

External Assessment 2021

# GENERAL MATHEMATICS

MTG315120

## Part **1** Bivariate Data Analysis

Pages	12
Questions	4
Information Sheet	1

**Reading time:** 15 minutes – you may begin writing during this time

**Suggested working time:** 36 minutes

### Instructions

- Attempt **all questions** and **all parts** within each question.
  - For questions worth **two (2)** or more marks you must show your workings, logical argument and mathematical detail to gain full marks.
- Write your answers in the spaces provided in this exam booklet.
  - Spare diagrams have been provided at the end of each section.  
Indicate in the box provided if you have used the spare diagram.
- TASC approved calculators are allowed.
- All answers must be written in **English**.
- You **must** make sure your answers address:
  - Criterion 4 interpret concepts, explore and apply methods of bivariate data analysis and time series analysis using the statistical investigation process.

Marker use	
C4	36

# Guide to Exam Structure

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	Questions available	How many questions to answer	Suggested working time	Marks available
<b>Part 1</b>	4	4	36 minutes	36
Part 2	4	4	36 minutes	36
Part 3	4	4	36 minutes	36
Part 4	5	5	36 minutes	36
Part 5	4	4	36 minutes	36
<b>Total</b>	<b>21</b>	<b>21</b>	<b>180 minutes (3 hours)</b>	<b>180</b>

**Question 1 (approximately 7 minutes)**

Marker use

There has been an outbreak of a disease called *Excrutia*. A medical test is developed to detect whether or not a person has *Excrutia*. The test is given to two groups of people; one group consists of confirmed *Excrutia* sufferers, and the other is a control group consisting of healthy people who do not have the disease.

The following table gives the results.

	Group 1 <i>Excrutia</i> sufferers	Group 2 Healthy people	Total
Test shows positive	175	32	207
Test shows negative	5	88	93
Total	180	120	300

← Grand total

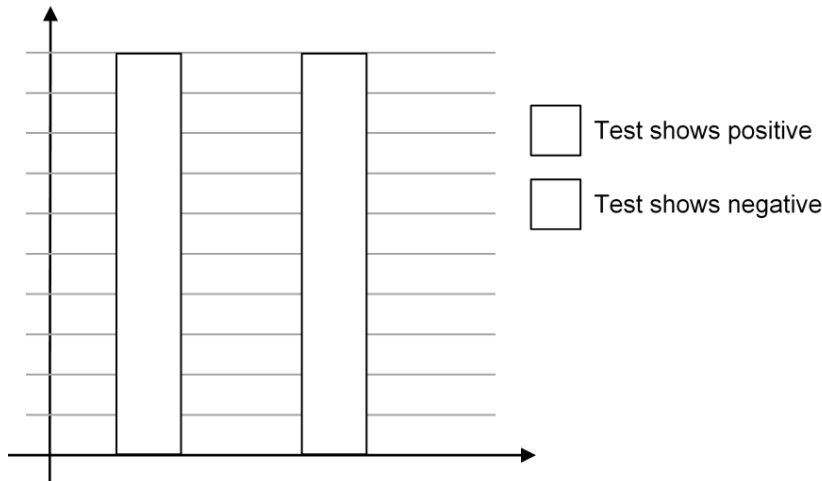
a) Express the data in percentage terms.

	Group 1 <i>Excrutia</i> sufferers	Group 2 Healthy people
Test shows positive		
Test shows negative		
Total	100%	100%

Spare  
diagram  
used  
(✓)

2

b) Display the percentage information using a segmented column chart.



Spare  
diagram  
used  
(✓)

2

c) Is the test suitable for detecting *Excrutia*? Use data in your answer.

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3

**Total Q1**

7

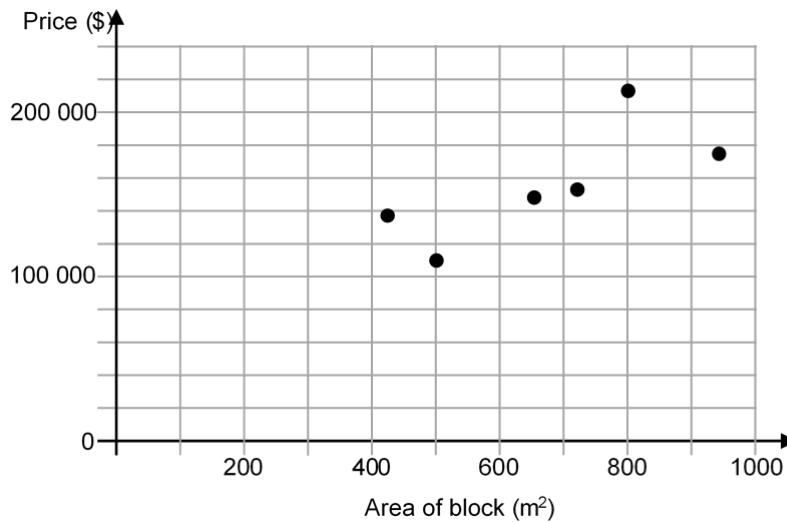
**Question 2 (approximately 13 minutes)**

Marker use

A developer is dividing an area of land into six blocks. He shows his plans to a real estate agent who gives him an estimate of the price of each block.

The table and scatterplot below show the relationship between the area of the blocks and their price.

Block	Area (m <sup>2</sup> )	Price (\$)
A	500	110 000
B	800	220 000
C	420	138 000
D	720	154 000
E	940	176 000
F	650	148 000



Spare diagram used (✓)

- a) Use your calculator's linear regression feature to determine the equation of the trend line. Express your equation in terms of price  $P$  and area  $a$ . (Use 2 decimal places.)

2

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- b) State **two (2)** points that are on the trend line and use them to mark the trend line on the graph.

2

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**Question 2 continues**

**Question 2 continued**

**Marker use**

c) Find the correlation coefficient and use it to draw a conclusion about the relationship between the variables.

**2**

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d) What is the gradient of the graph and what does it represent?

**2**

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e) Use your equation to find the amount of land that can be bought for \$150 000.

**1**

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f) Give a reason why you cannot be confident in your prediction.

**1**

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g) By the time that the developer has completed his works land values have increased. The real estate agent tells the developer that he could increase the price of each block by a fixed amount. How would this affect the gradient, y intercept, and correlation coefficient of the graph? (There is no need for calculations).

**3**

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**Total Q2**

**13**

**Question 3 (approximately 8 minutes)**

Marker use

The distance travelled by an electric scooter was measured for different amounts of charging time. The results are tabulated below. (Some data is missing.)

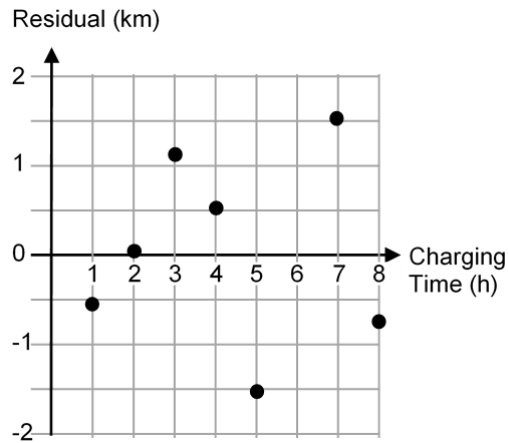
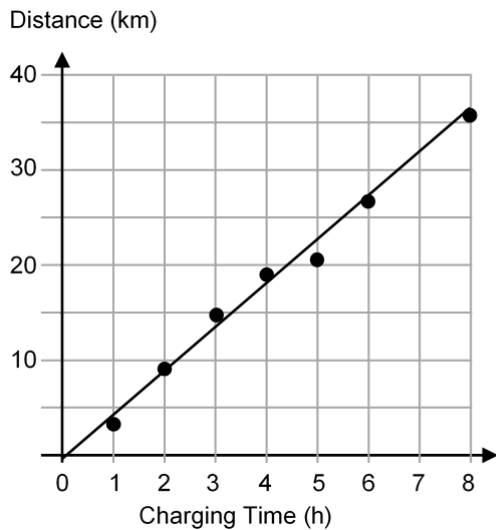
Charging time (h)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
Distance travelled (km)	3.8	9.0	14.7	18.7	21.2	26.8		36.0
Residual	-0.55	0.05	1.15	0.55	-1.55		1.55	-0.55

The data was modelled by the linear equation:

$$D = 4.60t - 0.25$$

where D is the distance travelled in kilometres and t is the time spent charging the scooter in hours.

