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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 2017 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 criteria 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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Spare diagrams have been provided in the back of the booklet for you to use if required.

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Question 1 (approximately 14 minutes)

Monica, who is studying reptiles, measures the length, L cm, and the mass, M grams, of a sample of 11 adult snakes of the same type. Her results are shown in the table.

Snake	A	B	C	D	E	F	G	H	I	J	K
L	46	39	54	79	47	58	73	35	43	51	36
M	55	48	58	88	61	55	82	51	50	66	57

- (a) Determine the linear model that can be used to predict the mass of a snake based on its length. Give all values to 2 decimal places. (2 marks)

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- (b) Determine the correlation coefficient, r , of the linear model and interpret its meaning in the context of the study. (3 marks)

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- (c) Another snake was found to have a mass of 75 grams, however it was too aggressive to measure its length. Use the linear model found in part (a) to predict the length of the snake and comment on the reliability of your prediction. (3 marks)

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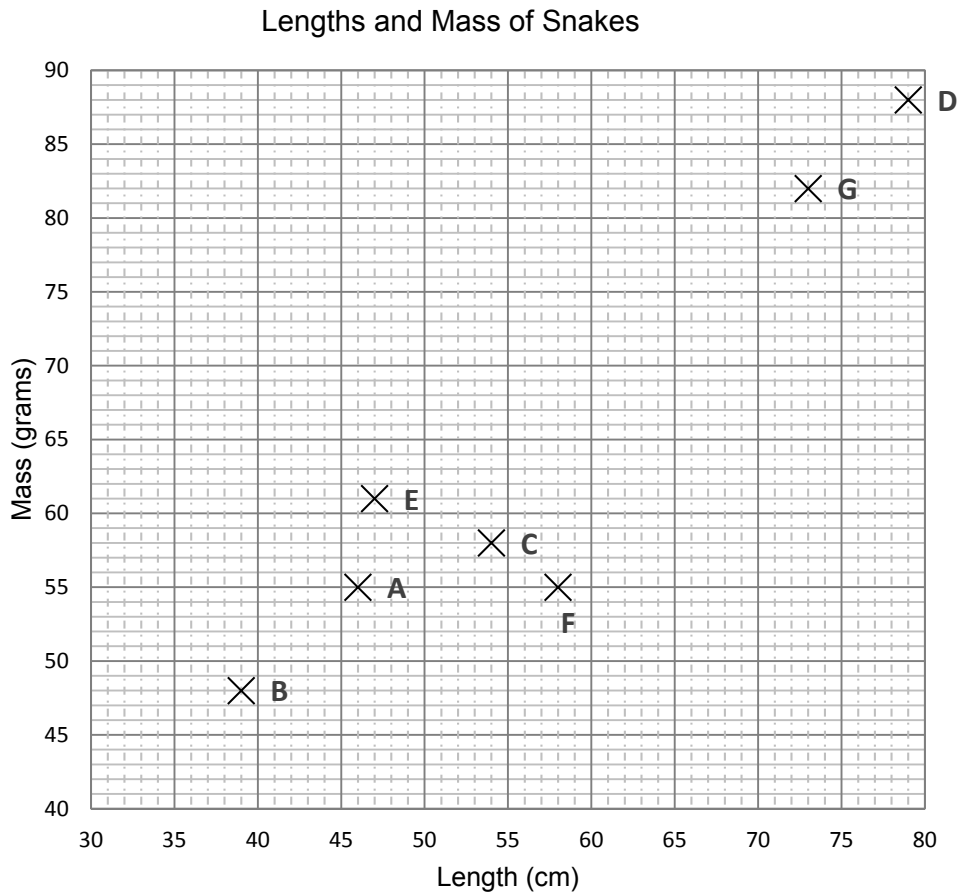
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Question 1 continues.

Question 1 (continued)

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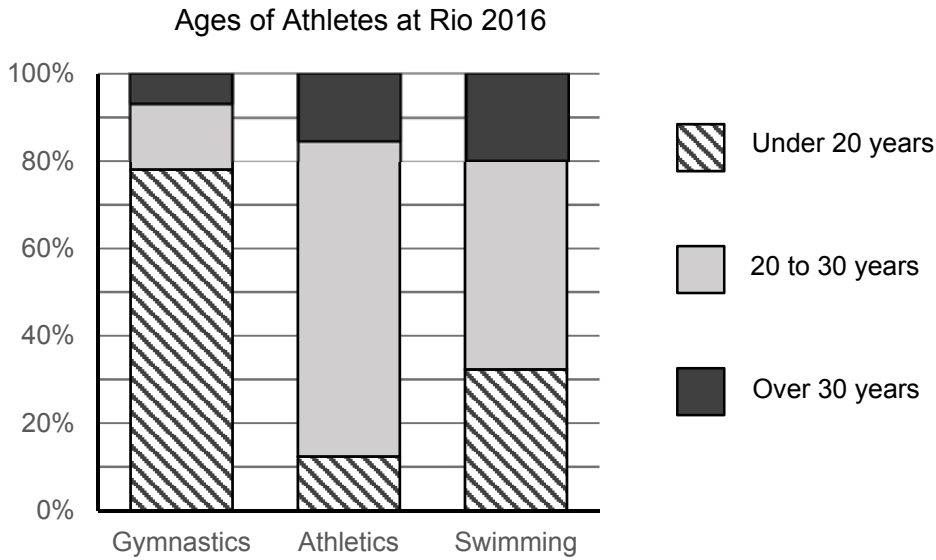
- (d) On the graph below, complete the scatter diagram by adding the missing data. (2 marks)



- (e) Subsequently, it is found that of the 11 adult snakes, 9 are male and 2 are female.
- (i) Given that female snakes are generally larger than male adult snakes, identify the 2 snakes which are most likely to be female. (1 mark)
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- (ii) The aggressive snake in part (c) was female. Has the reliability of the prediction of the snake's length changed? Discuss. (3 marks)
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Question 2 (approximately 7 minutes)

The following divided bar chart shows the age of athletes in three different sports at the Rio de Janeiro Olympic Games in 2016. The table below gives the total number of athletes in two of the sports.



Total number of athletes by sport		
Gymnastics	Athletics	Swimming
Unknown	546	384

- (a) Using the information above, estimate the **number** of swimmers aged between 20 and 30 years. (1 mark)

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A commentator recalled that only 28 of the gymnasts were older than 30 years old and that this represented 7% of the gymnasts at the games.

- (b) From this information, determine the total number of gymnasts at the games. (2 marks)

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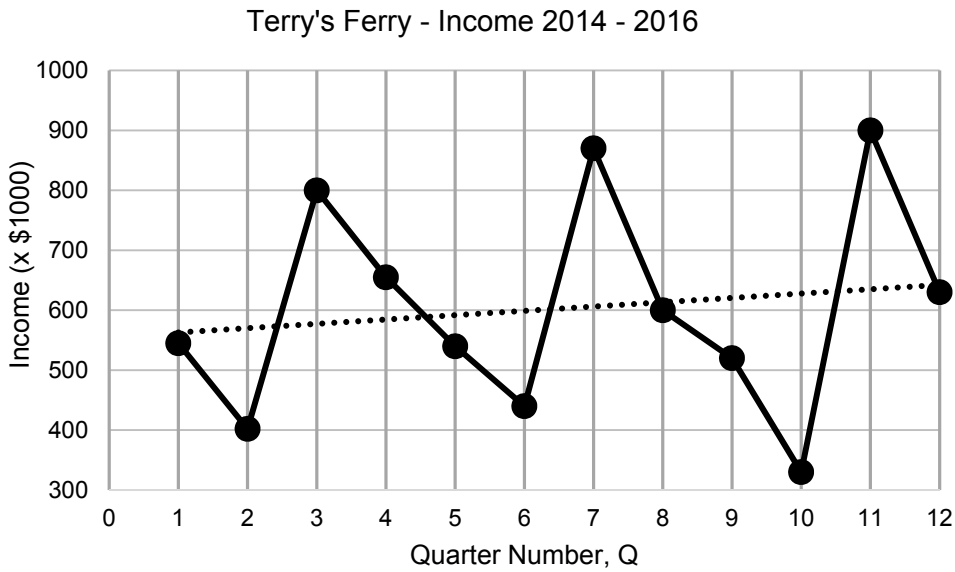
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Question 2 continues.

