General Mathematics SEE marking guide

External assessment 2022

SEE 1 (50 marks)

SEE 2 Paper 1 (57 marks)

SEE 2 Paper 2 (38 marks)

Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

1. select, recall and use facts, rules, definitions and procedures drawn from Unit 3 Topics 1, 2 and/or 3
2. comprehend mathematical concepts and techniques drawn from Unit 3 Topics 1, 2 and/or 3
3. communicate using mathematical, statistical and everyday language and conventions
4. evaluate the reasonableness of solutions
5. justify procedures and decisions by explaining mathematical reasoning
6. solve problems by applying mathematical concepts and techniques drawn from Unit 3 Topics 1, 2 and/or 3.

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

For all Queensland schools

Purpose

This marking guide:

- provides a tool for calibrating external assessment markers to ensure reliability of results
- indicates the correlation, for each question, between mark allocation and qualities at each level of the mark range
- informs schools and students about how marks are matched to qualities in student responses.

Mark allocation

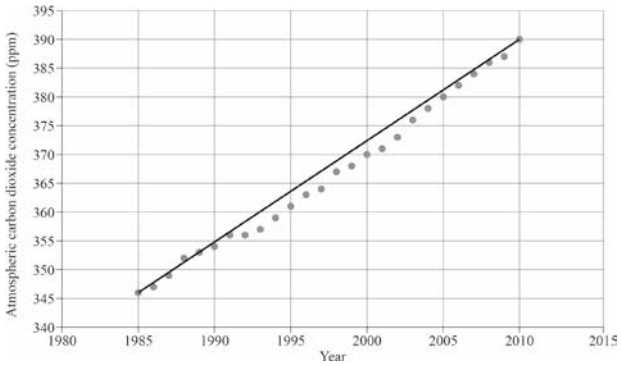
Where a response does not meet any of the descriptors for a question or a criterion, a mark of '0' will be recorded.

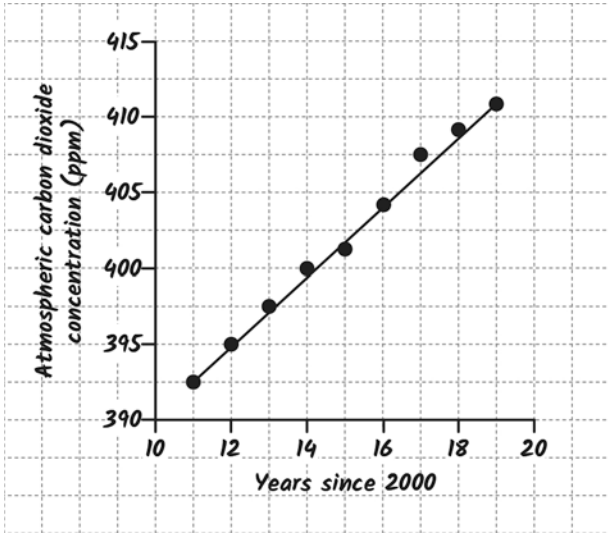
Allow FT mark/s — refers to 'follow through', where an error in the prior section of working is used later in the response, a mark (or marks) for the rest of the response can still be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

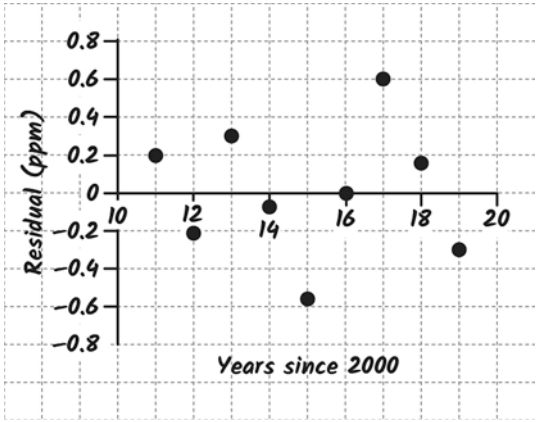
This mark may be implied by subsequent working — the full mathematical reasoning and/or working, as outlined in the sample response and associated mark, is not explicitly stated in the student response, but by virtue of subsequent working there is sufficient evidence to award the mark/s.

