TRINITY COLLEGE

Year 12 Mathematics Applications
Test 1 2019

Section 1 Calculator Free

Bivariate Data

STUDENT'S NAME Solutions

DATE: Wednesday 27 February **TIME:** 20 minutes **MARKS**: 21

INSTRUCTIONS:

Standard Items: Pens, pencils, drawing templates, eraser

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

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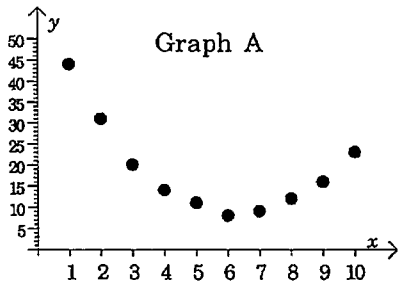
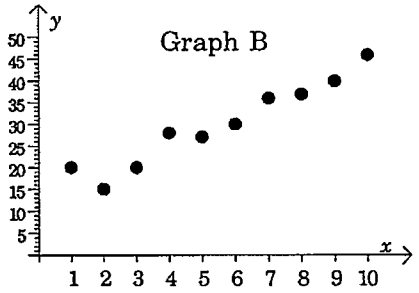
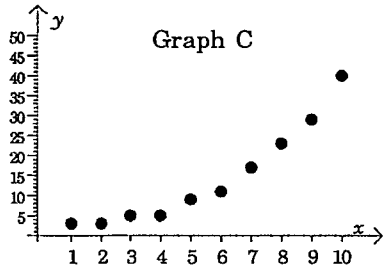
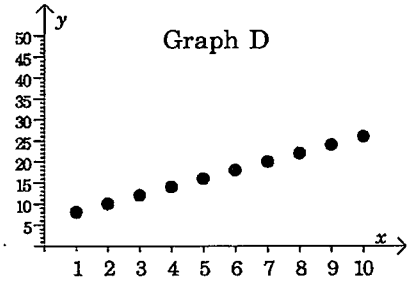
1. (3 marks)

Consider the following graphs:









(a) Which graph has a correlation closest to 0.9? [1]

Graph B

(b) Which graph(s) has a negative correlation? [1]

Graph A

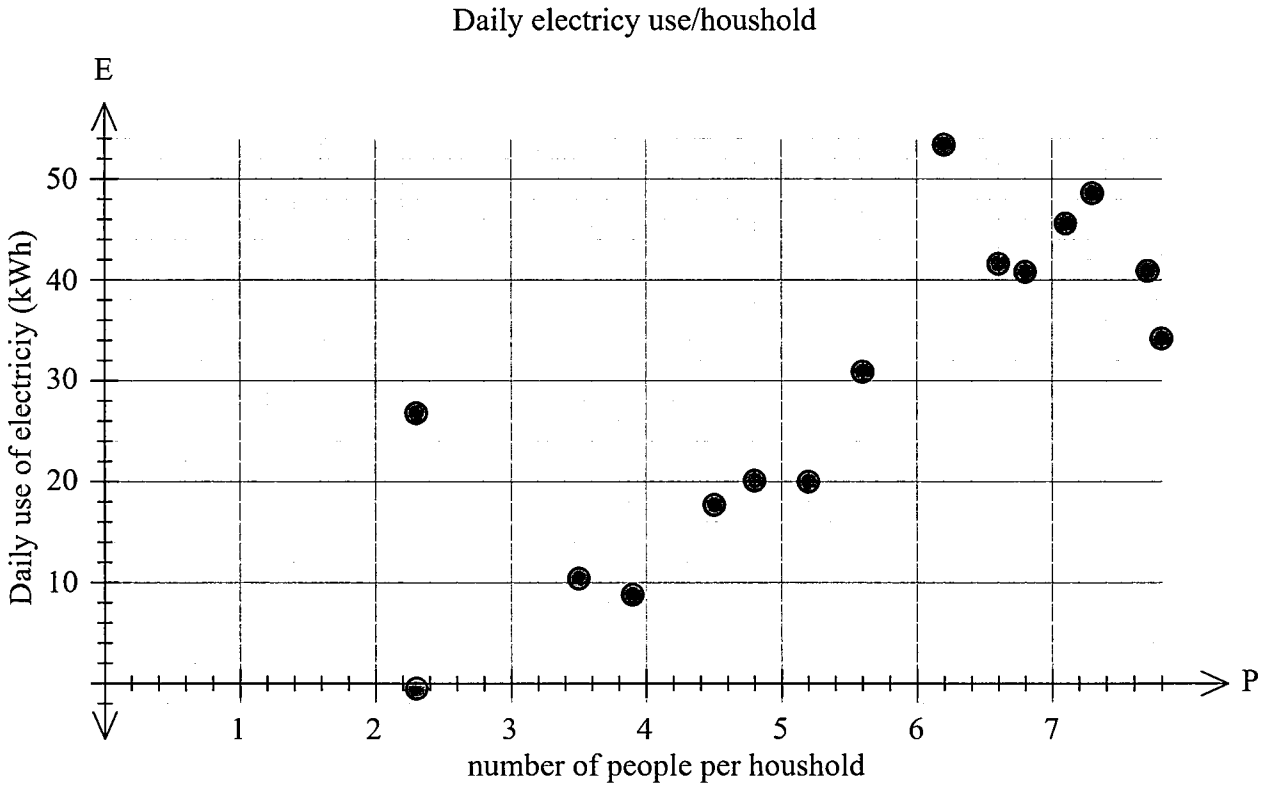
(c) Which graph(s) are suitable for linear regression? [1]