Question 3 (approximately 15 minutes)

A tourism operator approached a bank in the hope of securing a loan to expand their business. The following quarterly income figures were presented to the bank manager.



Equation of regression line: $I = 7.21Q + 556$

Coefficient of determination: $r^2 = 0.0208$

Q = 1 is the first quarter of 2014 (January – March)

- (a) Interpret the meaning of the gradient of the regression line stated above. (2 marks)

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- (b) What attributes of the information above indicate that the data is not well modelled? (2 marks)

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Question 3 continues.

Question 3 (continued)

- (c) The bank manager believed that the data set they were looking at was highly seasonal. Provide evidence from the graph that this is the case. (2 marks)

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Using the supplied quarterly incomes, the bank manager created the following seasonal indices.

	Quarter			
	1	2	3	4
Index	0.89	0.65	1.42	1.04

- (d) Explain the meaning of the Quarter 3 index. (2 marks)

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The tourism operator believed that his 2017 **total income** would be \$2.5 million.

- (e) If this is the case, what would be the expected income in Quarter 3 using the above seasonal indices? (2 marks)

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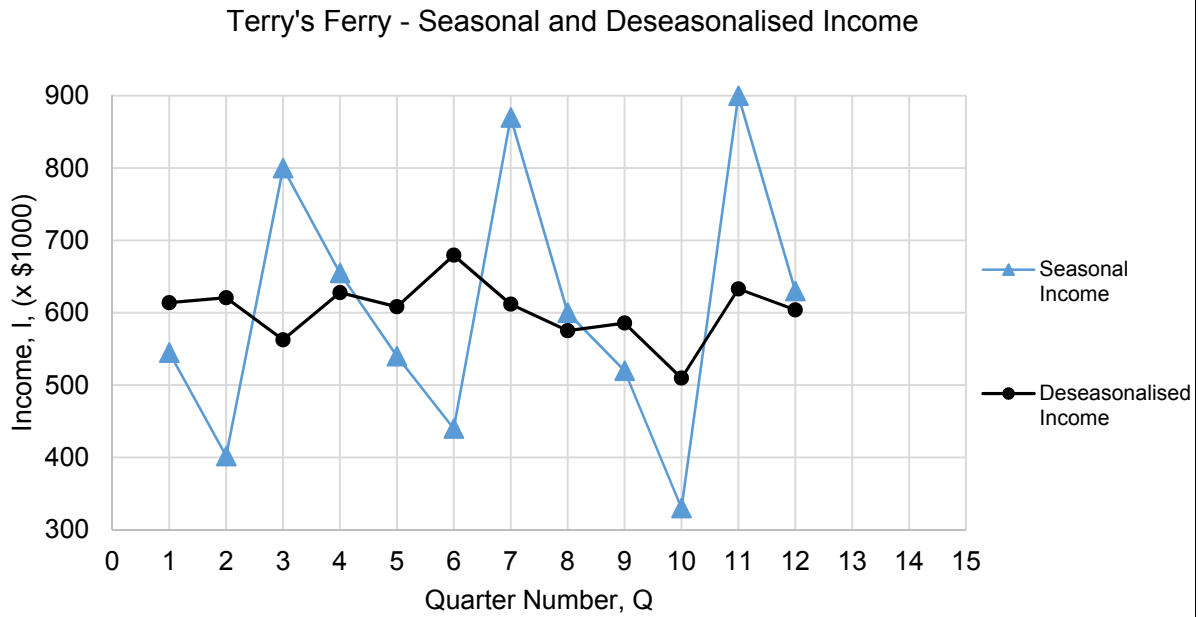
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Question 3 continues.

Question 3 (continued)

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The bank manager created another graph showing the income and the deseasonalised income on the same chart.



(f) What has been the effect of deseasonalising the data? (1 mark)

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(g) **On the graph above** draw a line of best fit by sight through the **deseasonalised data** from Q = 0 to Q = 15. (1 mark)

(h) Use your line of best fit to estimate the expected income for the **2nd quarter of 2017**. (3 marks)