A scatter plot of the data and a plot of residuals for the equation are presented below.



Spare diagram used  
(✓)

a) The point (4, 0.55) is on the graph of residuals. Explain what this means.

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1

Question 3 continues

**Question 3 continued**

**Marker use**

- b) i. Use the equation to predict the (theoretical) distance travelled by the scooter when  $t = 6$ .

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- ii. Hence, find the residual when  $t = 6$ .

1

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- iii. Place this point on the graph of residuals.

1

- c) Use the data and equation to find the actual distance travelled by the scooter when it had 7 hours of charge.

2

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- d) State **two (2)** features of the residuals graph which indicate that the data is well modelled by its equation.

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**Total Q3**

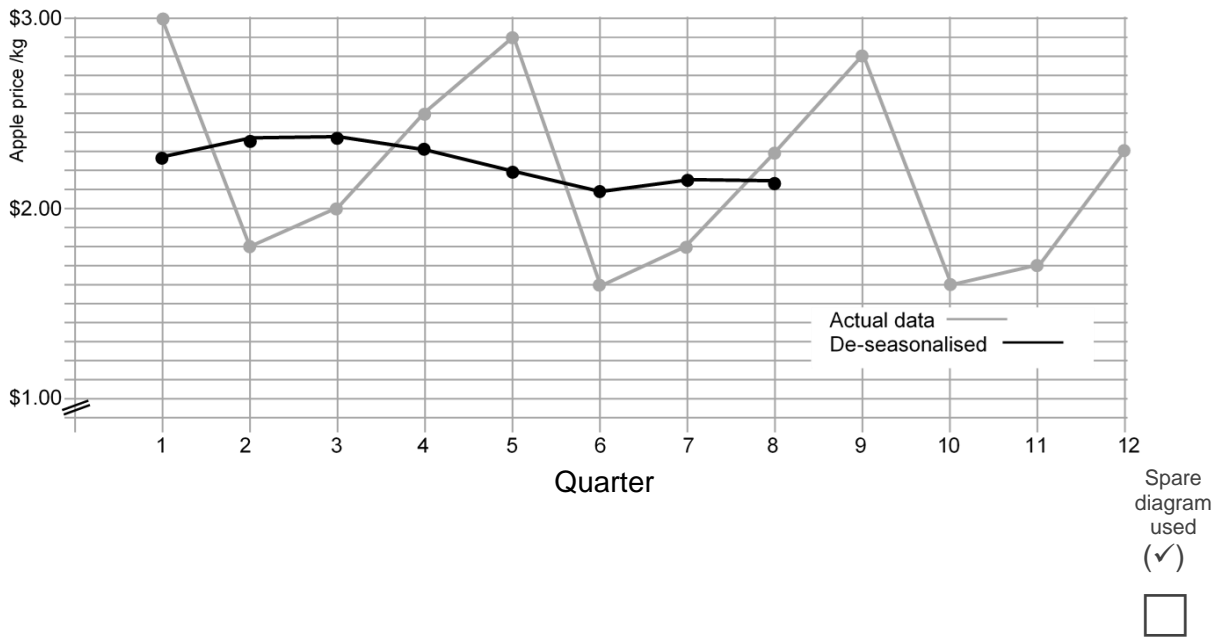
8

**Question 4 (approximately 8 minutes)**

Marker use

The following table and graph give information about apple prices.

	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
Quarter	1	2	3	4	5	6	7	8	9	10	11	12
Apple price (\$ per kg)	3.00	1.80	2.00	2.50	2.90	1.60	1.80	2.30	2.80	1.60	1.70	2.30
De-seasonalised apple price	2.27	2.36	2.38	2.31	2.19	2.10	2.14	2.13				



a) What features of the graph of actual data indicate that this is seasonal data?

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1

Some seasonal indices are given in the table below.

	Quarter			
	Summer	Autumn	Winter	Spring
Index	1.32	0.76	0.84	

b) Find the index for spring.

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1

**Question 4 continues**



**Question 4 continued**

**Marker use**

c) Confirm your answer to part b) by using quarter 4 data from the first table.

1

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d) Use the seasonal indices to complete the de-seasonalised data in the first table.

2

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e) Complete the graph of de-seasonalised data.

1

f) Which season has the highest index? Explain what this means.

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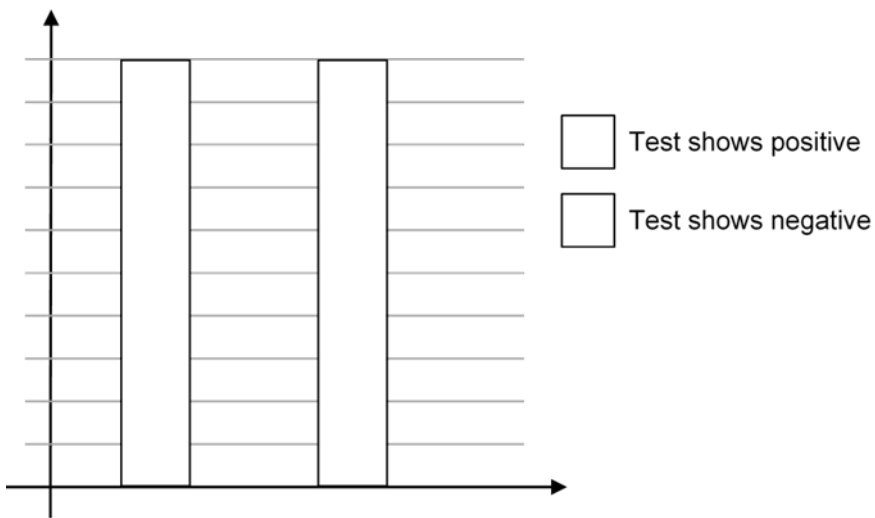
**Total Q4**

8

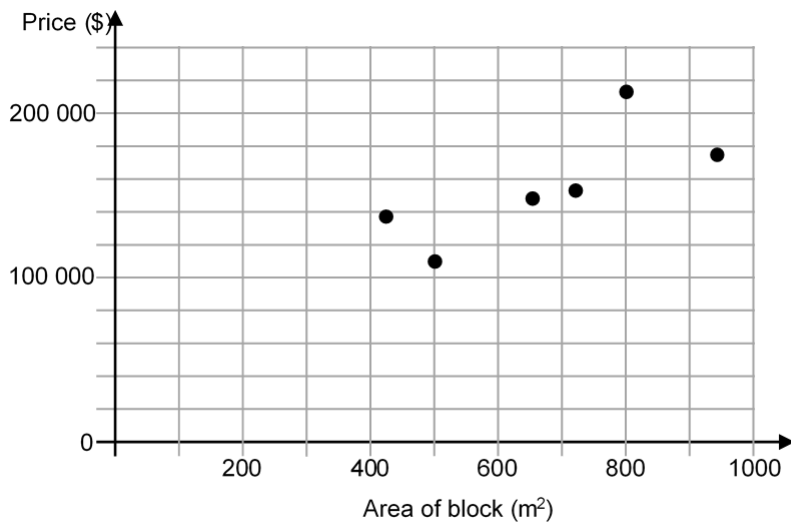
# Spare Diagrams

## Question 1

	Group 1 <i>Excrutia</i> sufferers	Group 2 Healthy people
Test shows positive		
Test shows negative		
Total	100%	100%