SEE 1 (50 marks)

Q	Sample response	The response:
1	For graph 1, the characteristics are: • cyclic/seasonal • irregular fluctuations.	• identifies a relevant characteristic of graph 1 **[1 mark]** • identifies another relevant characteristic of graph 1 **[1 mark]**
	For graph 2, the characteristics are: • a positive trend • no fluctuations/strong.	• identifies a relevant characteristic of graph 2 **[1 mark]** • identifies another relevant characteristic of graph 2 **[1 mark]**
	For graph 3, the characteristics are: • a positive trend • fluctuating.	• identifies a relevant characteristic of graph 3 **[1 mark]** • identifies another relevant characteristic of graph 3 **[1 mark]**

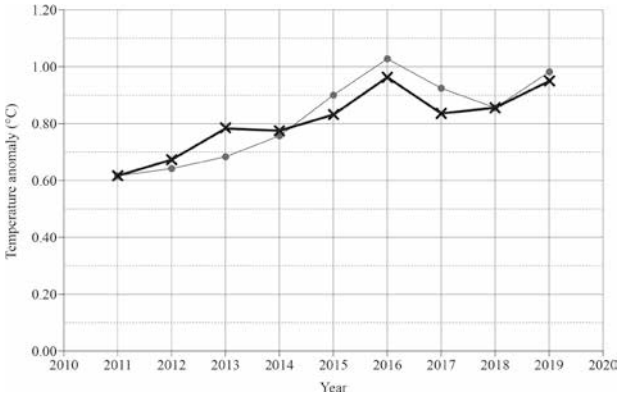
Q	Sample response	The response:
2a)	Calculating two points on the line: | Year | 1985 | 2010 | | Atmospheric carbon dioxide concentration (ppm) | 343.853 | 387.303 |  	• correctly calculates two points from the given equation **[1 mark]** • accurately plots both points on the scatterplot **[1 mark]** • joins the two points to form the least-squares regression line **[1 mark]**
2b)	99.3% of the atmospheric carbon dioxide concentration variation can be explained by the year variation.	• correctly identifies degree to which variation in atmospheric carbon dioxide concentration can be explained by year variation **[1 mark]**
2c)	$r = \sqrt{0.993}$ $r = 0.996493853$ The association between the variables is very strong and positive (with the latter justified by Question 2a)'s graph).	• correctly calculates correlation coefficient **[1 mark]** • describes the association in terms of direction and strength **[1 mark]**
2d)	$y = 1.738x - 3106.077$ $y = 1.738 \times 2050 - 3106.077$ $y = 456.823$ The atmospheric carbon dioxide concentration in 2050 is predicted to be approximately 457 ppm.	• correctly substitutes into supplied equation **[1 mark]** • correctly predicts atmospheric carbon dioxide concentration in 2050 **[1 mark]**

Q	Sample response	The response:
3a)	$y = 2.433x + 365.056$ Where y is the response variable: Atmospheric carbon dioxide concentration (ppm) Where x is the explanatory variable: Years since 2000. $r = 0.999$	• correctly provides equation to the least-squares regression line **[1 mark]** • defines the response variable **[1 mark]** • defines the explanatory variable **[1 mark]** • correctly provides correlation coefficient **[1 mark]**
3b)	Calculating two points on the line: Years since 2000: 11, 19 Atmospheric carbon dioxide concentration (ppm): 391.819, 411.283  	• correctly calculates two points from the equation determined in Question 3a) **[1 mark]** • accurately plots both calculated points **[1 mark]** • correctly plots data from Stimulus 2 **[1 mark]** • joins the two determined points to form the line of best fit **[1 mark]** • appropriately scales both axes **[1 mark]** • appropriately labels both axes **[1 mark]**