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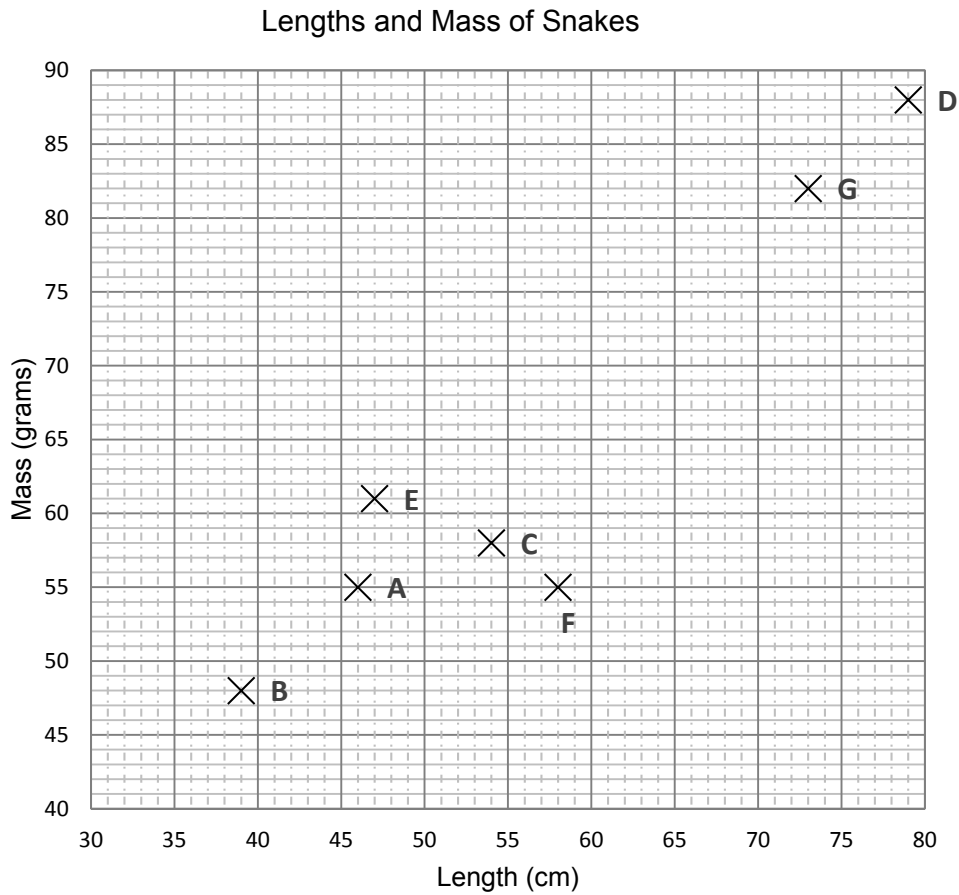
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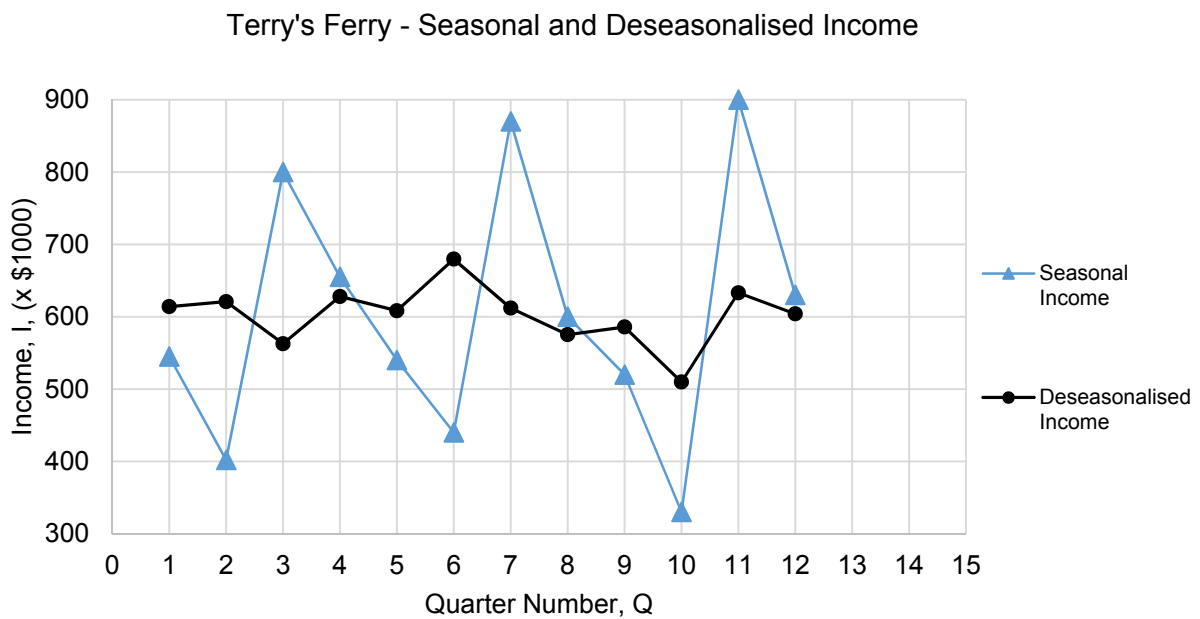
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SPARE DIAGRAMS

Question 1 (d)



Question 3 (g)





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GENERAL MATHEMATICS

(MTG315115)

PART 2 – Growth and Decay in Sequences

Time: 36 minutes

Pages:	12
Questions:	3
Attachments:	Information Sheet

Candidate Instructions

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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 2017 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 criteria 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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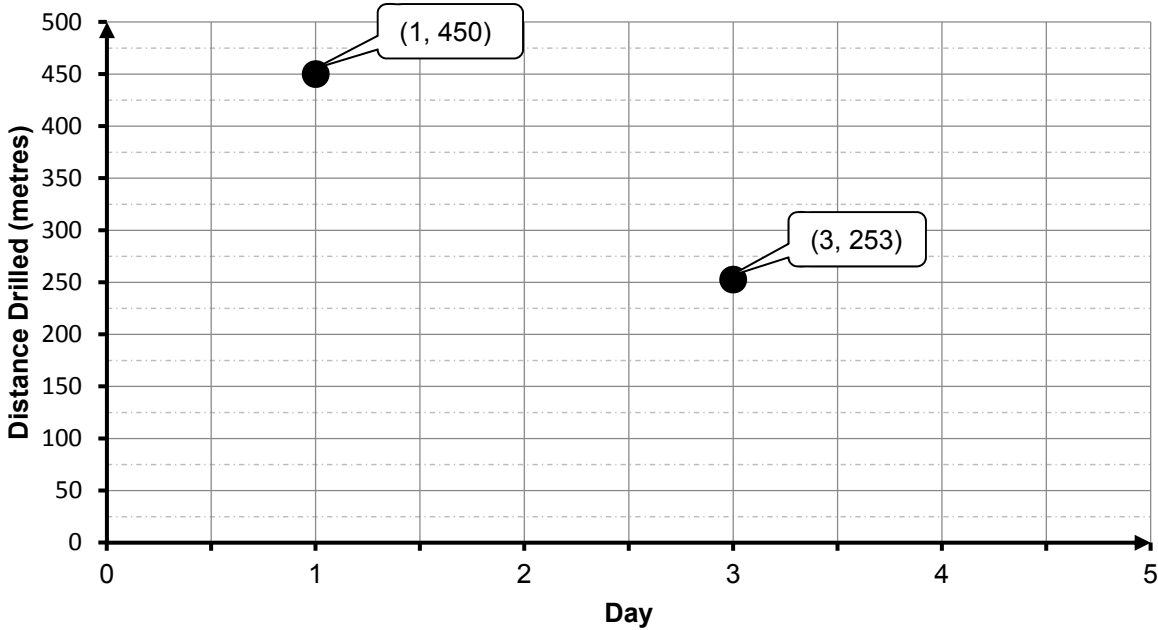
For questions worth 3 or more marks, you are **required to show** relevant working.

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 12 minutes)

An oil company is drilling a new oil well. The distance drilled each day follows the **geometric sequence**: $d_n = 450 \times 0.75^{n-1}$, where d_n is the distance drilled on day n .



- (a) Using the information above, show how the common ratio of the geometric sequence is calculated. (2 marks)

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- (b) Accurately add the missing data points for days 2, 4 and 5 on the **chart above**. (3 marks)

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- (c) Write the geometric sequence rule $d_n = 450 \times 0.75^{n-1}$ as a difference (recursive) equation. (2 marks)

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Question 4 continues.

Question 4 (continued)

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The oil company will only continue drilling if it is expected that they will be able to drill **more than 50 m** on any given day.

- (d) Using the sequence, $d_n = 450 \times 0.75^{n-1}$, determine the number of days the oil company will drill for **and** the total distance drilled. (3 marks)

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Number of days drilled:

Total distance drilled:

- (e) Describe what will happen to the total depth drilled if they continue drilling past your above prediction. (2 marks)

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Question 5 (approximately 12 minutes)

Ahmed is given an interest free loan from his grandmother to buy a second-hand car.

He repays the loan in monthly instalments. He repays \$30 the first month, \$35 the second month and the repayments continue to rise by \$5 per month until the loan is repaid.

- (a) Write a sequence rule that describes the monthly repayments made. (2 marks)

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- (b) Ahmed's final repayment is \$250. Algebraically determine the number of months it takes Ahmed to pay off the loan. (3 marks)

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- (c) Using an appropriate formula, find the total amount loaned to Ahmed. (3 marks)

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Question 5 continues.

Question 6 (approximately 12 minutes)

A trout farm and fishing business was established at the start of 2004 with 2000 trout being released into man-made lakes. Before fishing could start the number of trout needed to increase.



The number of trout at the start of each year was closely modelled by the following difference equation that takes into account the trout breeding and the additional release of 200 new trout at the end of each year:

$$P_{n+1} = 1.12P_n + 200; P_0 = 2000$$

- (a) From the above equation, what does the 1.12 represent? (2 marks)

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- (b) Use the difference equation to generate the terms P_1 and P_2 . (3 marks)

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- (c) At the start of which calendar year is the trout population first predicted to be above 5000? (2 marks)

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Question 6 continues.