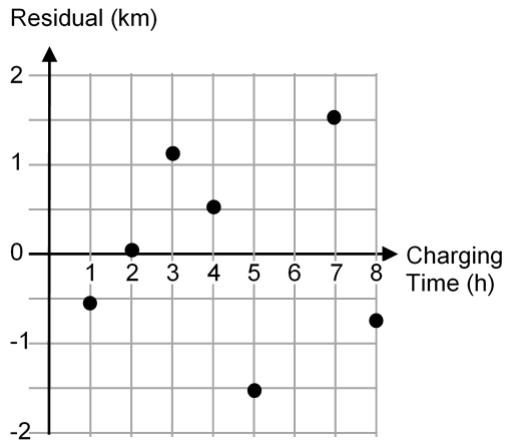


## Question 2

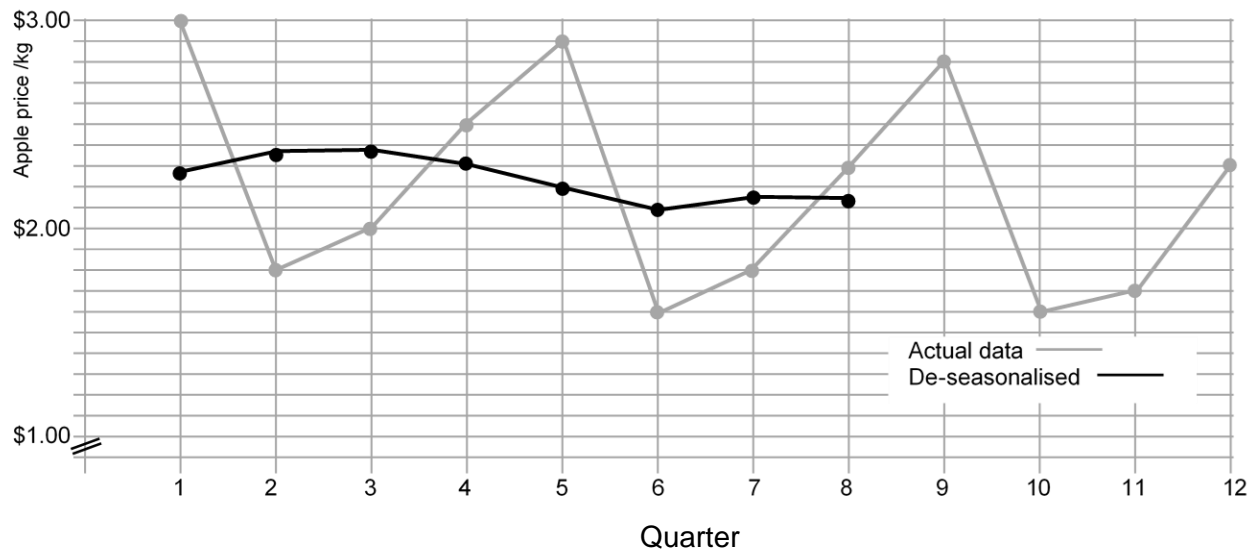


# Spare Diagrams

## Question 3



## Question 4



End of Part 1



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# GENERAL MATHEMATICS

MTG315120

## Part **2** Growth and Decay in Sequences

Pages	12
Questions	4
Information Sheet	1

**Suggested working time:** 36 minutes

### Instructions

- Attempt **all questions** and **all parts** within each question.
  - For questions worth **two (2)** or more marks you must show your workings, logical argument and mathematical detail to gain full marks.
- Write your answers in the spaces provided in this exam booklet.
  - Spare diagrams have been provided at the end of each section.  
Indicate in the box provided if you have used the spare diagram.
- TASC approved calculators are allowed.
- All answers must be written in **English**.
- You **must** make sure your answers address:
  - Criterion 5 interpret concepts and perform calculations to model and investigate patterns of growth and decay in discrete situations.

Marker use	
C5	36

# Guide to Exam Structure

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	Questions available	How many questions to answer	Suggested working time	Marks available
Part 1	4	4	36 minutes	36
Part 2	4	4	36 minutes	36
Part 3	4	4	36 minutes	36
Part 4	5	5	36 minutes	36
Part 5	4	4	36 minutes	36
<b>Total</b>	<b>21</b>	<b>21</b>	<b>180 minutes (3 hours)</b>	<b>180</b>

**Question 5 (approximately 7 minutes)**

**Marker use**

The table below shows the output of a factory every year since its opening.

	Year 1	Year 2	Year 3	Year 4
Number of units produced	66	69	72	75

a) What feature of the data indicates that the output of the factory is increasing as an arithmetic sequence?

/ 1

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b) Write the arithmetic sequence rule that describes the number of units produced each year.

/ 1

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c) Use your rule to predict the number of units produced in the 7th year.

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d) In what year would you expect the number of units produced to exceed 100 units?

/ 2

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e) Find the total number of units produced over the first 10 years.

/ 2

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**Total Q5**

/ 7

**Question 6 (approximately 6 minutes)**

The number packets of football cards sold by a shop is monitored every week. It is found that after the football season finishes there is a decline in the popularity of the cards which follows a geometric sequence.

Marker use

Weeks after end of season	1	2	3	4	5
Number of packets sold	2400		1536		

Spare diagram used (✓)

- a) Use information from the table to show that the common ratio between terms is 0.8.

/ 1

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- b) What is the geometric sequence rule?

/ 1

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- c) Use the rule to complete the table. (Round results to the nearest whole number.)

/ 2

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- d) Find the number of packets of cards sold over the 15-week period following the season's end.

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**Total Q6**

/ 6



**Question 7 (approximately 10 minutes)**

A population of trout in a lake system currently numbers 12 000. Excessive fishing is leading to the population declining by 15% each year. To help maintain trout stocks the Inland Fisheries Department releases an additional 1500 trout into the lakes each year.

- a) Use a difference equation to model the situation. (Use initial term  $T_0$ .)

.....

- b) Model the sequence on your calculator (to about 100 terms). Complete the table below showing the start of the sequence.

Year	0	1	2	3
Population	12 000			

Spare diagram used (✓)

- c) Is the sequence arithmetic, geometric or neither? Explain your answer.

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- d) What is happening to the population? And what is the long-term outcome?

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- e) Write a difference equation to represent the situation if, instead, the Inland Fisheries Department was to release 3000 trout into the lake each year.

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- f) Remodel the situation on your calculator. What is happening to the population now? And what is the long-term outcome?

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- g) How many fish should the Inland Fisheries Department release each year if it wishes to maintain the initial population level?

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Marker use

/ 2

/ 1

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**Total Q7**

/ 10

**Question 8 (approximately 13 minutes)**

Marker use

A large department store has opened in the City-Side shopping district. Initially City-Side had a patron base of 10 000 shoppers, but since the opening of the department store, numbers have increased by 6% each week.

West Mall is a near-by shopping district in the same town. Initially, West Mall had a patron base of 35 000 shoppers, but since the department store opened numbers using West Mall have decreased by 2000 each week.

- a) Find the number of shoppers using each district during the weeks following the opening of the department store.

