks being completed in the shortest time possible. (3 marks)

Spare grids – use as required.

- (b) Use your answer from part (a) to **allocate** Adam, Bai, Chen and Daria to the tasks. What is the total **mininum time** to complete the tasks? (2 marks)

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Total minimum time:

Daria actually completed task 4 in **13 minutes** and not 20 minutes.

- (c) Determine how this changes the assignment and find the (new) **minimum time** for the completion of the tasks. (3 marks)

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Question 18 (approximately 12 minutes)

A planar connected network (graph) has 5 **faces** and 8 **edges**.

- (a) Use **Euler's formula** to determine the number of **vertices** in this network. (2 marks)

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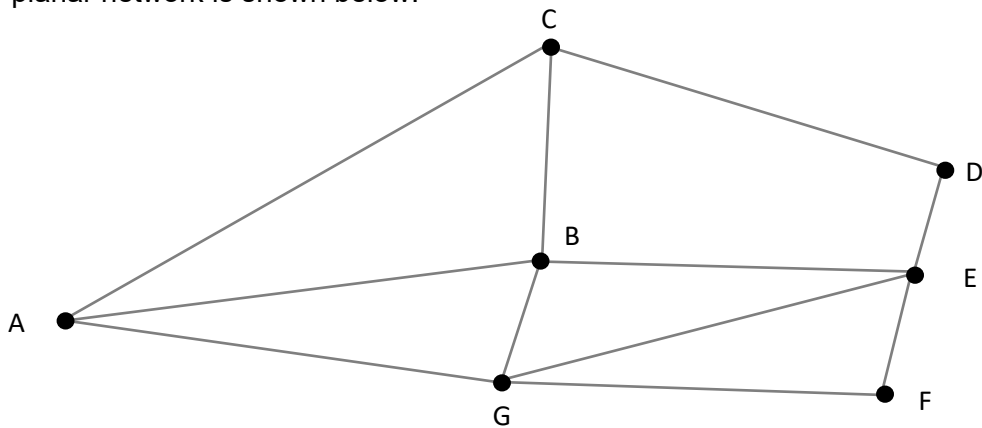
- (b) **Draw** the planar connected network in the space below. Label the vertices. (2 marks)

- (c) Describe a **Hamiltonian circuit** that can be travelled on the network in part (b). (1 mark)

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Another planar network is shown below.



- (d) Discuss whether or not it is possible to have an **Eulerian circuit** or an **Eulerian path** in this planar network. (2 marks)

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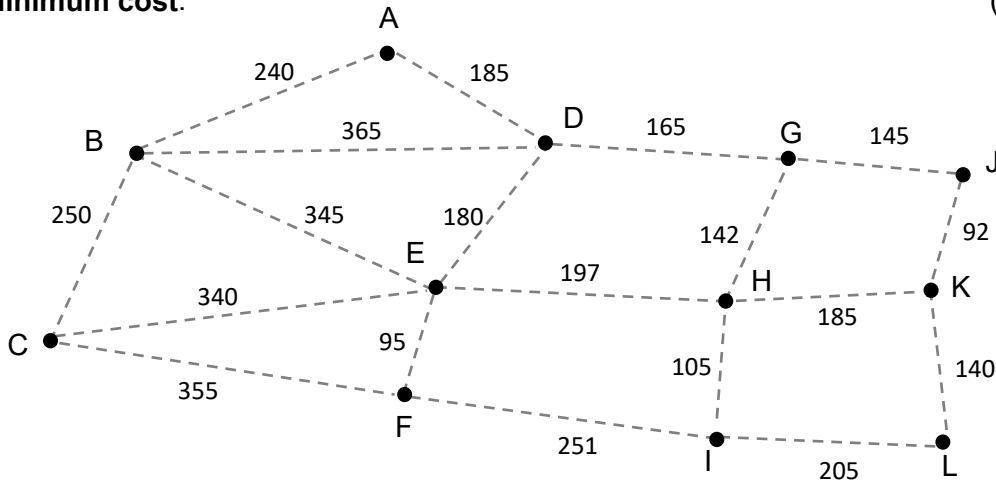
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Question 18 continues.