Question 6 (continued)

Another trout farm has a steady state population of 6000 trout. This trout population can be modelled by the difference equation:

$$T_{n+1} = 1.12T_n - d; \quad T_0 = 6000$$

- (d) Calculate d , the number of trout being caught each year. (2 marks)

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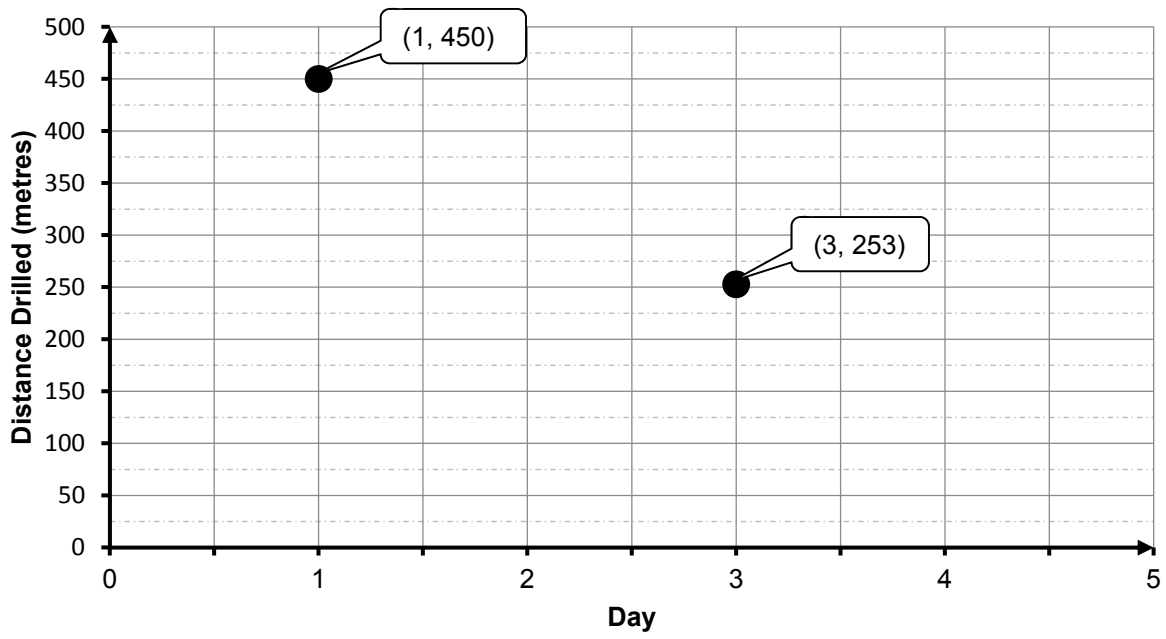
Angela believes that she can use better management techniques to improve the breeding rate of the trout to increase the percentage growth of the trout population to 16% each year. She also wishes to expand the business to allow for 1200 trout to be caught each year.

- (e) Determine the minimum number of trout that must be maintained at the farm under the new conditions, if the business is to be viable. (3 marks)

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SPARE GRAPH

Question 4 (b)



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GENERAL MATHEMATICS

(MTG315115)

PART 3 – Finance

Time: 36 minutes

Pages:	12
Questions:	4
Attachments:	Information Sheet

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Criterion 6 Demonstrate knowledge and understanding of standard financial models.

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Question 7 (approximately 5 minutes)

The interest rate on Raj's savings account is 3.85% p.a. based on a daily balance. He made the following transactions after opening the account on 2 July:

Date	Transaction	Balance
2 July 2017	Opening deposit \$4500	\$4500
21 July 2017	Deposit \$1500	\$6000
7 September 2017	Withdrawal \$800	\$5200

Interest is paid on 30 September.

- (a) How much interest will be paid into Raj's account on 30 September? (4 marks)

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- (b) Determine the balance of Raj's account on 30 September. (1 mark)

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Question 8 (approximately 11 minutes)

Justine opens a special school saver account for her son, Micky, that has a higher than usual interest rate and no account keeping fees.

She deposits a one off amount of \$750 for her son to watch grow.

The account pays interest at a rate of 7.52% p.a. compounded fortnightly.

- (a) Determine the amount in Micky's account after two years. (2 marks)

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- (b) Calculate the effective interest rate of the special school saver account and explain what this means. (3 marks)

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Question 8 continues.

Question 8 (continued)

When Micky has \$1000 in his account, the bank ends the special school saver account and his savings get transferred into a regular saver account.

The regular saver account has a **lower interest rate** and **charges an account keeping fee**.

The amount in Micky's account, at the beginning of each month can be modelled by the difference (recurrence) equation:

$$T_{n+1} = 1.0032T_n - 5, \quad T_1 = 1000$$

- (c) How much is the monthly account keeping fee? (1 mark)

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- (d) Determine the nominal interest rate per annum of the regular saver account. (2 marks)

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- (e) Discuss how the amount in the account will change if Micky keeps his savings in this account without making any future deposits. (3 marks)

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Question 9 (approximately 8 minutes)

Anne wants to save \$15 000 for a family holiday. She finds a savings account with an interest rate of 5.60% p.a., compounded monthly.

She plans to make regular deposits of \$400 per month into her account.

- (a) Determine how much will be in Anne's savings account after one year. (2 marks)

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- (b) At the end of which month will Anne first exceed her goal amount of \$15 000? (3 marks)

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Anne wants to take her family on a holiday in two years' time. Fortunately, she has access to some other savings, which she can use to kick-start her holiday savings account while keeping her regular monthly deposits at \$400.

- (c) In addition to her regular monthly payments, what must Anne's kick-start amount be if she wishes to reach her goal amount in two years? (3 marks)

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Question 10 (approximately 12 minutes)

A business woman donated \$200 000 to her local university to set up a scholarship in her name. The scholarship will give a first year student monthly payments for one year.

The university places the \$200 000 into a savings account which compounds monthly with a nominal interest rate of 3.25% p.a.

- (a) If the university decides to award the scholarship as a perpetuity, determine the value of the scholarship's monthly payment. (2 marks)

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It is decided that the scholarship needs to be worth more to a student. To achieve this, it is decided that the scholarship will be awarded for 12 years only.

- (b) Show that the monthly scholarship payment is \$1700, to the nearest \$100. (3 marks)

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- (c) Using the appropriate formula, and your monthly payment from part (b), calculate the amount left in the scholarship account after 5 years. (3 marks)

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Question 10 continues.

Question 10 (continued)

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An administration error was found after 5 years of awarding the scholarship. At this time the initial \$200 000 had decreased to only \$70 000.

- (d) Determine how much extra the scholarship winners were receiving each month than what was intended. (4 marks)

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GENERAL MATHEMATICS

(MTG315115)

PART 4 – Trigonometry

Time: 36 minutes

Pages:	16
Questions:	5
Attachments:	Information Sheet

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Criterion 7 Demonstrate knowledge and understanding of applications of trigonometry.

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Question 11 (approximately 6 minutes)

The diagram below shows the position of the information centre, **A**, relative to a hut, **B**, and the top of the ski-run, **D**.