2

For the City-Side      Initial:  $T_0 = 10\,000$  shoppers

Week 1:  $T_1 =$  .....

Week 2:  $T_2 =$  .....

For the West Mall      Initial:  $T_0 = 35\,000$  shoppers

Week 1:  $T_1 =$  .....

Week 2:  $T_2 =$  .....

- b) Describe in words the type of increase or decrease shown by each of the sequences.

1

City-Side: .....

West Mall: .....

- c) Represent the sequence of the number of shoppers using each district with difference equations.

2

City-Side: .....

West Mall: .....

**Question 8 continues**

**Question 8 continued**

**Marker use**

d) Find the number of shoppers visiting each of the districts during week 12.

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/ 2

e) During which week does the number of shoppers using West Mall fall to zero?

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/ 1

f) Sketch graphs for both shopping districts (on the axes below) showing how the number of shoppers changes over 18 weeks. (Note: There is no need for accurate plotting.)



Spare  
diagram  
used  
(✓)

/ 3

g) When does the number of shoppers using City-Side exceed the number of shoppers using West Mall?

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/ 2

**Total Q8**

/ 13

# Spare Diagrams

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### Question 6

Weeks after end of season	1	2	3	4	5
Number of packets sold	2400		1536		

### Question 7

Year	0	1	2	3
Population	12 000			

### Question 8



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End of Part 2

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Attach your candidate label here

External Assessment 2021

# GENERAL MATHEMATICS

MTG315120

## Part **3** Finance

Pages	12
Questions	4
Information Sheet	1

**Suggested working time:** 36 minutes

### Instructions

- Attempt **all questions** and **all parts** within each question.
  - For questions worth **two (2)** or more marks you must show your workings, logical argument and mathematical detail to gain full marks.
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Indicate in the box provided if you have used the spare diagram.
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- All answers must be in **English**.
- You **must** make sure your answers address:
  - Criterion 6 interpret concepts and perform calculations to solve problems involving standard financial models.

Marker use	
C6	36

# Guide to Exam Structure

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	Questions available	How many questions to answer	Suggested working time	Marks available
Part 1	4	4	36 minutes	36
Part 2	4	4	36 minutes	36
Part 3	4	4	36 minutes	36
Part 4	5	5	36 minutes	36
Part 5	4	4	36 minutes	36
<b>Total</b>	<b>21</b>	<b>21</b>	<b>180 minutes (3 hours)</b>	<b>180</b>

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**Question 9 (approximately 6 minutes)**

Marker use

The information below shows Tony Merchant's savings account transactions for the month of January. Interest on this account is awarded at 2.5% p.a. calculated on the daily balance and added at the end of each month.

Date	Transaction	Debit (\$)	Credit (\$)	Balance (\$)
Jan 1	Balance (after interest)			3420.60
Jan 8	Deposit		500.00	
Jan 24	Withdraw	1200.00		
Feb 1	Balance (after interest)			

Spare diagram used  
(✓)

a) Complete the balances for Jan 8 and Jan 24.

1

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b) Find the amount of interest that is added to Tony's account on Feb 1.

4

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c) What is the balance after interest has been added?

1

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**Total Q9**

6

**Question 10 (approximately 8 minutes)**

**Marker use**

Rani has \$10 000 to invest for a period of 5 years and is considering the compound interest offered by two banks.

Frontline Bank: 3.5% p.a. compounding monthly

Bank of Prosperity: 3.7% p.a. compounding twice each year.

a) Calculate the effective interest rate offered by each account.

2

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b) If Rani chooses to invest with Bank of Prosperity, find the amount in her account after 5 years.

2

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c) Instead, Rani is considering purchasing an asset with her money with the thought of selling it in 5 years time. Find the value of the asset after 5 years, given the annual rate of inflation is 5.1%.

2

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d) What other things should Rani consider if she chooses to “invest” by purchasing an asset?

2

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**Total Q10**

8

**Question 11 (approximately 11 minutes)**

Marker use

Nathan and Mia have saved a considerable deposit and have found a home that they wish to purchase which costs \$420 000.

Their bank will lend them money at 5.8% p.a. interest repayable in fortnightly instalments over 30 years (with interest compounded on the fortnightly balance).

LOAN OPTION 1: Borrow \$400 000 (and pay deposit \$20 000 from their savings)

LOAN OPTION 2: Borrow \$320 000 (and pay deposit \$100 000 from their savings)

a) Find the size of the repayments for each option.

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b) Find the total paid for the house under each option and the saving made by choosing the better option.

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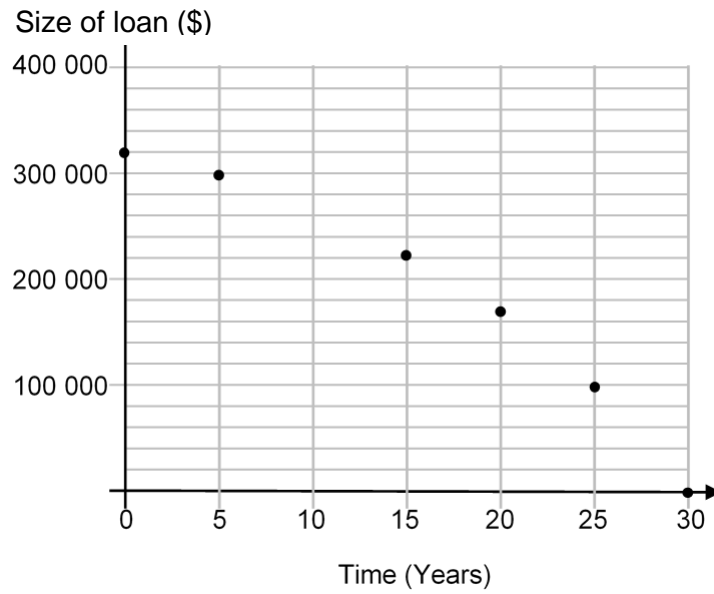
**Question 11 continues**

**Question 11 continued**

Marker use

Nathan and Mia choose LOAN OPTION 2. The table and graph below show the amount owed at different stages of their loan.

Time since start of loan (Years)	Size of loan (\$)
0	320 000
5	297 057
10	
15	225 454
20	170 744
25	97 651
30	0



c) Complete the table by finding the missing entry.

2

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d) Explain why the graph is curved.

2

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**Total Q11**

11

**Question 12 (approximately 11 minutes)**

Marker use

As a self-employed tradesperson Michael makes a \$250 deposit each fortnight into a superannuation account. This account pays 4.8% p.a. interest compounding fortnightly.

- a) Use an algebraic formula to show that the amount he can expect as a lump sum payout at the end of his career after working for 40 years is \$788 073.

3

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When Michael retires he invests the total lump sum so that he receives a monthly annuity which pays 4.2% p.a. interest on the monthly balance. The annuity is designed to last 25 years.

- b) Find the size of Michael's monthly annuity payment.

3

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- c) Write a difference equation which models this annuity.

3

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**Question 12 continues**



**Question 12 continued**

**Marker use**

Michael dies 10 years into his retirement and the remainder of his investment is passed to his next of kin.

**2**

d) How much does his next of kin receive?

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**Total Q12**

**11**

# Spare Diagram

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## Question 9

Date	Transaction	Debit (\$)	Credit (\$)	Balance (\$)
Jan 1	Balance (after interest)			3420.60
Jan 8	Deposit		500.00	
Jan 24	Withdraw	1200.00		
Feb 1	Balance (after interest)			

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End of Part 3



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# GENERAL MATHEMATICS

MTG315120

## Part **4** Trigonometry

Pages	12
Questions	5
Information Sheet	1

**Suggested working time:** 36 minutes

### Instructions

- Attempt **all questions** and **all parts** within each question.
  - For questions worth **two (2)** or more marks you must show your workings, logical argument and mathematical detail to gain full marks.
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- You **must** make sure your answers address:
  - Criterion 7 interpret concepts and perform calculations to solve problems involving applications of trigonometry.

