TRINITY ✠ COLLEGE

Year 12 Mathematics Application
Test 4   2022

Section 1   Calculator Assumed
Time Series Data

STUDENT'S NAME   _____

DATE: Friday 24th June   **TIME:** 35 minutes   **MARKS**: 39

INSTRUCTIONS:

Standard Items: Pens, pencils, drawing templates, eraser, approved Formula sheet
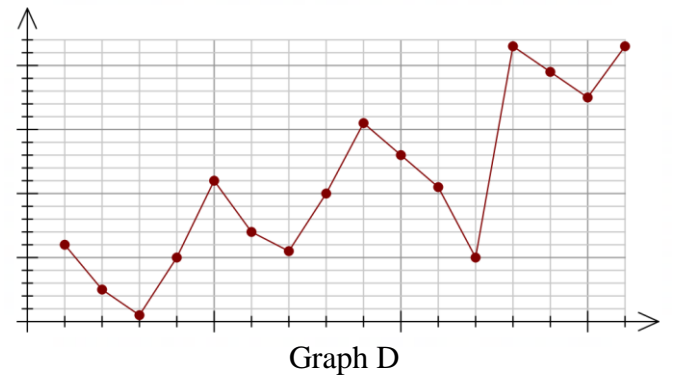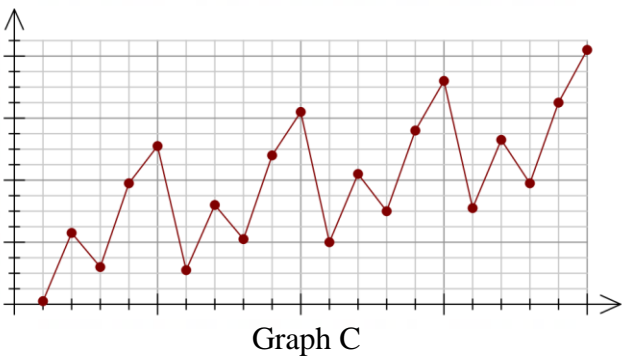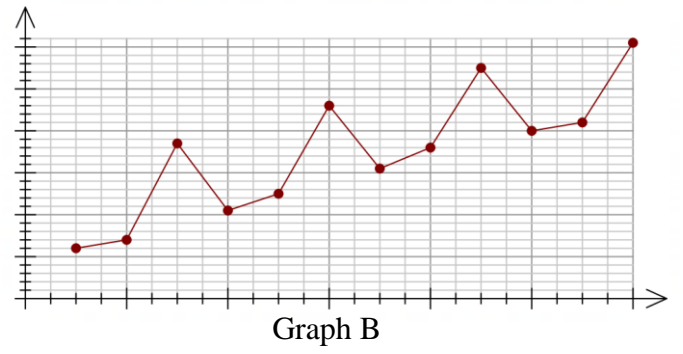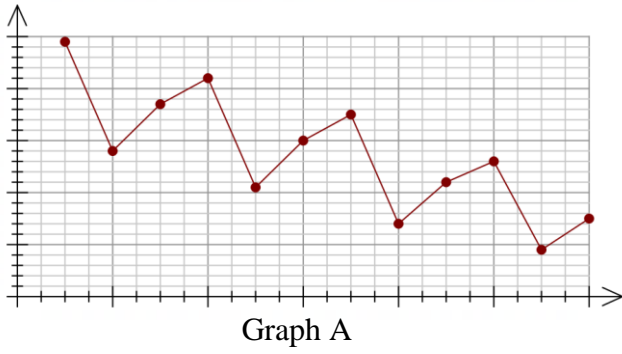
Special Items: Three calculators, notes on one side of a single A4 page (these notes are to be handed in with this assessment)

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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1.   (4 marks)

Graph A

Graph B

Graph C

Graph D

Consider the time series plots above. State, with justification, whether the following statements are true or false.

(a)   Graph A has a long-term decreasing trend.   [1]

(b)   It is appropriate to use a 3-point moving average to smooth the data in graph B.   [1]

(c)   Graph C has a 4 point cycle.   [1]

(d)   Graph D contains an unusual fluctuation.   [1]

2. (8 marks)

The table below shows the quarterly sales figures for the number of hammers sold at Hampson Hardware over a three-year time period.