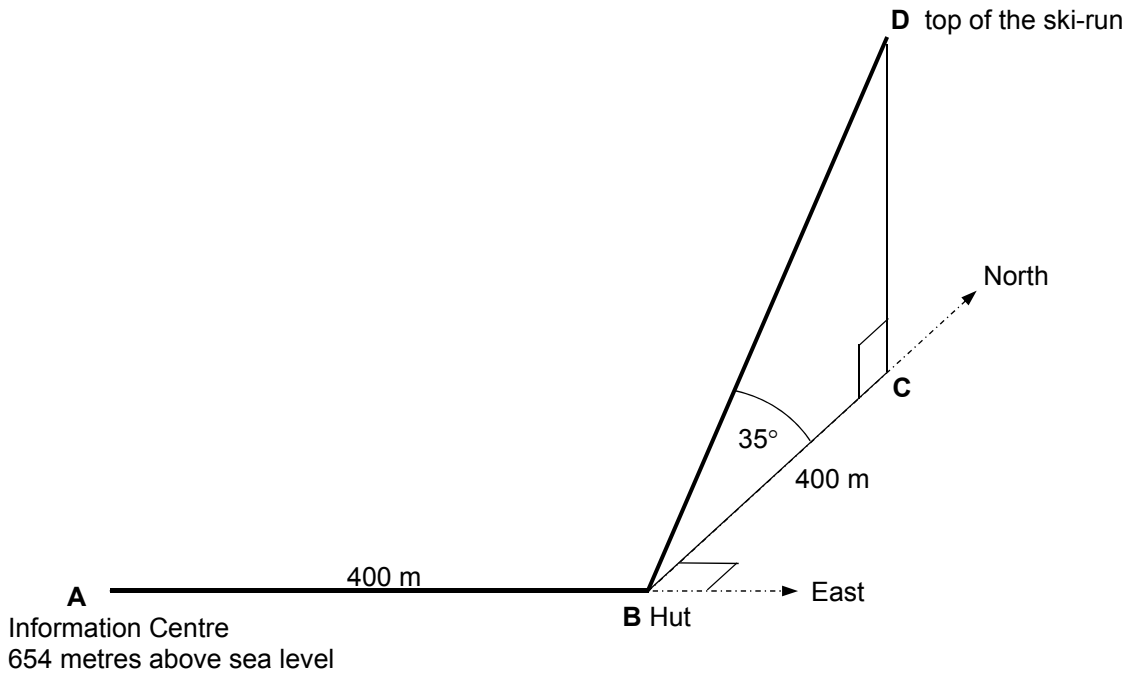
The information centre and the hut are 654 m above sea level.

The top of the ski-run is at an angle of elevation of 35° when viewed from the hut.

The distance $AB = BC = 400$ m.

The hut, **B**, is east of the information centre, **A**.

The top of the ski-run, **D**, is north of the hut, **B**.



- (a) Show that the top of the ski-run is 934 m above sea level. (2 marks)

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Question 11 continues.

Question 11 (continued)

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The operators of the chair-lifts on the ski-run are going to buy walkie-talkies to use for communication between the top of the ski-run, **D**, and the information centre, **A**.

The manufacturer claims that the useful range of the walkie-talkies is 650 metres.

- (b) Investigate the usefulness of the walkie-talkies in this scenario. **Show clear mathematical reasoning as part of your response.** (4 marks)

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Question 12 (approximately 9 minutes)

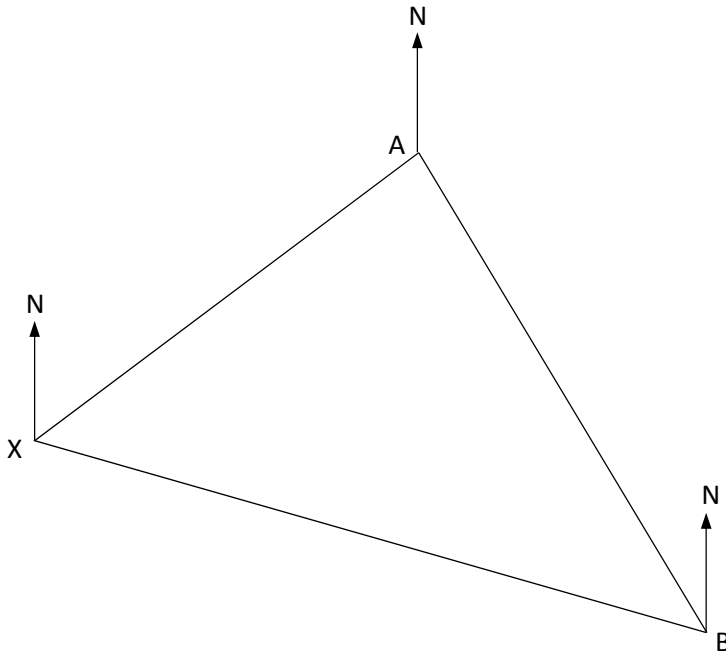
A windsurfer is on the surf beach (X). He is going to take part in a race around the course as shown in the diagram below. From X he must surf around the anchored buoys A and B, then return to X to finish the race.

Buoy A is 1.10 kilometres from X on a bearing of 065° T.

Buoy B is 1.35 kilometres from A on a bearing of 150° T.

The angle between the second leg (AB) and the final leg (BX) is $19^\circ 27'$.

- (a) Complete the diagram below by displaying all the information given above. (1 mark)



- (b) Provide a calculation to show that the angle XAB is 95° . (2 marks)

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Question 12 continues.

Question 12 (continued)

- (c) Using the cosine rule, determine the distance from buoy B to the surf beach X and hence determine the length of the race. (3 marks)

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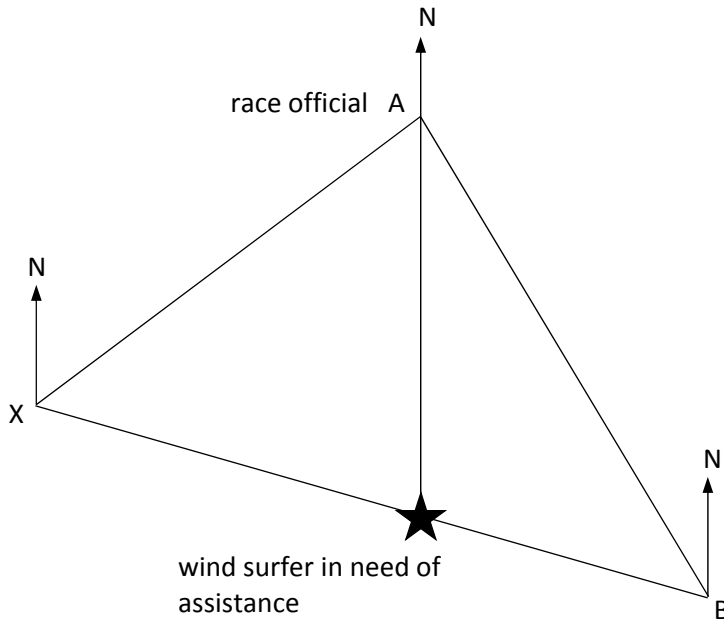
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While surfing along the final leg of the race, from buoy B to the surf beach X, the wind surfer gets into trouble and stops. A race official located at buoy A sees that he needs help. The race official travels due south to help the wind surfer.