Question 18 (continued)

A company is planning to set up a cabled local area network. The plan below shows their twelve computer servers (A to L) and the cost of each section in dollars (\$).

- (e) Draw the **minimum spanning tree** on the diagram below. Hence calculate the **minimum cost**. (2 marks)

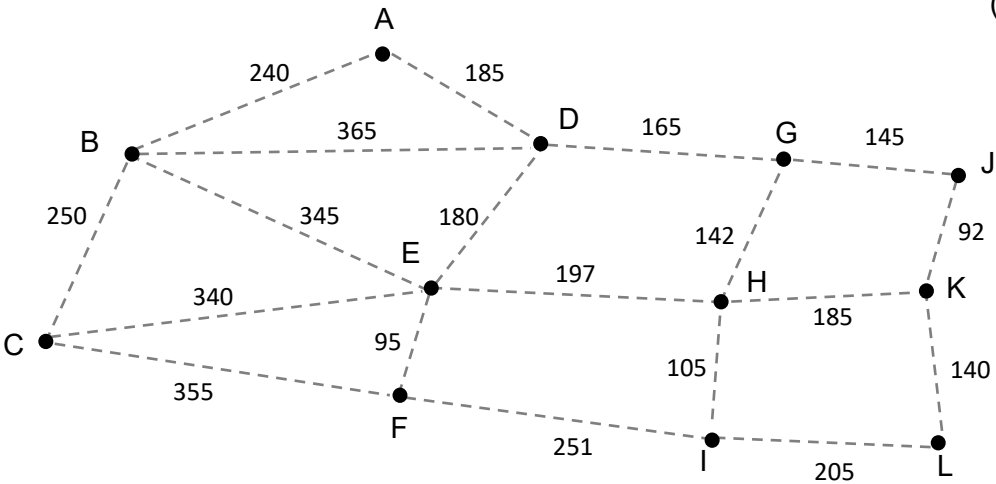


Minimum cost:

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- (f) In an attempt to save some money, it was decided to **remove computer server D** from the network. Using the plan below, determine the new minimum cost. Comment on the cost effectiveness of this change. (3 marks)



New cost:

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Comment:

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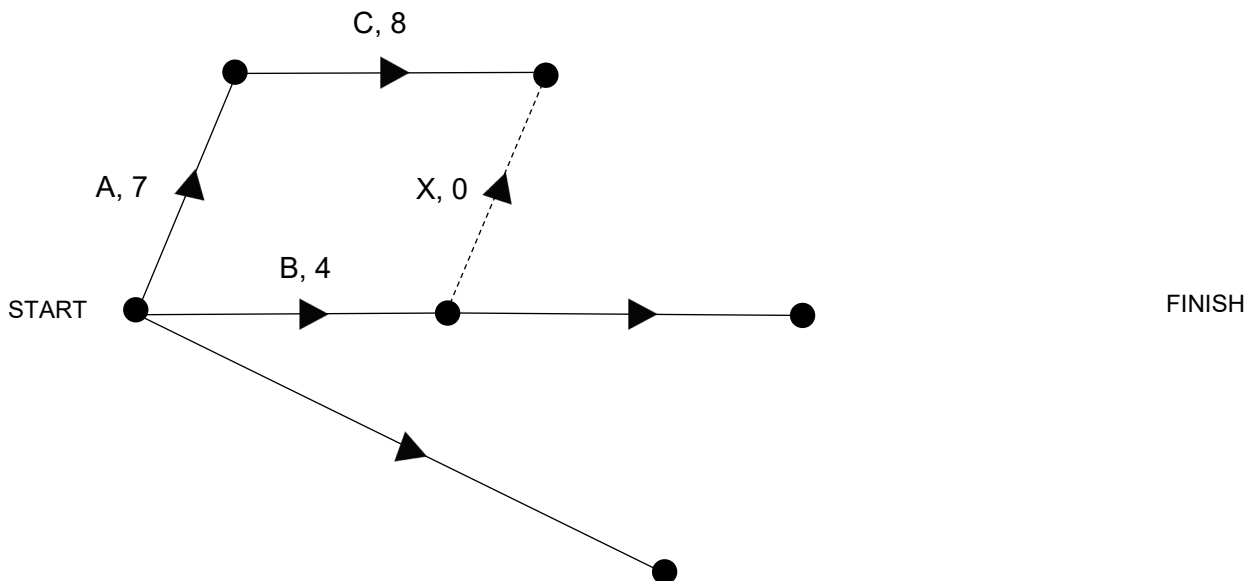
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Question 19 (approximately 9 minutes)