	1st quarter	2nd quarter	3rd quarter	4th quarter
2019	53	23	45	79
2020	67	30	51	86
2021	72	35	59	94

(a) Calculate the cycle mean for 2019. [1]

(b) Calculate the 4 point centred moving average for the 2nd quarter of 2020. [2]

(c) The following table shows the seasonal indices over the three years. Calculate the seasonal index for the 4th quarter. [1]

|	1st quarter	2nd quarter	3rd quarter	4th quarter
Seasonal Index	110.4%	50.4%	89.3%	

(d) What does the seasonal index for the 3rd quarter indicate? [2]

(e) If 85 hammers are sold during the 2022 1st quarter, estimate the annual sales of hammers for 2022. [2]

3.   (13 marks)

The number of visitors at Portaro Playworld on each day for the first five full weeks are shown in the graph below.

Number of Visitors (in 1000's)
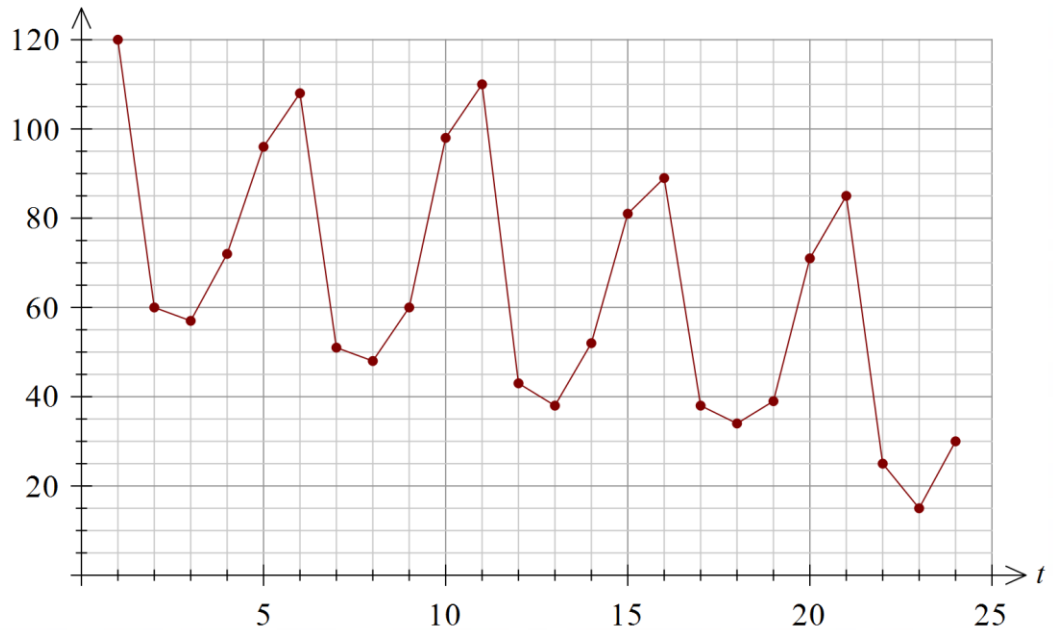
(a)   Describe the trend for this data.   [1]

Portaro Playworld is closed on Mondays and Tuesdays. For the graph above, $t = 1$ represents Sunday of Week 1 and $t = 6$ represents Sunday of Week 2, etc.

(b)   The 5 point moving average for Thursday of Week 5 ($t = 23$) is 45. Calculate the actual number of visitors for Saturday of Week 5 ($t = 25$).   [2]

The table below shows the seasonal effect for all Fridays.

Week 1	Week 2	Week 3	Week 4	Week 5
88.9%	82.2%	80.2%	72.0%	66.7%

(c) Determine the seasonal index for Fridays. [1]

The least-squares regression line for the above data, based on the deseasonalised data, is $D = -2.076t + 91.126$, where D is the number of visitors (in 1000s) and t is the days of the weeks (with $t = 1$ being Sunday of Week 1)

(d) Plot this line on the graph above. [2]

(e) Predict the number of visitors for Friday of Week 6 using the least-squares regression line. [3]

(f) The number of visitors on Saturdays are generally 33% above average.