- (d) Determine the distance the race official travels to the wind surfer. (3 marks)

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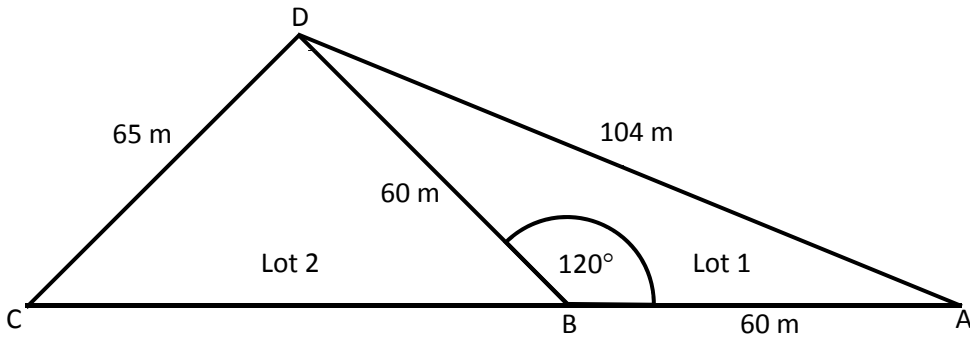
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Question 13 (approximately 6 minutes)

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Below is a diagram showing two triangular sections of land that are being measured in order to sell. The points A, B and C all lie along a straight boundary and BD is a common fence line between Lot 1 and Lot 2.



- (a) Calculate the area of Lot 1, triangle ABD. (2 marks)

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- (b) Calculate the area of Lot 2, triangle BCD. (4 marks)

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Question 14 (approximately 5 minutes)

Peter is returning from Canada after a skiing holiday. He boards a flight from Vancouver, Canada (42°N , 123°W) to Sydney, Australia (34°S , 151°E).

- (a) Determine the standard time difference between Vancouver and Sydney. (2 marks)

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Peter left Vancouver at 9:00 am local time on Friday, 21 March and arrived in Sydney at 6:45 pm local time on Saturday, 22 March.

- (b) Determine how long the flight took from Vancouver to Sydney. (3 marks)

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Question 15 (approximately 10 minutes)

A cargo ship leaves Burnie, Tasmania, (41°S , 146°E) at 10:00 am on 12 September and travels to Perth, Western Australia, (34°S , 115°E) arriving at 3:30 pm on 15 September.



- (a) Calculate the shortest distance between Burnie and Perth in kilometres. (3 marks)

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Due to large ocean swells, the actual distance travelled by the cargo ship between the two ports was **3150 km**.

- (b) Determine the average speed of the cargo ship during the journey in kilometres per hour. (4 marks)

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Question 15 continues.

Question 15 (continued)

The cargo ship then leaves Perth, Western Australia and travels **8936 km** due west to The Cape of Good Hope, South Africa.

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- (c) Determine the coordinates of The Cape of Good Hope, given that it lies on the same parallel of latitude as Perth, Western Australia. (3 marks)

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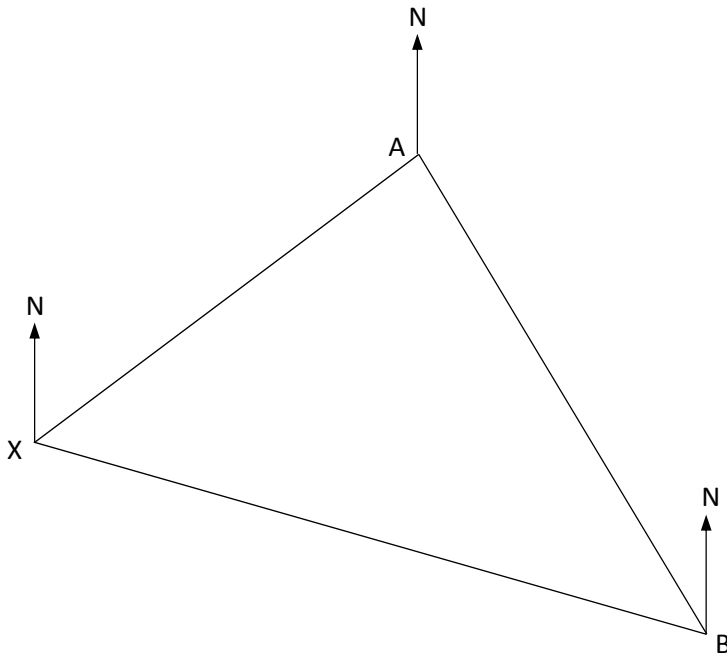
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SPARE DIAGRAM

Question 12 (a)



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Tasmanian Certificate of Education
External Assessment 2017

PLACE YOUR CANDIDATE
LABEL HERE

GENERAL MATHEMATICS

(MTG315115)

PART 5 – Graphs and Networks

Time: 36 minutes

Pages:	16
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 2017 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 criteria 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).

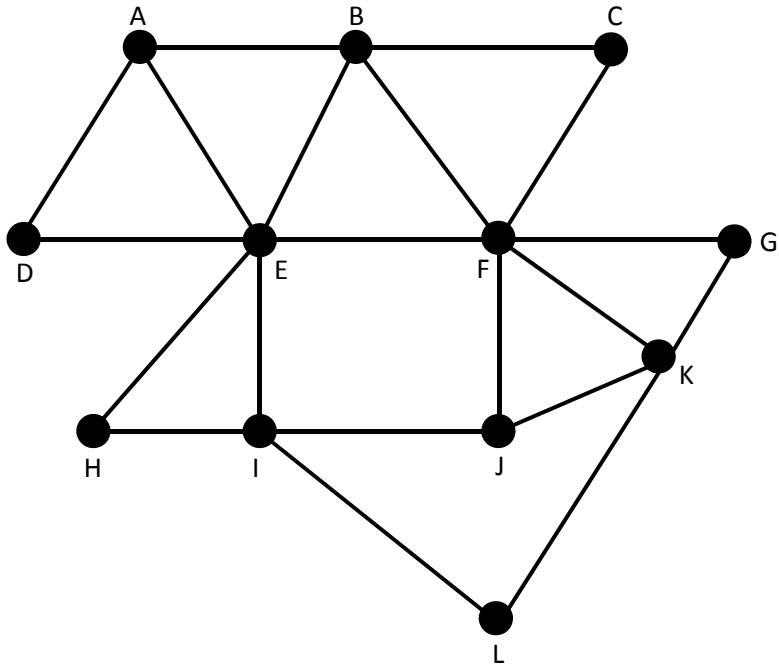
For questions worth 3 or more marks, you are **required to show** relevant working.

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

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

Question 16 (approximately 10 minutes)

Below is a network with 12 vertices and 20 edges.