Q	Sample response	The response:
3c)	Table residuals Years since 2000 | Atmospheric carbon dioxide concentration (ppm) [A] | Modelled atmospheric carbon dioxide concentration (ppm) [M] | Residual (ppm) [A–M] 11 | 392 | 391.819 | 0.181 12 | 394 | 394.252 | -0.252 13 | 397 | 396.685 | 0.315 14 | 399 | 399.118 | -0.118 15 | 401 | 401.551 | -0.551 16 | 404 | 403.984 | 0.016 17 | 407 | 406.417 | 0.583 18 | 409 | 408.850 | 0.15 19 | 411 | 411.283 | -0.283	• correctly calculates all residuals **[1 mark]**
		• uses an appropriate scale for both axes of residual plot **[1 mark]** • appropriately labels both axes **[1 mark]** • accurately plots calculated residuals **[1 mark]**
	The residual plot is random, therefore the use of a linear model for the data is appropriate.	• validly interprets the residual plot to assess the appropriateness of fitting a linear model to the data **[1 mark]**

Q	Sample response	The response:
3d)	$y = 2.433x + 365.056$ $y = 2.433 \times 50 + 365.056$ $y = 486.706$ This model predicts an atmospheric carbon dioxide concentration of approximately 487 ppm.	• substitutes into the model from Question 3a) **[1 mark]** • accurately calculates predicted atmospheric carbon dioxide concentration for 2050 **[1 mark]**
3e)	The predicted atmospheric carbon dioxide concentration (ppm) for the 1985–2010 data is 456.823 and for the 2011–2019 data is 486.706. Both are significantly higher than the stimulus data, which is expected when using trends indicated by models and graphs, but 2011–2019 data model yields a significantly higher prediction. This could be due to CO_2 concentration increasing since 2011 at a faster rate than 1985–2010 on average (2.433 ppm/year versus 1.738 ppm/year), most likely indicating worsening global emmissions.	• provides a valid statement of comparison for the two predictions **[1 mark]** • appropriately documents the statement **[1 mark]**
4	Where x is the explanatory variable: Atmospheric carbon dioxide concentration (ppm) Where y is the response variable: Temperature anomaly (°C) The slope of the fitted line is positive, meaning that the temperature anomaly is increased with respect to atmospheric carbon dioxide concentration.	• defines the explanatory variable **[1 mark]** • defines the response variable **[1 mark]** • correctly identifies positive nature of the slope of the fitted line and that the response variable is increasing with respect to the explanatory variable **[1 mark]**

Q	Sample response	The response:
5	Let C = Atmospheric carbon dioxide concentration (ppm) Let Y = years since 2000 Let T = temperature anomaly (°C) $C = 2.433 \times Y + 365.056$ $C = 2.433 \times 50 + 365.056$ $C = 486.706$ $T = 0.019 \times C - 6.969$ $T = 0.019 \times 486.706 - 6.969$ $T = 2.278414$ Using the result from Question 3d) and the model from Question 4, the temperature anomaly in 2050 is predicted to be approximately 2.28 °C to two decimal places. This value is significantly larger than the data from the years 2011–2019.	• substitutes the concentration into the correct model **[1 mark]** • calculates the temperature anomaly in 2050 **[1 mark]** • provides relevant comment about the size of the temperature anomaly **[1 mark]**
6a)	$T = 0.011C + 0.051N - 3.602$ $T = 0.011 \times 392 + 0.051 \times -1.68 - 3.602$ $T = 0.62432$ Using the refined model, the temperature anomaly in 2011 is 0.62 °C to two decimal places.	• correctly substitutes into refined model **[1 mark]** • calculates the modelled temperature anomaly **[1 mark]**