Marker use	
C7	36

# Guide to Exam Structure

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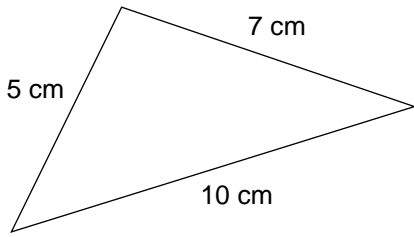
	Questions available	How many questions to answer	Suggested working time	Marks available
Part 1	4	4	36 minutes	36
Part 2	4	4	36 minutes	36
Part 3	4	4	36 minutes	36
Part 4	5	5	36 minutes	36
Part 5	4	4	36 minutes	36
<b>Total</b>	<b>21</b>	<b>21</b>	<b>180 minutes (3 hours)</b>	<b>180</b>

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**Question 13 (approximately 4 minutes)**

Marker use

a) Find the area of the triangle below.



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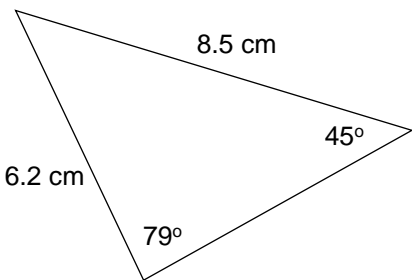
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2

b) Find the area of the triangle below.



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2

**Total Q13**

4

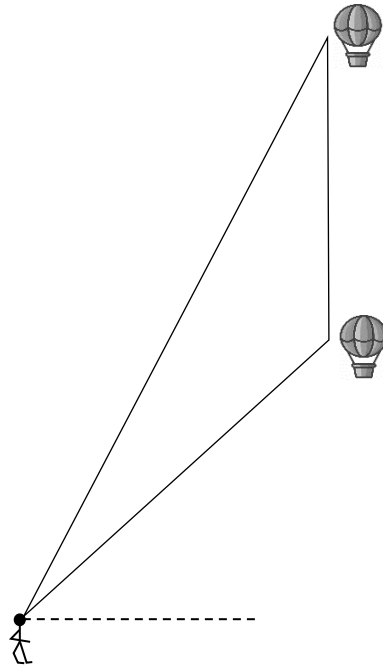


**Question 14 (approximately 6 minutes)**

Marker use

A hot air balloon is rising vertically. An observer first notices that the balloon has an angle of elevation of  $48^\circ$ . Five minutes later she finds that the balloon's angle of elevation is  $62^\circ$ .

a) Mark the angles of elevation on the diagram below.



Spare  
diagram  
used  
(✓)

1

b) If the balloon's speed is 0.4 m/s, how far has it risen between the two observations?

2

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c) Find the distance separating the observer and the balloon at the time of the second observation.

3

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**Total Q14**

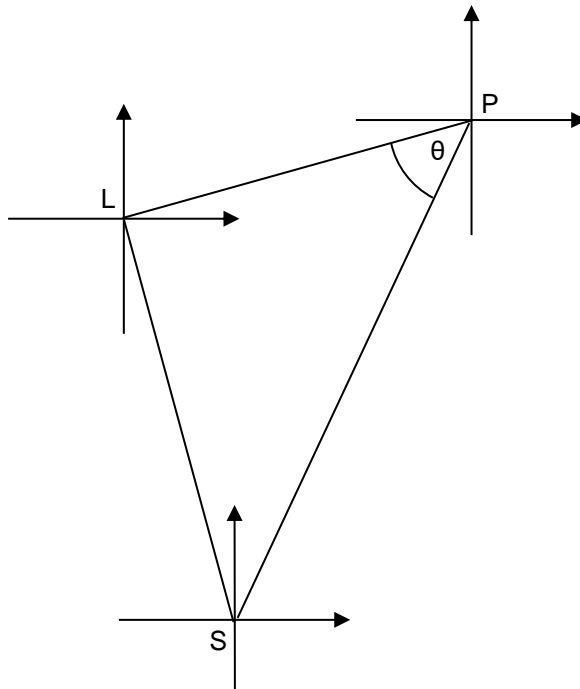
6

**Question 15 (approximately 8 minutes)**

A lifeguard (L) who is standing on a beach can see a man on a paddle-board (P) 250 m away on a bearing of  $N68^\circ E$ .

The paddle-boarder can see a swimmer (S) 320 metres away on a bearing of  $S25^\circ W$ .

- a) Mark the bearings on the diagram below.



Spare diagram used  
(✓)

- b) Show that  $\theta = 43^\circ$ .

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- c) Find the distance of the swimmer from the lifeguard.

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- d) Find the bearing of the swimmer from the lifeguard. (Answer in degrees and minutes.)

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Marker use

/ 1

/ 2

/ 2

/ 3

**Total Q15**

/ 8

**Question 16 (approximately 8 minutes)**

Marker use

A pilot flies an aircraft from Hanoi ( $21^\circ\text{N}$ ,  $105^\circ\text{E}$ ) to Honolulu ( $21^\circ\text{N}$ ,  $158^\circ\text{W}$ ).

- a) Find the distance travelled (in kilometres) if the pilot flies due east.

3

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- b) Find the distance travelled (in kilometres) if the pilot flies via the shortest possible route.

3

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- c) Given that:      the aircraft flies at 880 km/h,  
                         it uses 175 litres of fuel each minute flying at this speed,  
                         and aircraft fuel costs \$ 0.53 per litre,

find the value of fuel saved by flying the shortest possible route.

2

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**Total Q16**

8

**Question 17**

Marker use

Boris works in London (longitude 0°).

Scott works in Canberra (longitude 149°E).

Joe works in Washington (longitude 77°W).

The three men wish to link up for a video meeting, but all would like to do it at a convenient time.

a) Find the universal time zones (UTC) of the three cities.

London .....

Canberra .....

Washington .....

2

b) What time is it in Canberra when it is 6 a.m. in London?

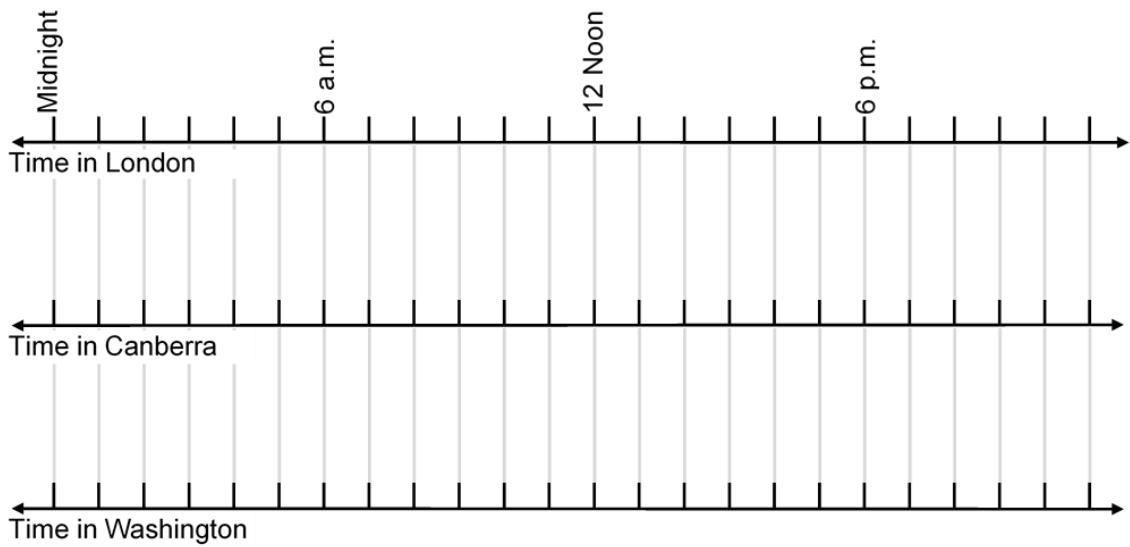
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1

c) Prepare a timeline for Canberra in relative position directly below the London timeline.