The following table shows the activities and their times, for a project in a manufacturing company.

Activity	Time (hours)	Predecessor(s)
A	7	-
B	4	-
C	8	A
D	9	B
E	8	-
F	7	E
G	5	B, C
H	4	E
I	8	D, F
J	9	G

- (a) Use the activities table to **complete** the project network graph shown below. Draw and label all of the edges showing the activities and the times they take. (3 marks)



Question 19 continues.

Question 19 (continued)

- (b) Determine the **critical path** and **minimum completion time** for the project. (3 marks)

Critical path:

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Minimum completion time:

- (c) Due to unforeseen problems with Activities I and J, one of these activities will require additional time to complete. Which activity could be chosen for the completion time to be **minimised** and by how much? Explain, with reference to float time(s). (3 marks)

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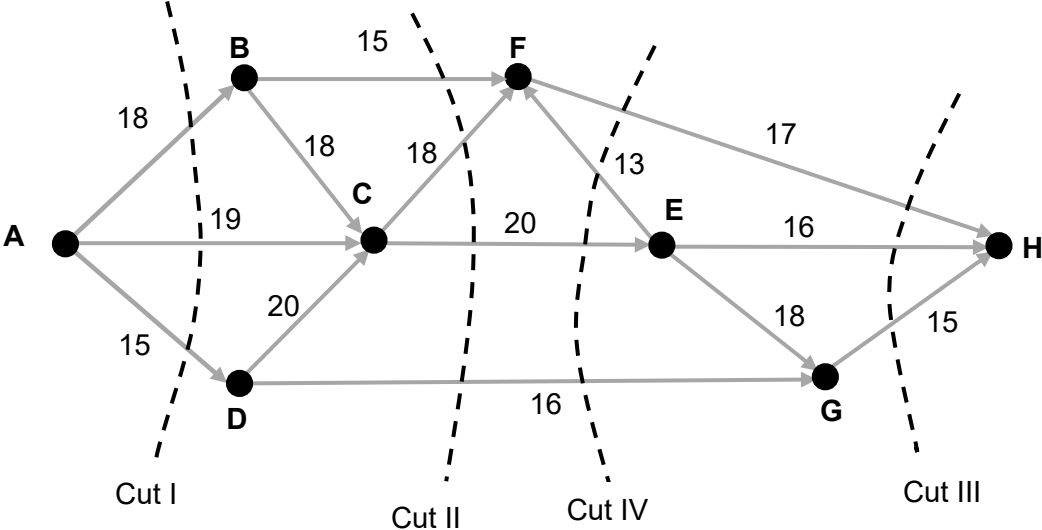
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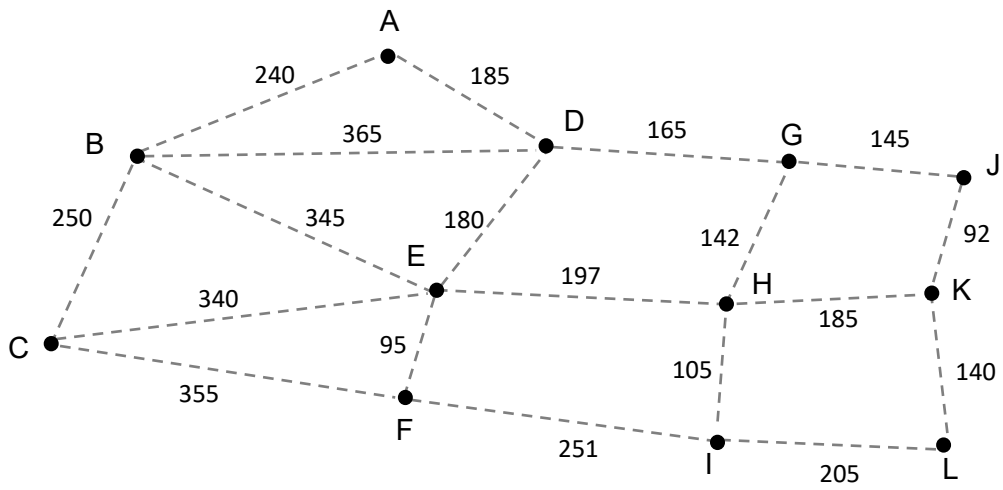
SPARE DIAGRAMS