<table>
<tr><th>Q</th><th>Sample response</th><th>The response:</th></tr>
<tr><td>6b)</td><td>
<table>
<tr><th>Years</th><th>Atmospheric carbon dioxide concentration (ppm) [A]</th><th>NINO3.4 index]</th><th>Modelled temperature anomaly (°C)</th></tr>
<tr><td>2012</td><td>394</td><td>–1.04</td><td>0.68</td></tr>
<tr><td>2013</td><td>397</td><td>0.23</td><td>0.78</td></tr>
<tr><td>2014</td><td>399</td><td>–0.21</td><td>0.78</td></tr>
<tr><td>2015</td><td>401</td><td>0.46</td><td>0.83</td></tr>
<tr><td>2016</td><td>404</td><td>2.40</td><td>0.96</td></tr>
<tr><td>2017</td><td>407</td><td>–0.73</td><td>0.84</td></tr>
<tr><td>2018</td><td>409</td><td>–0.69</td><td>0.86</td></tr>
<tr><td>2019</td><td>411</td><td>0.73</td><td>0.96</td></tr>
</table>
</td><td>• correctly calculates modelled temperature anomalies from 2012 to 2019 [1 mark]</td></tr>
<tr><td>6c)</td><td> 
</td><td>• plots the modelled temperature anomalies from 2011 to 2019 [1 mark]
• joins all modelled temperature anomalies [1 mark]</td></tr>
<tr><td>6d)</td><td>The refined model shows strong alignment between modelled and observed temperature anomalies from 2011 to 2019.
The general shape of each time series follows the same pattern and the gaps between temperature anomaly data for most years are relatively small across the dataset, demonstrating that the two time series observed and modelled are similar enough to suggest the model is reasonable.</td><td>• evaluates the reasonableness of the refined model [1 mark]
• provides evidence to support the evaluation [1 mark]</td></tr>
</table>

Q	Sample response	The response:
7	Neutral ENSO phase strength means that the NINO3.4 index is between –0.8 and 0.8.	• correctly identifies range of NINO3.4 values for neutral ENSO phase strength **[1 mark]**
	$T = 0.011 \times 540.5 + 0.051 \times -0.8 - 3.602 = 2.3027$	• substitutes into the model to calculate the lower temperature anomaly for neutral conditions **[1 mark]**
	$T = 0.011 \times 540.5 + 0.051 \times 0.8 - 3.602 = 2.3843$	• substitutes into the model to calculate the upper temperature anomaly for neutral conditions **[1 mark]**
	The model predicts that under neutral conditions, the range of temperature anomaly will be between 2.30 ºC and 2.38 ºC to two decimal places in the predicted worst-case scenario for atmospheric carbon dioxide concentration in 2050.	• states the range of temperature anomalies **[1 mark]**

Marking guide

Multiple choice
SEE 2 Paper 1 (57 marks)

Question	Response
1	B
2	C
3	A
4	D
5	B
6	C
7	C
8	A
9	B
10	D
11	D
12	C
13	D
14	A
15	A

Short response

Q	Sample response	The response:
16a)	$n = 42.6t + 55.4$	• correctly determines the equation of the least-squares line **[1 mark]**
16b)	Let $t = 21$ $n = 42.6(21) + 55.4$ $= 950$ The predicted number of sales is 950.	• substitutes into equation from Question 16a) **[1 mark]** • predicts number of sales **[1 mark]**

Q	Sample response	The response:
17a)	$r = 1 + \frac{i}{n}$ $1.00375 = 1 + \frac{i}{12}$ $0.00375 = \frac{i}{12}$ $i = 0.045$ Therefore, the annual interest rate is 4.5% p.a. compounding monthly.	• correctly substitutes into an appropriate rule **[1 mark]** • calculates annual interest rate **[1 mark]**
17b)	Method 1: Recursion $A_0 = 50\,000$ $A_1 = 50\,187.50$ $A_2 = 50\,375.70$ $A_3 = 50\,564.61$ $A_4 = 50\,754.23$ $A_5 = 50\,944.56$ $A_6 = 51\,135.60$ Therefore, the investment would exceed $51 000 at 6 months. Method 2: Compound interest rule $A = P(1 + i)^n$ $51\,000 = 50\,000 \times 1.00375^n$ Using trial and error: when $n = 5, A = 50\,944.56$ $n = 6, A = 51\,135.60$ Therefore, the investment will exceed $51 000 at 6 months.	• correctly uses an appropriate method **[1 mark]** • determines when the investment would exceed $51 000 **[1 mark]**