- (a) Use Euler's formula to calculate the number of faces of the network. (1 mark)

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- (b) An Euler path exists on the network above. Identify the starting and finishing vertices for such a path on this network. (2 marks)

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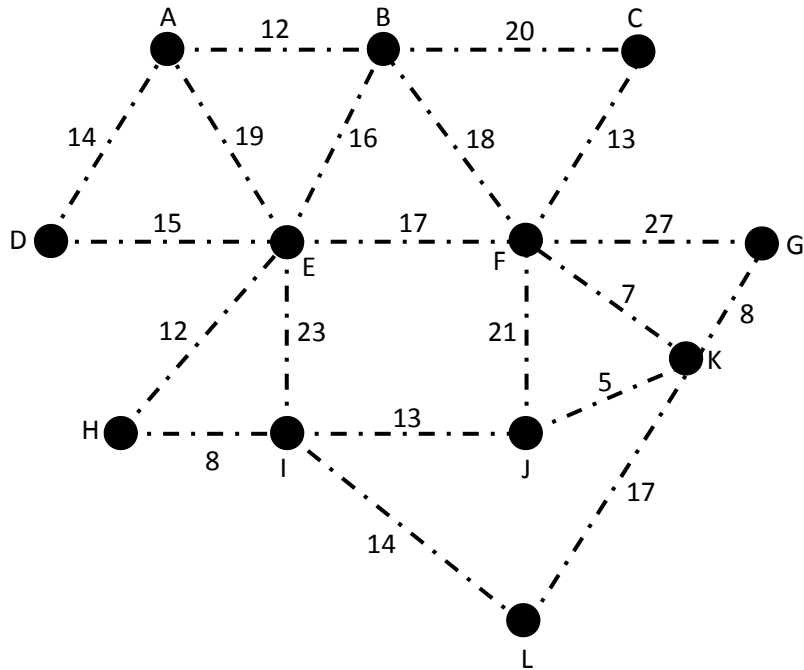
- (c) Draw an example of a network, with 5 vertices and 7 edges, for which Euler's formula does not apply. State why Euler's formula does not apply in this case. (3 marks)

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Question 16 continues.

Question 16 (continued)

Weightings have now been added to the edges of the network.



(d) Draw the **minimum spanning tree** for the network on the diagram above. (2 marks)

(e) State the total weight of the **minimum spanning tree**. (1 mark)

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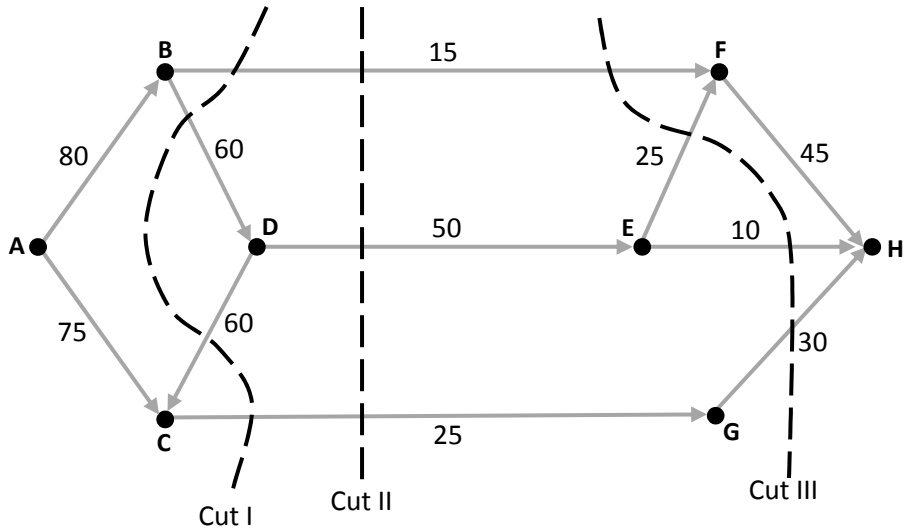
(f) If Prim's algorithm was started on **vertex A**, identify the last edge that would be added to the minimum spanning tree. (1 mark)

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Question 17 (approximately 8 minutes)

The diagram below shows the flow capacity, in megalitres per hour (ML/h), of gas pipes, which connect a gas field to a large storage facility.



(a) Determine the capacity of the cuts shown above. (2 marks)

Cut I:

Cut II:

Cut III:

(b) Considering other possible cuts, determine the maximum flow of gas through the network. (2 marks)

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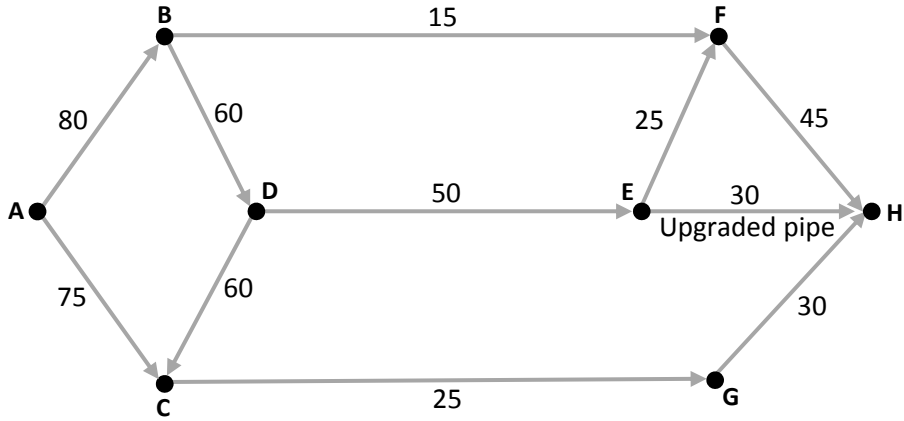
Maximum flow:

Question 17 continues.

Question 17 (continued)

To increase the maximum flow in the network, an engineer decided to upgrade the flow capacity of the pipe joining point **E** and point **H**. The flow capacity of this pipe was increased from **10 ML/h** to **30 ML/h**, as shown below.

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Only**



(c) Critically discuss the effectiveness of this upgrade. (4 marks)

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Question 18 (approximately 8 minutes)

A team with four members, Abby, Bob, Cait and Drew, is training to take part in a quiz. The team members attempted sample questions on four topics and their scores are given in the table.

	Topic 1	Topic 2	Topic 3	Topic 4
Abby	27	29	25	35
Bob	33	22	17	29
Cait	23	29	25	33
Drew	22	29	29	27

For the actual quiz, each topic must be allocated to exactly one of the team members. The maximum total score for the sample questions is to be used to allocate the different topics to the team.

- (a) Explain why the Hungarian algorithm may be used if each number, x , in the table is replaced by $35 - x$. (2 marks)

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After this is done the table looks like:

	Topic 1	Topic 2	Topic 3	Topic 4
Abby	8	6	10	0
Bob	2	13	18	6
Cait	12	6	10	2
Drew	13	6	6	8

Question 18 continues.

Question 18 (continued)

- (b) Using information from the table, complete the Hungarian Algorithm until optimal assignment is possible. Use the tables below to show your working. (3 marks)

Spare grid - use only if required

- (c) (i) Hence find and state the possible allocations of topics to the four team members so that the total score for the sample questions is maximised. (2 marks)

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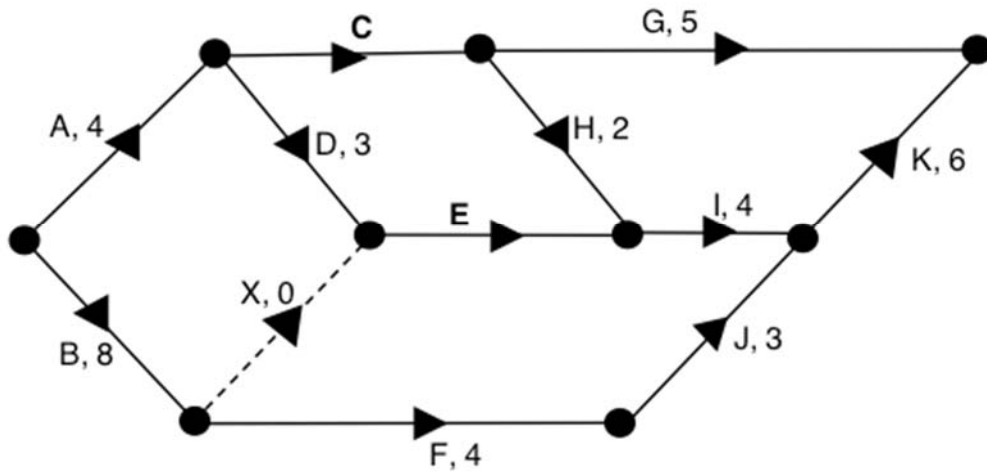
- (ii) State the value of this maximum total score. (1 mark)

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Question 19 (approximately 10 minutes)

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Only

- (a) The project network below consists of 11 tasks, from task **A** to task **K**, with completion times in days.