To do this: start by positioning your answer to part b) in direct alignment with 6 a.m. in London. Then position noon, 6 p.m., midnight and 6 a.m. appropriately.

1



Spare diagram used  
(✓)

d) What time is it in Washington when it is 6 a.m. in London?

.....

1

**Question 17 continues**

**Question 17 continued**

**Marker use**

e) Prepare a timeline for Washington on the same graph. (Start by positioning your answer to part d) in direct alignment with 6 a.m. in London.)

1

f) Each of the men would like to make the call between 6 a.m. and 10 p.m.. Mark, for each person, lines on their timeline which represent convenient times.

2

g) At what time(s) (UTC) can the video call be arranged so that it suits everyone?

2

.....

.....

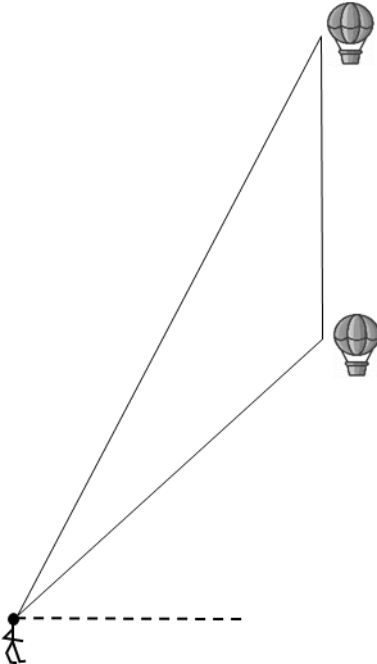
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**Total Q17**

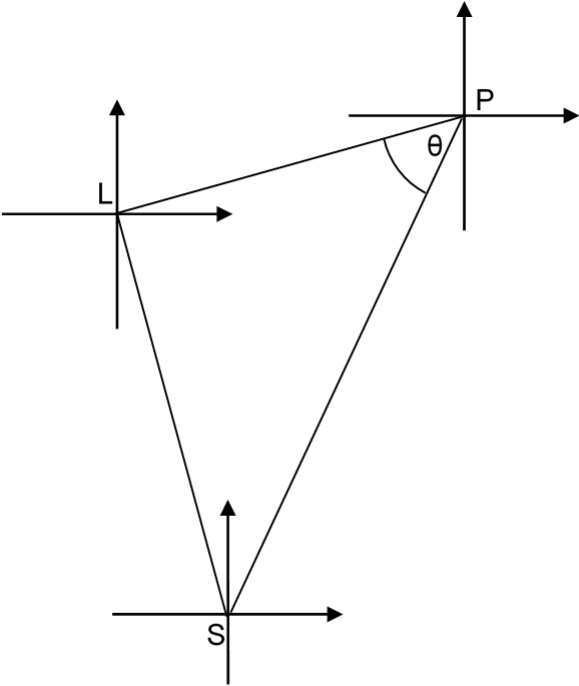
10

# Spare Diagrams

## Question 14



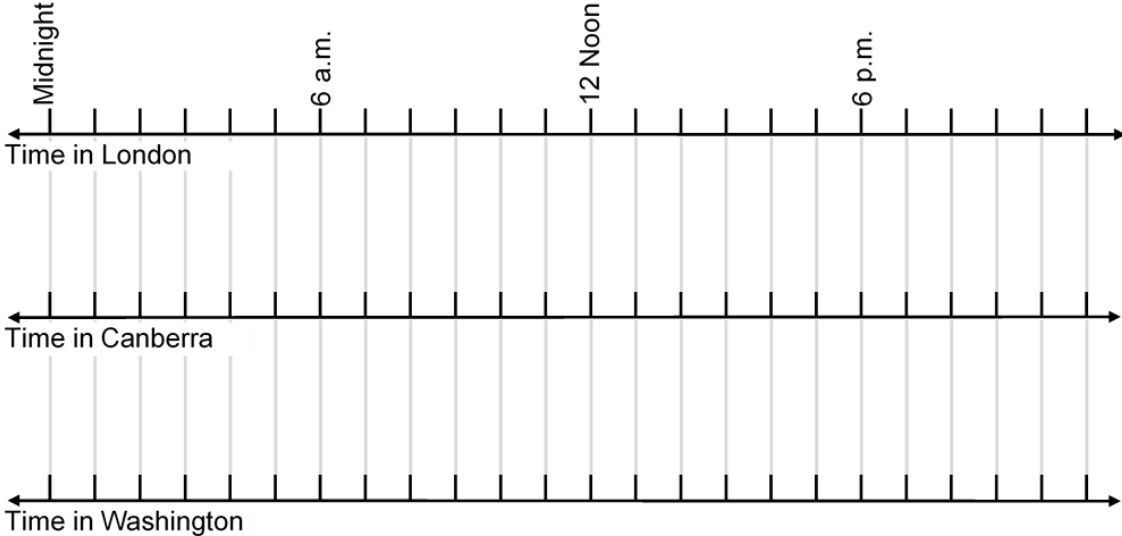
## Question 15



# Spare Diagrams

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## Question 17



End of Part 4



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External Assessment 2021

# GENERAL MATHEMATICS

MTG315120

## Part **5** Networks

Pages	12
Questions	4
Information Sheet	1

**Suggested working time:** 36 minutes

### Instructions

- Attempt **all questions** and **all parts** within each question.
  - For questions worth **two (2)** or more marks you must show your workings, logical argument and mathematical detail to gain full marks.
- Write your answers in the spaces provided in this exam booklet.
  - Spare diagrams have been provided at the end of each section.  
Indicate in the box provided if you have used the spare diagram.
- TASC approved calculators are allowed.
- All answers must be in **English**.
- You **must** make sure your answers address:
  - Criterion 8 interpret language and concepts of graphs and networks in order to model and analyse practical situations aiding mathematical decision making.

Marker use	
C8	36

# Guide to Exam Structure

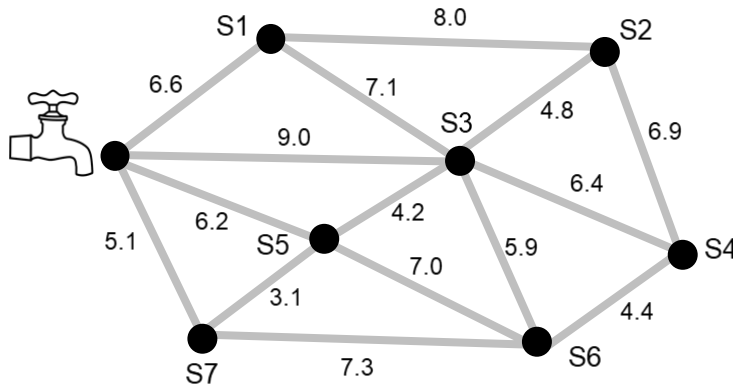
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	Questions available	How many questions to answer	Suggested working time	Marks available
Part 1	4	4	36 minutes	36
Part 2	4	4	36 minutes	36
Part 3	4	4	36 minutes	36
Part 4	5	5	36 minutes	36
Part 5	4	4	36 minutes	36
<b>Total</b>	<b>21</b>	<b>21</b>	<b>180 minutes (3 hours)</b>	<b>180</b>

**Question 18 (approximately 6 minutes)**

Marker use

An array of garden sprinklers (S1–S7) is to be connected by pipes to a tap. The graph below shows distances (in metres) separating different elements of the network.