Q	Sample response	The response:
18	Arithmetic sequence $t_1 = 87$	• correctly determines t_1 **[1 mark]**
	$d = t_2 - t_1$ $= 209 - 87$ $= 122$	• correctly determines d **[1 mark]**
	$t_n = t_1 + (n-1)d$ $\therefore t_n = 87 + 122(n-1)$	• uses an arithmetic sequence **[1 mark]**
	At 25 weeks, $n = 25$ $t_{25} = 87 + 122 \times 24$ $t_{25} = 3015$	• predicts number of songs at 25 weeks **[1 mark]**

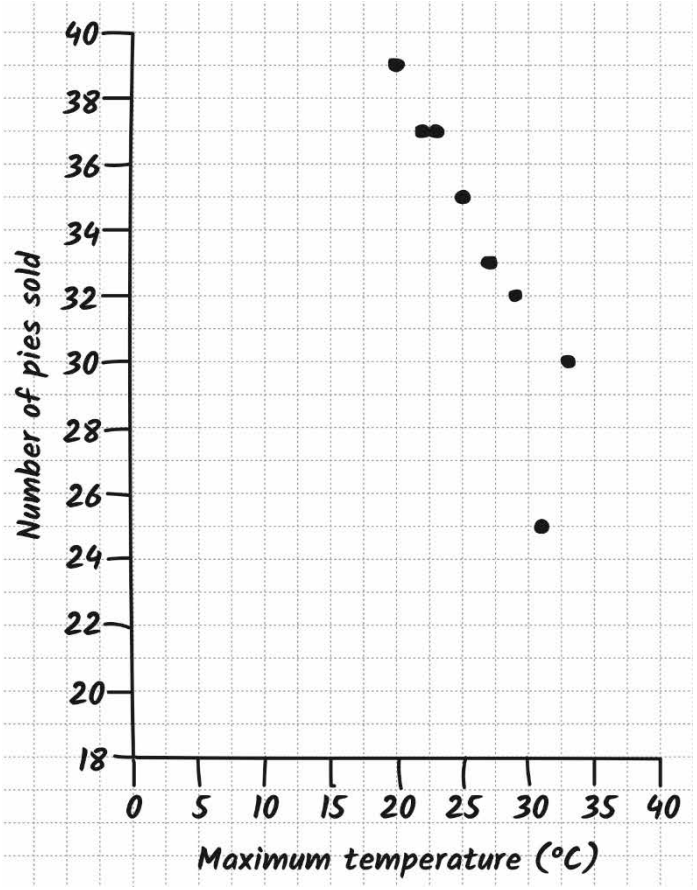
Q	Sample response	The response:
19a)	Trend — long term is positive because the amount of rainfall generally increases as time increases. Seasonality — The data is seasonal with a high 4th quarter every year.	• appropriately describes the long-term trend **[1 mark]** • appropriately describes the seasonality **[1 mark]**
19b)	y-intercept — The model predicts that 156.5 mm of rainfall was falling in the 4th quarter of 2015. Slope — On average an additional 1.763 mm of rainfall was precipitated each quarter.	• appropriately interprets the y-intercept **[1 mark]** • appropriately interprets the slope **[1 mark]**