The minimum completion time for this project is 24 days and task **E** is on the **unique** critical path.

- (i) Determine the duration time for task **E**. (2 marks)

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- (ii) Determine the possible duration times for task **C**. (2 marks)

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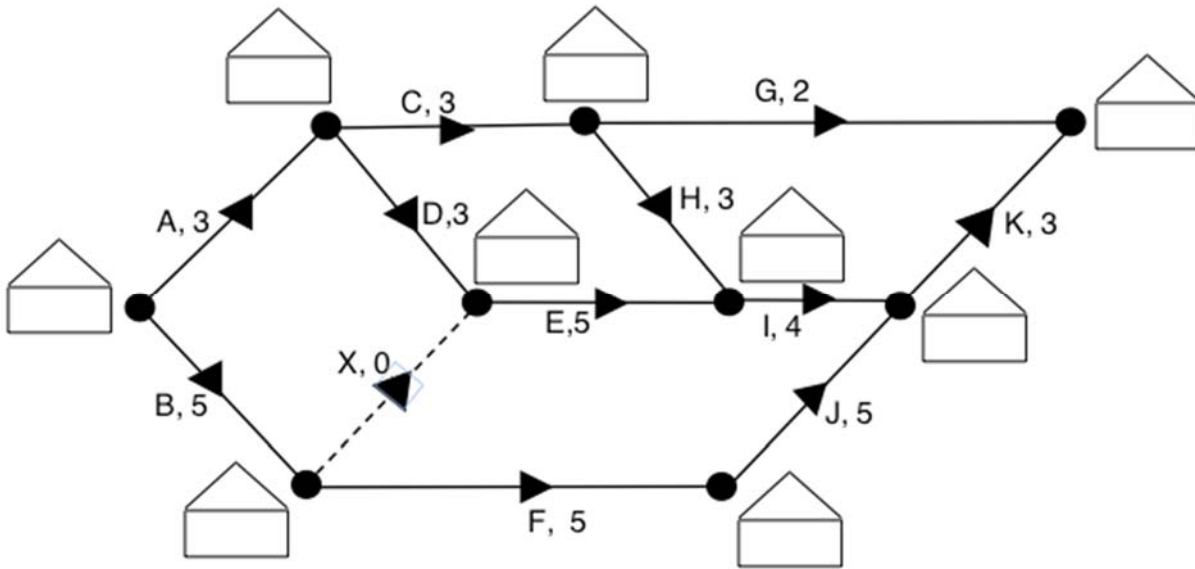
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Question 19 continues.

Question 19 (continued)

(b) The project network below has different completion times, in days, to that of part (a).



- (i) Complete a forwards and backward scan of the above network to determine the critical path(s) and minimum completion time for the project. (4 marks)

Critical Path(s):

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Minimum completion time:

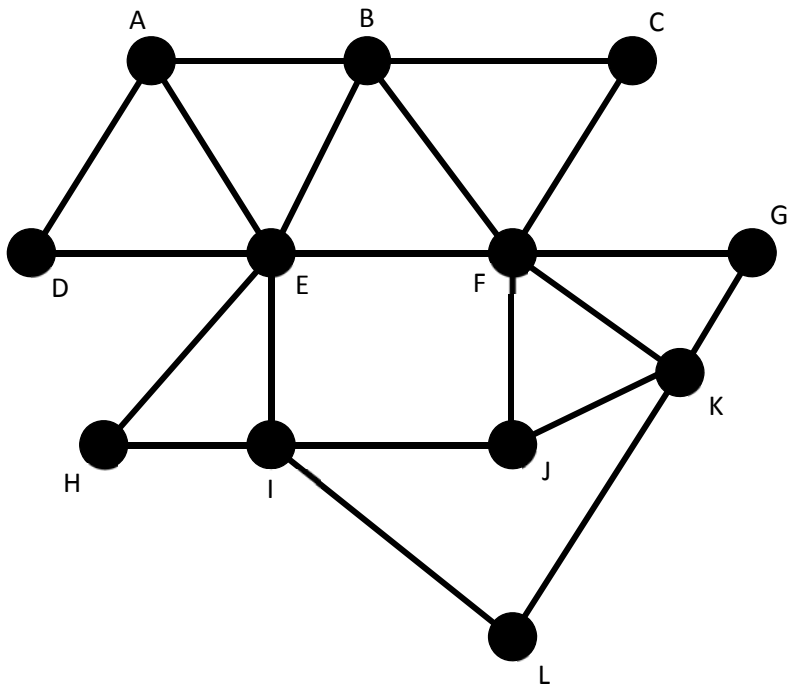
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- (ii) Describe the impact on the minimum completion time for the project if task **H** was delayed by 4 days. (2 marks)

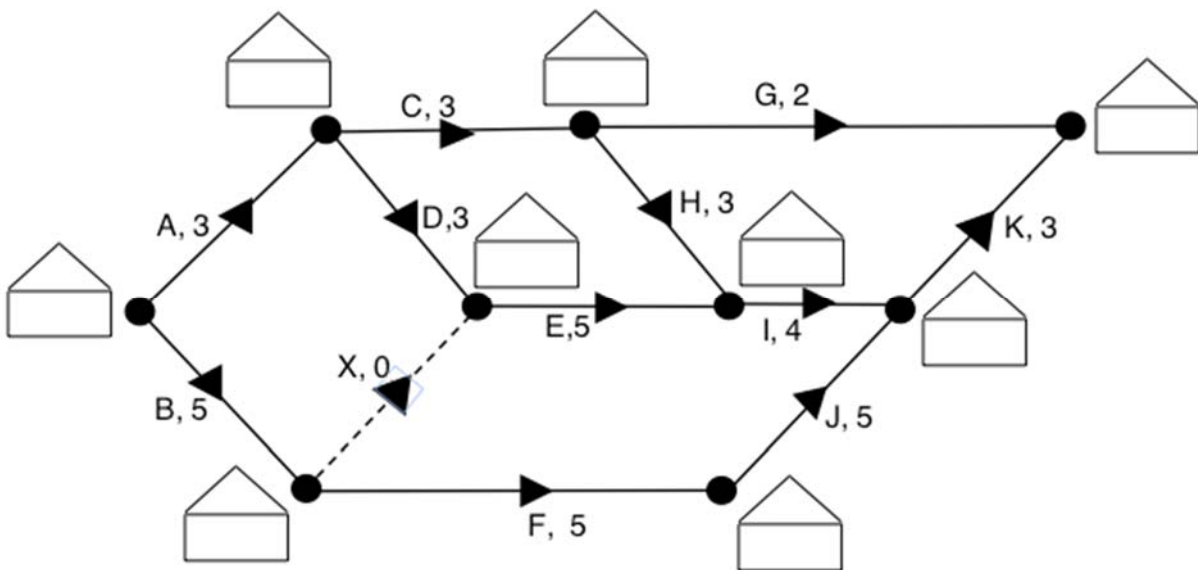
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SPARE DIAGRAMS

Question 16 (c)



Question 19 (b)



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