TRINITY COLLEGE

YEAR 12
MATHEMATICS
APPLICATIONS

Test 1, 2023
Section One: Calculator Free
Bivariate Data and Sequences

STUDENT'S NAME: _____

DATE: Monday 13 March **TIME:** 15 minutes **MARKS**: 15
ASSESSMENT %: 10

INSTRUCTIONS:
Standard Items: Pens, pencils, drawing templates, eraser, formula sheet
Special Items:

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

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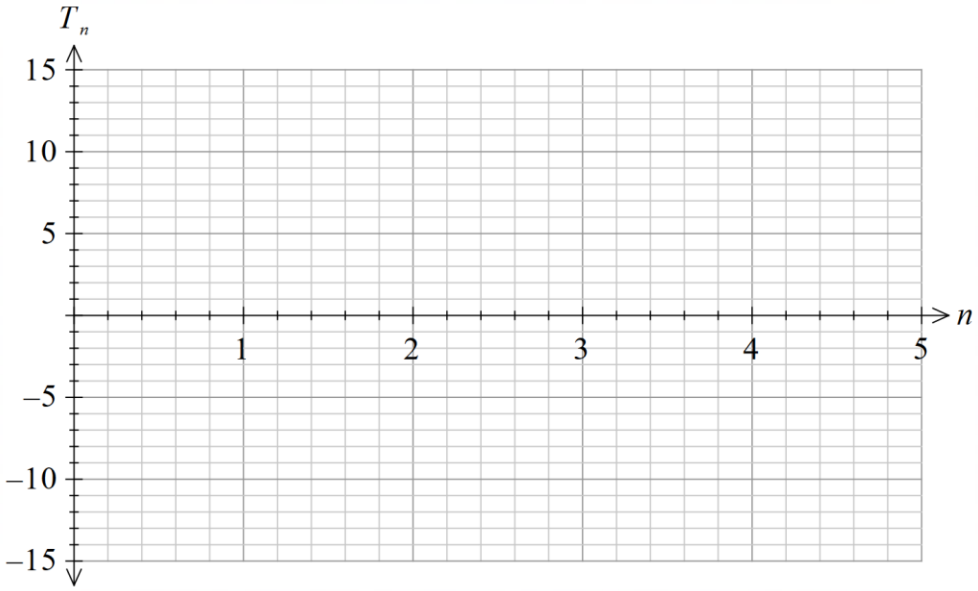
Question 1 **(7 marks)**

At 6 am, an object at room temperature is placed into a cooling vat. Its temperature, in degrees Celsius, recorded each minute is given by the following recursive rule:

$$T_n = T_{n-1} - 5$$
$$T_3 = -2$$

(a) Display the first five terms of the sequence on the axes below. (2 marks)



(b) (i) Write a rule for the nth term of the sequence in the form $T_n = A + Bn$, which will model this situation where T_n is the temperature of the object after n minutes. (2 marks)

(ii) Hence, determine when the temperature first falls below -75 degrees Celsius. (3 marks)

Question 2 **(8 marks)**

An opinion poll was conducted on the statement 'Trinity College has a litter problem', with partial results being shown in the table below.

		Opinion			
		Agree	Disagree	Undecided	Total
Age	Year 7&8	11	21	18	50
	Year 9&10			18	36
	Year 11&12		16	4	40
	Total	40			126

(a) Complete the table above. (2 marks)

(b) Identify the response variable. (1 mark)

(c) Use the template below to construct a percentage two-way frequency table showing either column or row percentages as appropriate, to investigate if there is an association between age and opinion. (3 marks)

		Opinion			
		Agree	Disagree	Undecided	
Age	Year 7&8				
	Year 9&10				
	Year 11&12				

(d) State an association that can be observed from the percentage two-way frequency table. (2 marks)

END OF QUESTIONS

TRINITY COLLEGE

YEAR 12
MATHEMATICS
APPLICATIONS

Test 1, 2023
Section Two: Calculator Allowed
Bivariate Data and Sequences

STUDENT'S NAME: _____

DATE: Monday 13 March **TIME:** 35 minutes **MARKS**: 35
ASSESSMENT %: 10

INSTRUCTIONS:
Standard Items: Pens, pencils, drawing templates, eraser, formula sheet
Special Items: 1 A4 page notes, Classpad, Scientific Calculator

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

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Question 3 **(9 marks)**

Mr Presser noticed there was a growing number of seagulls at Trinity College during 2023. Mr Presser first started counting seagulls on Monday 13 February, where he counted 100 seagulls, and on Thursday 16 February he counted 119 seagulls. Mr Presser assumes that the number of seagulls is growing exponentially each day at a rate of 6%. Note that 2023 is not a leap year.