Question 16

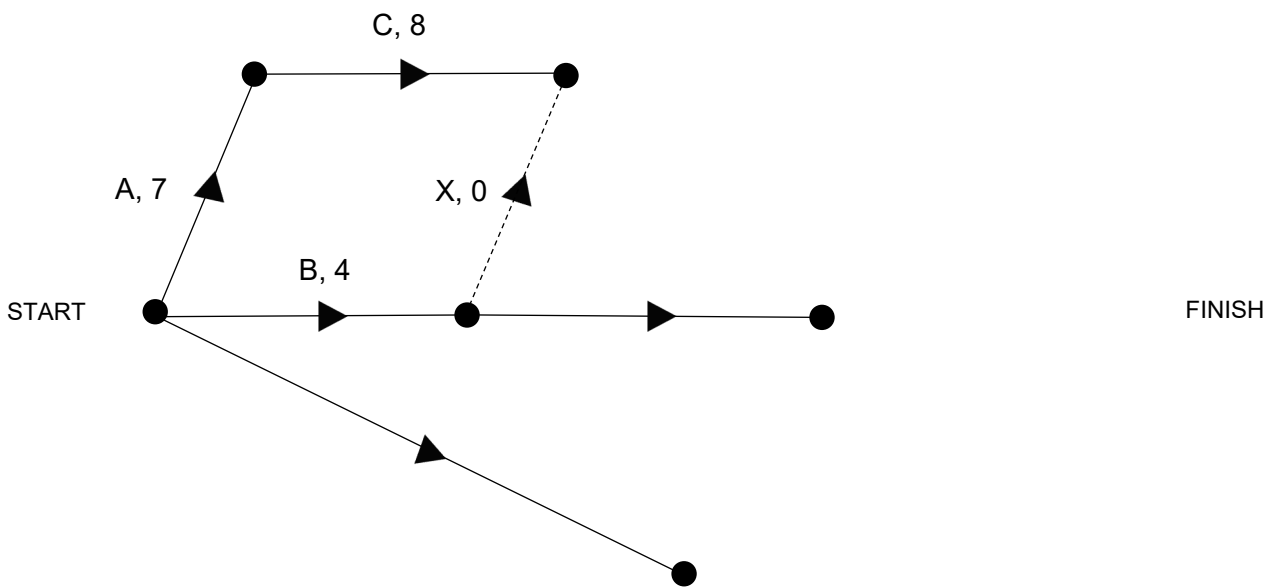


Question 17

Question 18



Question 19





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