Mr Portaro, the owner of Portaro Playworld, decides that if the predicted number of visitors falls below 20 000 by Saturday of Week 7, that he will shut the business down. Decide, with justification, whether he will shut Portaro Playworld down. [4]

4. (14 marks)

The table below shows the number of turkeys sold at Deli De Santis recorded quarterly over a four-year time period.

Year	Quarter	Time (t)	Number of Turkeys sold	4pt CMA	Cycle Mean	Seasonal Effect	Deseasonalised Data
2010	Quarter 1	1	310			66.9%	415.9
	Quarter 2	2	381		463.25	c	452.0
	Quarter 3	3	203	474.5		43.8%	373.3
	Quarter 4	4	959	495.9		207.0%	513.4
2011	Quarter 1	5	400	b		72.7%	536.6
	Quarter 2	6	462	538.5	550.00	84.0%	548.1
	Quarter 3	7	287	560.9		52.2%	527.7
	Quarter 4	8	1051	582.0		191.1%	562.7
2012	Quarter 1	9	487	602.8		76.6%	653.4
	Quarter 2	10	544	624.4	635.50	85.6%	645.4
	Quarter 3	11	a	649.0		58.4%	682.2
	Quarter 4	12	1140	672.0		179.4%	610.3
2013	Quarter 1	13	595	692.5		81.9%	798.4
	Quarter 2	14	620	715.1	726.75	85.3%	735.6
	Quarter 3	15	459			63.2%	844.0
	Quarter 4	16	1233			169.7%	660.1

(a) Determine the values of a, b and c in the table above. [3]

(b) Comment on the underlying trend of the turkey sales. [1]

(c)   Plot the missing points for the year 2013 onto the graph using the values from the given table. [2]

Number of Turkeys Sold
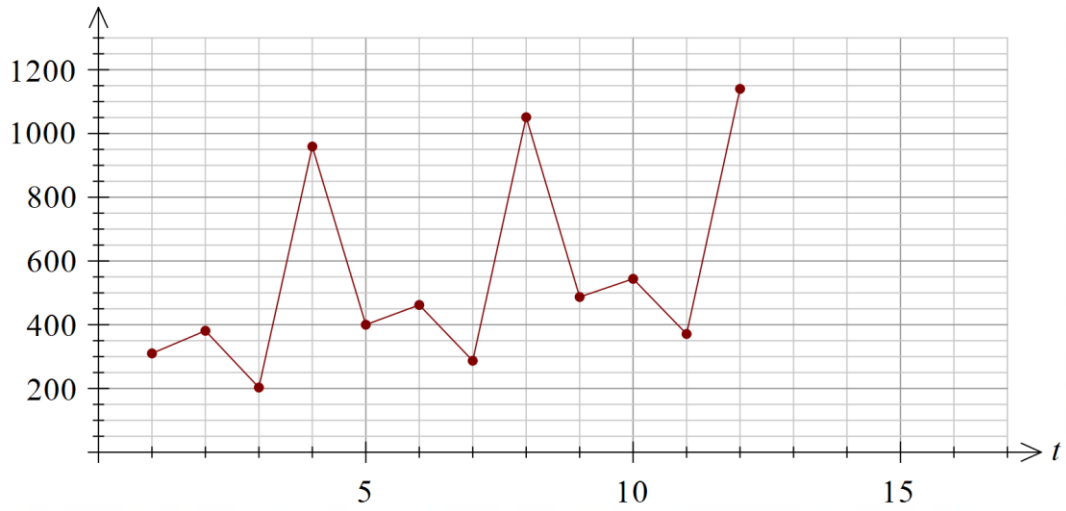
(d)   Calculate the seasonal index for the 1st quarter. [2]

(e)   Show how the deseasonalised value for the 1st quarter of 2013 is calculated. [1]

(f)   Determine the least squares line using the seasonally adjusted figures. [2]

(g)   Using your line from part (e), estimate the number of turkeys that will be sold the 1st quarter of 2014. [3]