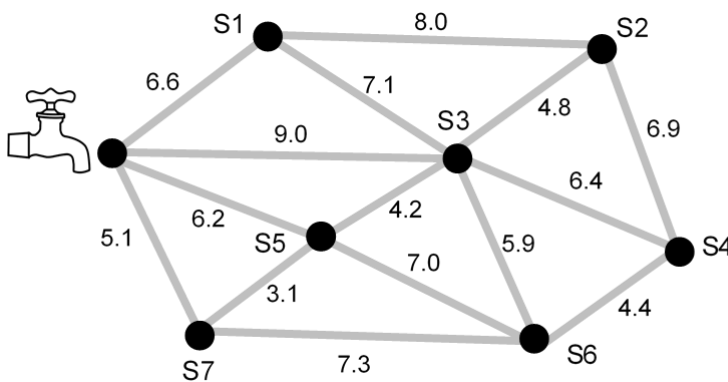
Spare diagram used  
(✓)

- a) Using Prim's algorithm, show on the above graph how all the sprinklers and tap can be connected so that the minimum length of pipe is used.
- b) What is the minimum total length of pipe?
- .....
- .....
- c) A landscape gardener charges on the basis of \$22.50 per metre of pipe laid. While preparing to quote on this job she finds that there is already a pipe laid between the tap and S3. Find the amount that the landscape gardener should charge for connecting the sprinkler array.

2

1

3



Spare diagram used  
(✓)

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.....

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**Total Q18**

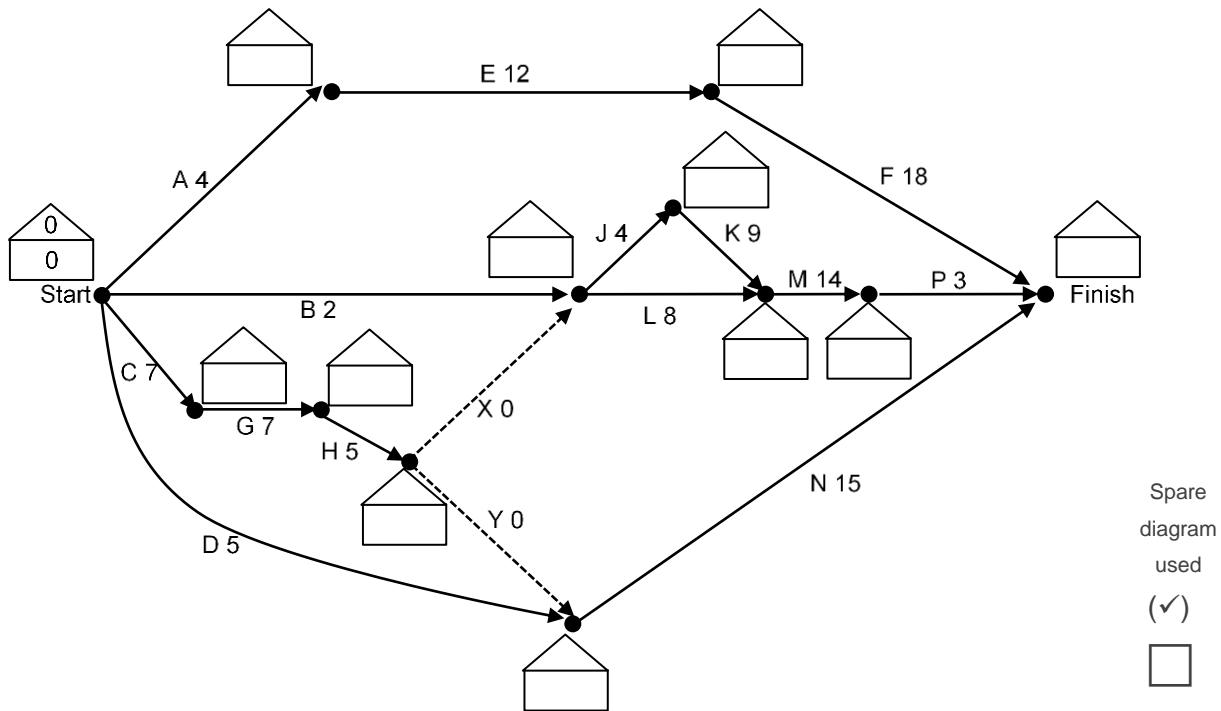
6

**Question 19 (approximately 12 minutes)**

Marker use

The following list and precedence graph show activities associated with preparing a passenger aircraft for its next flight.

	Time (min)	Activity
A	4	Position baggage truck and elevator
B	2	Position service truck
C	7	Position passenger air-bridge
D	5	Position fuel truck
E	12	Unload baggage
F	18	Reload new baggage
G	7	Disembark passengers
H	5	Security check
J	4	Unload food trolleys
K	9	Reload fresh food trolleys
L	8	Clean rubbish from the aircraft
M	14	Embark new passengers
N	15	Refuel aircraft
P	3	Remove passenger air-bridge and lock doors



a) Complete the graph by showing the earliest starting time (EST) and latest finishing time (LFT) for each activity.

b) Mark the critical path on the graph.

4

1

Question 19 continues

**Question 19 continued**

**Marker use**

c) What is the minimum time needed to prepare the aircraft for its next flight?

1

.....

d) What is the float involved in unloading baggage (E)?

1

.....

.....

e) What would happen if unloading baggage (E) took 20 minutes longer?

2

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Airline authorities have decided that the aircraft can be refueled (N) without waiting for the security check to take place (H).

f) What effect would this decision have on the graph?

1

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g) What effect would the decision have on the total time taken to prepare the aircraft for its next flight? Explain your answer.

2

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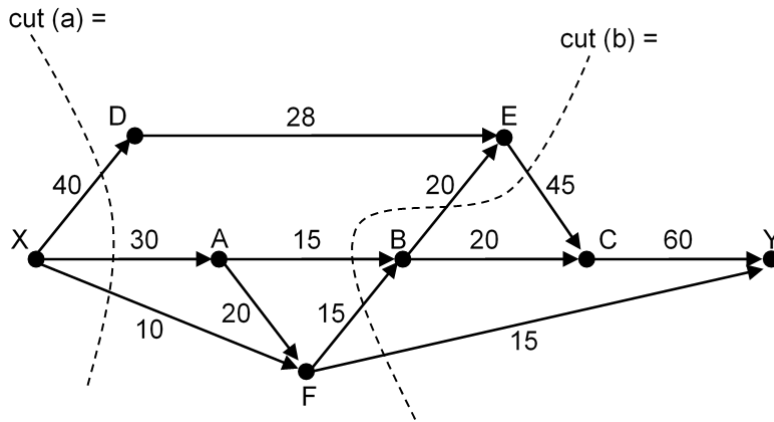
**Total Q19**

12

**Question 20 (approximately 11 minutes)**

Marker use

The graph below shows how much gas (in L/min) can flow through pipes joining different places in a factory. The management of the factory wishes to determine the maximum flow of gas from point X to point Y.



Spare diagram used (✓)

- a) What is meant by the terms “source” and “sink”? Explain with reference to the graph above.

.....