Q	Sample response	The response:
20	Method 1 $\begin{matrix} & \text{A} & \text{B} & \text{C} & \text{Row reduction} \\ \text{Store 1} & 19 & 17 & 24 & -17 \\ \text{Store 2} & 15 & 14 & 22 & -14 \\ \text{Store 3} & 23 & 16 & 40 & -16 \end{matrix}$ $\begin{matrix} & \begin{bmatrix} 2 & 0 & 7 \\ 1 & 0 & 8 \\ 7 & 0 & 24 \end{bmatrix} \\ \text{Column reduction} & -1 \quad 0 \quad -7 \end{matrix}$ $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 6 & 0 & 17 \end{bmatrix}$ Therefore for minimum distance, Store 1 must deliver to C, Store 2 must deliver to A and Store 3 must deliver to B. Minimum total distance = 24 + 15 + 16 = 55 km Method 2 $\begin{matrix} & \text{A} & \text{B} & \text{C} \\ \text{Store 1} & 19 & 17 & 24 \\ \text{Store 2} & 15 & 14 & 22 \\ \text{Store 3} & 23 & 16 & 40 \\ \text{Column reduction} & -15 & -14 & -22 \end{matrix}$ $\begin{matrix} & & \text{Row reduction} \\ \begin{bmatrix} 4 & 3 & 2 \\ 0 & 0 & 0 \\ 8 & 2 & 18 \end{bmatrix} & & \begin{matrix} -2 \\ 0 \\ -2 \end{matrix} \end{matrix}$ $\begin{bmatrix} 2 & 1 & 0 \\ 0 & 0 & 0 \\ 6 & 0 & 16 \end{bmatrix}$ Therefore for minimum distance, Store 1 must deliver to C, Store 2 must deliver to A and Store 3 must deliver to B. Minimum total distance = 24 + 15 + 16 = 55 km	• correctly reduces each row **[1 mark]** • correctly reduces each column **[1 mark]** • identifies which store delivers to which location **[1 mark]** • determines minimum total distance **[1 mark]** • correctly reduces each column **[1 mark]** • correctly reduces each row **[1 mark]** • identifies which store delivers to which location **[1 mark]** • determines minimum total distance **[1 mark]**

Q	Sample response	The response:
21a)	RWPDR	• correctly identifies one cycle **[1 mark]**
21b)	The graph is semi-Eulerian because it has two odd degree vertices and the remaining vertices are even degree.	• correctly identifies the graph as semi-Eulerian **[1 mark]** • justifies the decision **[1 mark]**
21c)	$\begin{array}{c} \\ B \\ C \\ D \\ P \\ R \\ W \end{array} \begin{array}{c} \begin{array}{cccccc} B & C & D & P & R & W \end{array} \\ \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 2 & 1 & 1 \\ 0 & 1 & 2 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 2 \\ 1 & 1 & 1 & 1 & 2 & 0 \end{bmatrix} \end{array}$	• correctly constructs a valid adjacency matrix with same horizontal and vertical labels **[1 mark]** • correctly determines values in the adjacency matrix **[1 mark]**

Q	Sample response	The response:
22a)	Marovoay 16.1° S 46.6° E Iakora 23.1° S 46.6° E	• correctly determines the latitudes for both locations within ±0.2° **[1 mark]**
22b)	Angular distance = 23.1 – 16.1 = 7 Distance = 111.2 x angular distance = 111.2 x 7 = 778.4 Marovoay is approximately 778 km north of Iakora.	• determines angular distance **[1 mark]** • substitutes into appropriate distance formula **[1 mark]** • determines distance, including units **[1 mark]**

Q	Sample response	The response:
23a)	$m = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{40-20}{7-2}$ $= \frac{20}{5}$ $= 4$ $p - p_1 = m(n - n_1)$ $p - 20 = 4(n - 2)$ $p - 20 = 4n - 8$ $p = 4n + 12$	• correctly determines the slope **[1 mark]** • determines equation of least-squares line **[1 mark]**
23b)	$p = 4(15) + 12$ $p = 72$ A person with 15 years experience could expect an hourly pay of $72.	• substitutes into equation from Question 23a) **[1 mark]** • predicts hourly pay, including units **[1 mark]**

Q	Sample response	The response:
24a)		• correctly identifies the explanatory and response variables **[1 mark]** • accurately plots points **[1 mark]** • formats scatterplot with appropriate scaling and labelling of axes **[1 mark]**
24b)	The association is a strong, negative, linear relationship	• describes association as – strong **[1 mark]** – negative **[1 mark]**