(a) Describe what type of sequence this follows. (1 mark)

(b) Show how the ratio of 1.06 is calculated. (1 mark)

(b) Using the ratio of 1.06,

(i) determine a recursive formula for the number of seagulls at Trinity College. (2 marks)

(ii) determine the number of seagulls at Trinity College on February 23. (2 marks)

The College Leadership team initiates a plan to reduce the number of seagulls at Trinity College. They install bird deterrent devices around the campus on February 23. This has seen the number of seagulls at Trinity College decrease by 4% each day.

(d) Calculate the date when the seagull numbers first return to their initial number of 100.

(3 marks)

Question 4 **(15 marks)**

Western Australia uses approximately 6 million hectares of land to grow wheat crops each year. The quality of the soil varies, and fertiliser is used to boost the nitrogen level in the soil to promote growth in wheat crops. The amount of fertiliser applied and the yield of wheat for a sample of data is given in the table below. Note that 1 tonne is 1000 kg.

Fertiliser in kg per hectare (f)	39	40	43	25	55	44	35	42
Yield in tonnes per hectare (y)	2.7	3.1	3.0	2.5	3.1	3.3	2.7	2.9

(a) Identify the explanatory variable. (1 mark)

The least-squares regression line is given by $\hat{y} = 0.0239f + 1.9459$

(b) Interpret the gradient of the least-squares regression line in the context of the question. (2 marks)

(c) Calculate the coefficient of determination and interpret its meaning in the context of the question. (2 marks)

(d) Comment of the association between yield and fertiliser in terms of strength and direction. (2 marks)

(e) A farmer makes the following statement: "*I can see that higher fertiliser rates cause a higher yield*". Comment on the validity of the statement. (2 marks)

(f) A farmer is planting 1200 hectares of wheat and uses 60 tonnes of fertiliser.

(i) Using the least-squares regression line, calculate the expected total yield of wheat. (3 marks)

(ii) Comment on the validity of the prediction in part (f)(i). Justify your response. (2 marks)

(f) Provide a non-causal explanation for the association between yield and fertiliser. (1 mark)

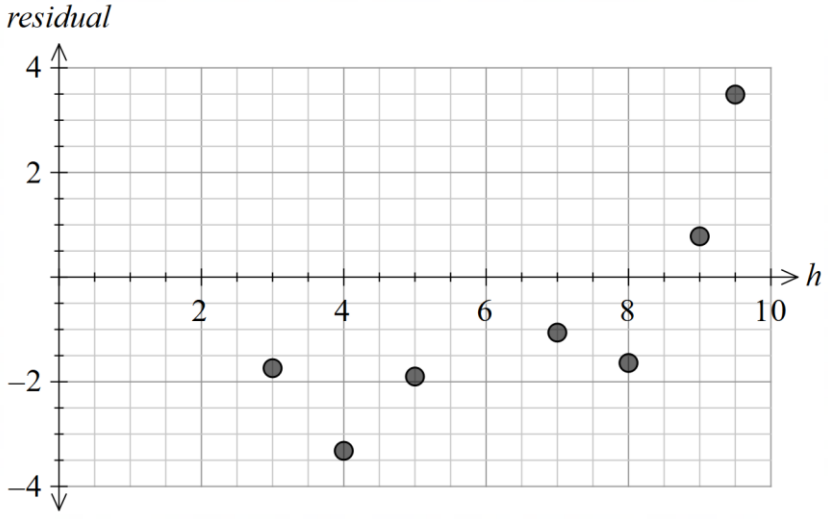
Question 5 **(11 marks)**

A sports scientist is interested in the number of hours people exercise per week and their body weight. They sample ten people and calculate the coefficient of determination between the two variables as 0.9405. Unfortunately, the sports scientist who was collecting the data accidentally spilled their coffee on the table of data, causing some of the data to be illegible.

Exercise per week in hours (h)	1	2	2			7	8	9	9.5
Body weight in kilograms (w)	***A***	99				77	73	72	73
$\hat{w}$	98.58	95.16	***B***				74.64	71.22	69.51
residual	3.42	3.84	-2.16		-1.9	-1.06	-1.64	0.78	***C***

(a) Determine the missing values, ***A***, ***B*** and ***C*** in the table above. (3 marks)

(b) Plot the first three residuals on the graph below to complete the residual plot. (2 marks)



(c) Justify, using the residual plot in part (b), whether the least-squares regression line is a good model for this data. (2 marks)

(d) Determine the correlation coefficient. (2 marks)

(e) Determine the equation of the least-squares regression line. (2 marks)

END OF QUESTIONS