/ 2

- b) Find the capacity of each of cuts (a) and (b). Write your answers on the graph.

/ 2

- c) Make six more cuts through the graph and show the capacity of each.

/ 3

- d) Determine the maximum flow from X to Y.

/ 1

.....

- e) Which pipes could be considered for upgrade if the management wishes to improve flow from X to Y?

/ 1

.....

.....

Question 20 continues

**Question 20 continues**

**Marker use**

The management decides to improve the capacity of one pipe only. It chooses to upgrade the pipe joining D and E.

f) What would be the maximum worthwhile upgrade of this pipe?

**1**

.....  
.....

g) What would be the new maximum flow from X to Y?

**1**

.....  
.....

**Total Q20**

**11**

**Question 21**

Marker use

The Freycinet Challenge is an adventure multi-sport event which is held annually on Tasmania's East Coast. The event involves four sports: kayaking, trail running, road cycling and mountain biking. Teams of four can compete with each person taking on just one sport.

Anna, Bonnie, Claire and Danni have entered as a team and while training for the event, record their practice times for each sport.

	Practice time (min)			
	Kayak	Trail run	Road cycle	Mountain bike
Anna	55	80	62	70
Bonnie	60	82	58	65
Claire	62	85	60	71
Danni	70	91	65	75

- a) Represent the table as a matrix and use the Hungarian method to reduce it to a form where it is possible to allocate each girl to a sport in a way that minimises total time taken.

3







Spare diagram used (✓)

Question 21 continues



**Question 21 continued**

**Marker use**

b) Which competitor should be assigned to each sport if the total race time is to be minimised?

1

.....  
.....  
.....  
.....

c) What total time can the team expect using this assignment?

1

.....  
.....

d) A few days before the Freycinet Challenge Bonnie suffers a wrist injury and can only compete if she does either the trail run or the road cycle. She is confident that she will be able to maintain her practice times in these two events. Explain how you would rework this problem given the constraint that Bonnie must be assigned to either the trail run or the road cycle.

2

(There is no need for calculations – just explain the method that you would use.)

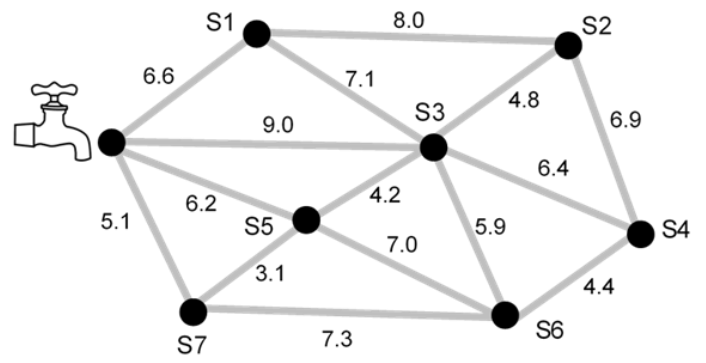
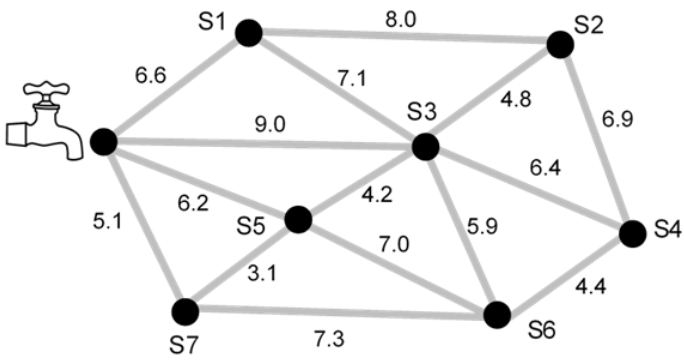
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**Total Q21**

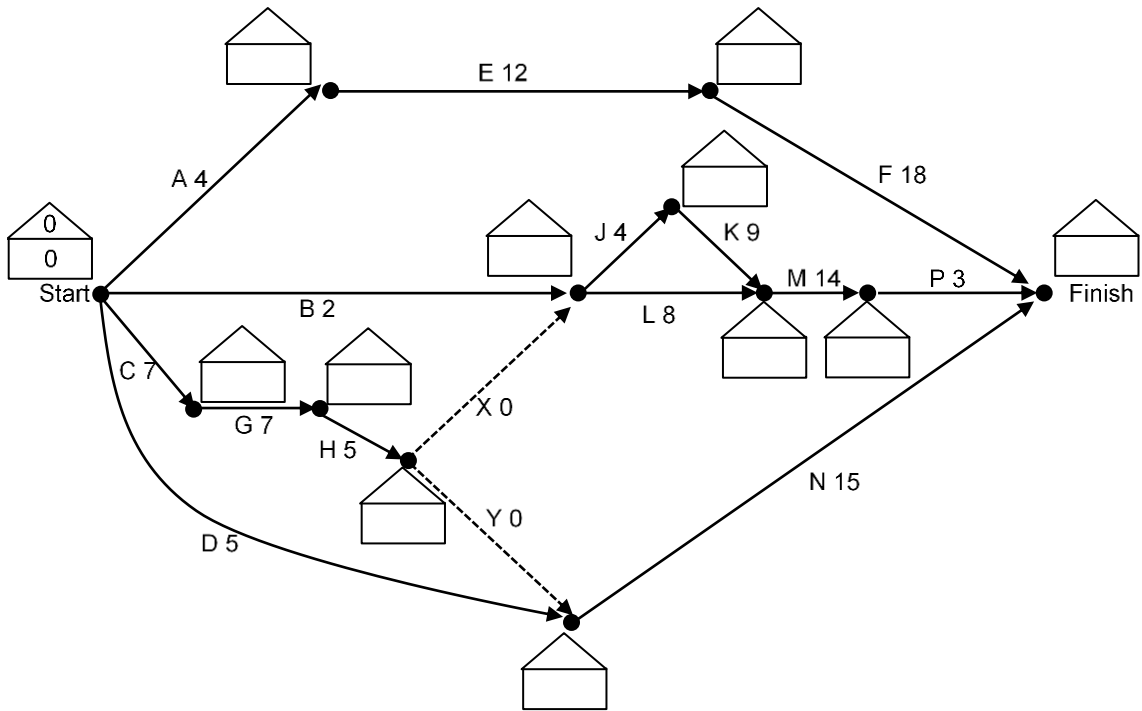
7

# Spare Diagrams

## Question 18

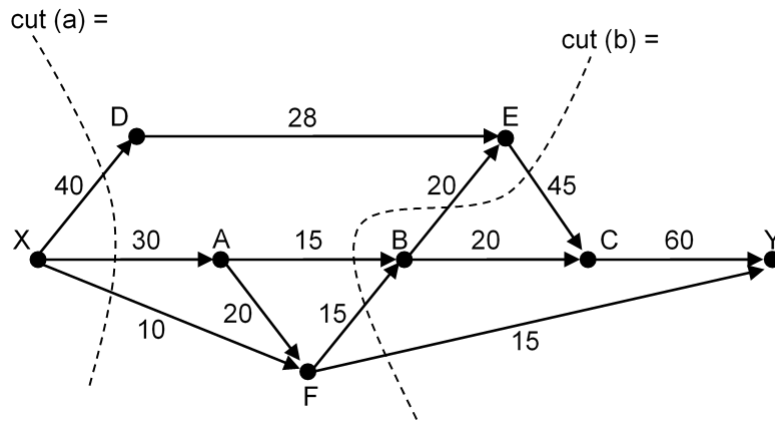


## Question 19



# Spare Diagrams

## Question 20



## Question 21







End of Part 5



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