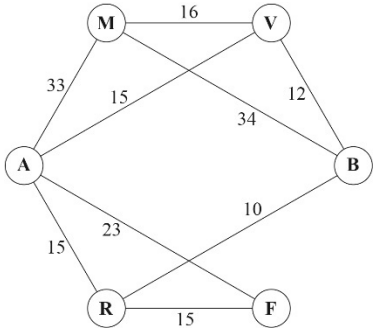
Q	Sample response	The response:
25a)	$i = \frac{2.4}{1200}$ $= 0.002$ $n = 15 \times 12$ $= 180$ $M = 993.14$ $A = M\left(\frac{1-(1+i)^{-n}}{i}\right)$ $= 993.14\left(\frac{1-(1+i)^{-180}}{i}\right)$ $= 150\,000.29$ They borrowed \$150 000.	• correctly determines the i, n and M values **[1 mark]** • substitutes into the appropriate annuity formula **[1 mark]** • determines amount of money borrowed, including units **[1 mark]**
25b)	$A_{n+1} = rA_n - R$ $A_{n+1} = \left(1 + \frac{2.4}{1200}\right)A_n - 993.14$ $A_{n+1} = 1.002A_n - 993.14$	• correctly uses the appropriate formula **[1 mark]** • determines recurrence relation **[1 mark]**

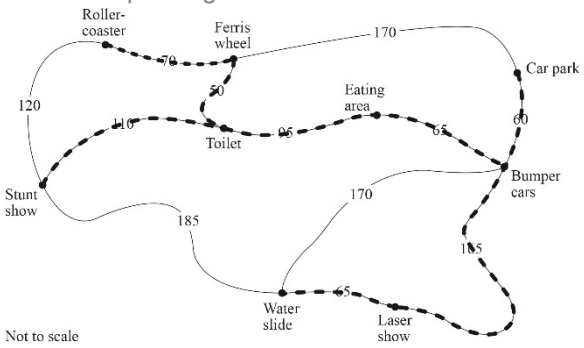
Short response
SEE 2 Paper 2 (38 marks)

Q	Sample response	The response:
1	Let $x =$ autumn's seasonal index Total of seasonal indices: $1.11 + 1.42 + 0.62 + x = 4$	• correctly identifies the sum of all the seasonal indices **[1 mark]**
	$\therefore x = 0.85$	• correctly determines autumn's seasonal index **[1 mark]**
	Actual value for autumn $\text{actual value} = \text{deseasonalised value} \times \text{seasonal index}$ $= 36.4 \times 0.85$ $= 30.94$	• uses an appropriate method for determining actual value **[1 mark]**
	In autumn they had actual sales of 30 940 swimsuits.	• determines actual sales for autumn **[1 mark]**

Q	Sample response	The response:
2	Monthly amount $A = M\left(\frac{(1+i)^n - 1}{i}\right)$ $51\,343.85 = M\left(\frac{\left(1+\frac{0.086}{12}\right)^{48} - 1}{\frac{0.086}{12}}\right)$ $51\,343.85 = M \times 57.0487$ $\therefore M = 900$ Fortnightly annuity balance $A = M\left(\frac{(1+i)^n - 1}{i}\right)$ $A = 450\left(\frac{\left(1+\frac{0.079}{26}\right)^{104} - 1}{\frac{0.079}{26}}\right)$ $= 54\,941.61$ $\text{Diff} = 54\,941.61 - 51\,343.85$ $= 3597.76$ The advice that she would have been at least \$3000 better off is reasonable as \$3597.76 > \$3000.	• correctly substitutes parameters into the appropriate annuity rule **[1 mark]** • correctly determines the monthly amount **[1 mark]** • determines value of fortnightly annuity **[1 mark]** • determines difference in annuity balances **[1 mark]** • compares values to evaluate the reasonableness of the advice **[1 mark]**

Q	Sample response	The response:
3	x parameters x = 1, 2, …, 10 $\bar{x} = 5.5$ $s_x = 3.02765$ Given $\bar{y} = 9660$ $s_y = 3010$ $r = 0.9987$ Least-squares line parameters $b = r\frac{s_y}{s_x}$ $= 0.9987 \times \frac{3010}{3.02765}$ $= 992.878$ $a = \bar{y} - b\bar{x}$ $= 9660 - 992.878 \times 5.5$ $= 4199.17$ Profit in the 11th year $y = a + bx$ $= 4199.17 + 992.878(11)$ $= 15\ 120.83$ $= \$15\ 121$ Predicted profit in the 11th year is \$15 121.	• correctly determines $\bar{x}$ and s_x **[1 mark]** • determines b **[1 mark]** • determines a **[1 mark]** • determines 11th year profit to the nearest dollar **[1 mark]** • shows logical organisation communicating key steps **[1 mark]**

Q	Sample response	The response:
4	Network diagram  Shortest path = M-V-B-R-F	• correctly represents the connected towns as a network **[1 mark]** • correctly includes lengths on the network **[1 mark]** • determines shortest current path **[1 mark]**
	= 16+12+10+15 = 53	• identifies length of shortest path **[1 mark]**
	New road length = 53 – 4 = 49 The new road will be 49 km long.	• determines new road length **[1 mark]**

Q	Sample response	The response:
5	Minimum spanning tree  Total length of removed paths $= 120 + 185 + 170 + 170$ $= 645$ Annual savings $= 645 \times 214$ $= 138\,030$ ∴ The manager is correct and they will save more than \$138 000 if they remove the unnecessary paths to all nine key locations.	• correctly identifies minimum spanning tree **[1 mark]** • correctly calculates total length of the removed paths **[1 mark]** • calculates annual savings **[1 mark]** • compares values to evaluate the reasonableness of the belief **[1 mark]** • shows logical organisation communicating key steps **[1 mark]**

Q	Sample response	The response:
6	Slope sequence $-0.8, 0.4, -0.2, \ldots$ This forms a geometric sequence with $t_1 = -0.8$ and $r = -0.5$. $\therefore t_n = -0.8 \times (-0.5)^{(n-1)}$ y-intercept sequence 1.2, 2.7, 4.2, … This forms an arithmetic sequence with $t_1 = 1.2$ and $d = 1.5$. $\therefore t_n = 1.2 + (n-1) \times 1.5$ The equation for Line 5 $m = -0.8 \times (-0.5)^4$ $= -0.05$ $c = 1.2 + 4 \times 1.5$ $= 7.2$ $\therefore y_5 = -0.05x + 7.2$ Solve simultaneously $y_1 = y_5$ $\therefore -0.8x + 1.2 = -0.05x + 7.2$ $\therefore -0.75x = 6$ $\therefore x = -8$ sub into y_1 $\therefore y = -0.8(-8) + 1.2$ $\therefore y = 7.6$ The intersection point is $(-8, 7.6)$.	• correctly determines the geometric sequence parameters for the slopes **[1 mark]** • correctly determines the arithmetic sequence parameters for the y-intercepts **[1 mark]** • determines slope for Line 5 **[1 mark]** • determines y-intercept for Line 5 **[1 mark]** • determines x-coordinate of intersection point **[1 mark]** • determines y-coordinate of intersection point **[1 mark]** • shows logical organisation communicating key steps **[1 mark]**

Q	Sample response	The response:
7	Ship's travel time from X to Tarawa $\text{speed} = \frac{\text{distance}}{\text{time}}$ $50 = \frac{1350}{\text{time}}$ $\therefore \text{time} = 27 \text{ hours}$ Ship's travel time is 27 hours. Time difference between Tarawa (GMT +12) and X (GMT –12) +12 – (–12) = 24 hours ∴Tarawa is 24 hours ahead of X. Time difference between Queensland (GMT +10) and Tarawa (GMT +12) +10 – (+12) = -2 hours ∴ Queensland is 2 hours behind Tarawa. Tarawa time at time of message = 6:12 am Wednesday + 24 hours = 6:12 am Thursday Tarawa time when ship arrives in Tarawa = 6:12 am Thursday + 27 hours = 9:12 am Friday Queensland time when ship arrives in Tarawa = 9:12 am Friday – 2 hours = 7:12 am Friday	• correctly substitutes into an appropriate rule **[1 mark]** • correctly calculates ship's travel time of 27 hours **[1 mark]** • correctly determines the time difference between Tarawa and X **[1 mark]** • correctly determines the time difference between Queensland and Tarawa **[1 mark]** • appropriately applies ship's travel time and both time differences to 6:12 am Wednesday **[1 mark]** • determines time and day in Queensland at time of ship's arrival in Tarawa **[1 mark]** • shows logical organisation, communicating key steps **[1 mark]**