Graph B & Graph D

2. (9 marks)

The Western Australian Government wanted to determine whether the number of people/household, P, affected the amount of electricity (E kwh/day) used.

The graph below illustrates the data recorded for 15 households within the metropolitan area.



(a) Describe the association between the number of people/household, P, and the daily amount of electricity used, E, in terms of strength and form. [2]

Strong, positive linear association

(b) It was found that approximately 64% of the variation in daily electricity use, E, could be explained by the variation in the number of people/household. Determine the correlation coefficient (r_{PE}) [1]

$r_{PE} = \sqrt{0.64}$ ✓

$= 0.8$

(c) The equation of the least-squares regression line for the graph showing daily electricity use per people/household is

$$E = 7P - 9$$

(i) Interpret the slope of this line. [2]

For every one increase in the number of people per household, daily electricity use increases by 7 kwh

(ii) Predict the daily amount of electricity used for a household with 10 people. Comment on the likelihood of this being a valid prediction and justify your answer. [3]

$E = 7(10) - 9$

$= 61$ kwh / day

Not a valid prediction due to extrapolation

(d) The Western Australian Government argued that increasing the number of people/household causes the daily amount of electricity used to increase. Provide a non-causal explanation for the association between these two variables. [1]

Any reason that does not use more people.

eg Larger households have more lights

more heaters etc.

3. (9 marks)

100 school students were asked the following question 'Does completing homework lead to an improved examination result?'

The results are summarised below:

	Agree	Disagree	Undecided	Total
Year 7	6	4	0	10
Year 8	20	10	10	40
Year 9	35	9	6	50

(a) Complete the missing entries in the table above. [3]

(b) State the explanatory variable for this data. [1]

Year Group

(c) Complete the table below that shows percentages. [3]

	Percentages		
	Agree	Disagree	Undecided
Year 7	60%	40%	0%
Year 8	50%	25%	25%
Year 9	70%	18%	12%

(d) Use the data to determine one association between the variables. Describe the association and explain your reasoning. [2]

As year level increases, the percentage of people who disagree with the statement decreases

TRINITY COLLEGE

Year 12 Mathematics Applications
Test 1 2019

Section 2 Calculator Assumed

Bivariate Data

STUDENT'S NAME _____

DATE: Wednesday 27 February **TIME:** 30 minutes **MARKS**: 29

INSTRUCTIONS:

Standard Items:	Pens, pencils, drawing templates, eraser
Special Items:	Three calculators, notes on one side of a single A4 page (these notes 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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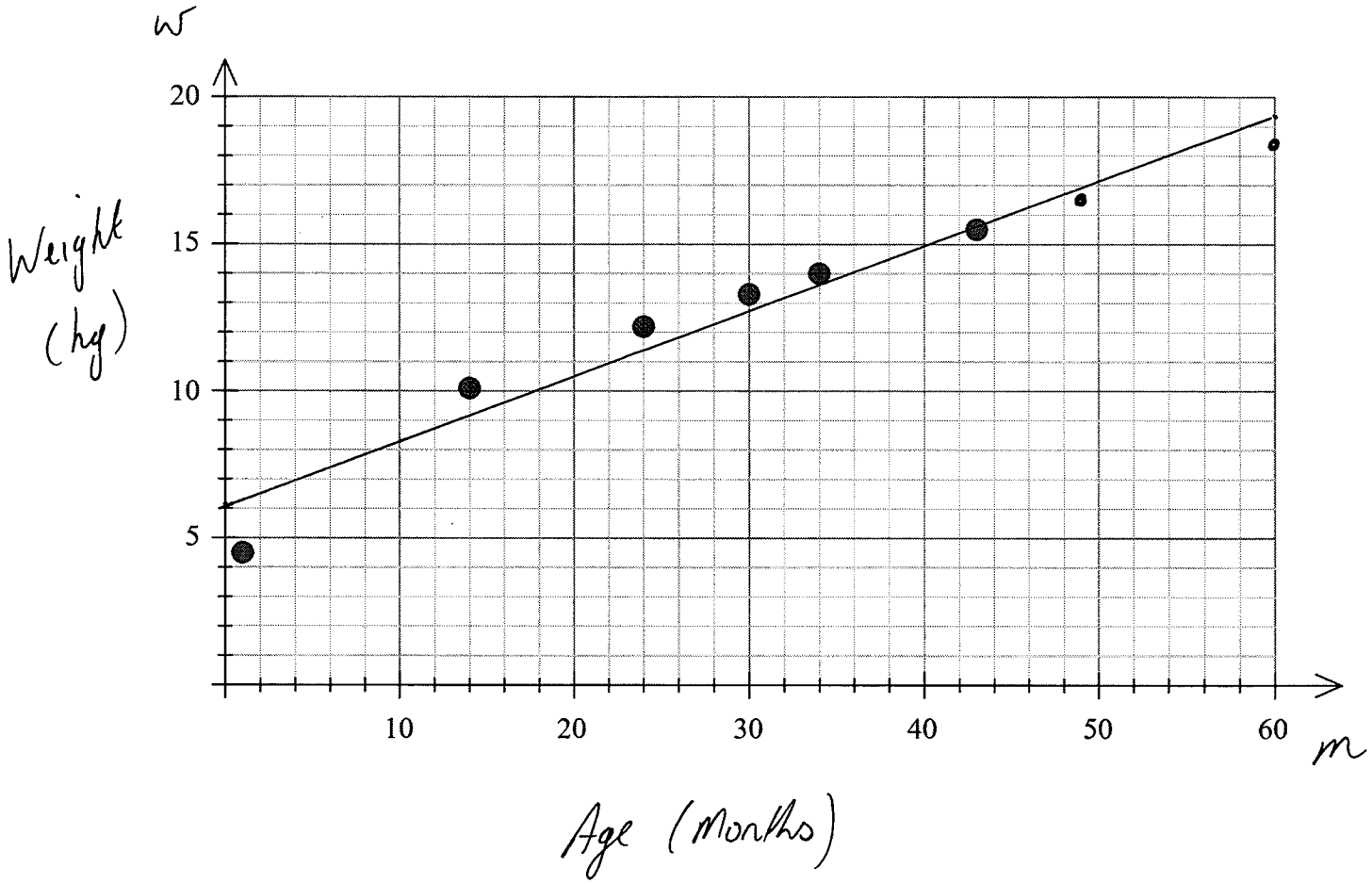
4. (12 marks)

The World Health Organisation produces tables showing Child Growth Standards. The median weight (kg) for boys at various times during the first five years of life are shown below:

Age (months) (m)	1	14	24	30	34	43	49	60
Median weight (kg) (w)	4.5	10.1	12.2	13.3	14.0	15.5	16.5	18.3

(a) Complete the scatter plot below by plotting the last two data points and labelling the horizontal axis and the vertical axis clearly. [2]



(b) Calculate the correlation coefficient for the data and interpret your result. [2]

$r_{mw} = 0.97$

Strong positive linear relationship

(c) (i) Determine the equation for the least-squares regression line that models this data. Answer to one decimal place. [2]

$\hat{w} = 0.22m + 6.07$

(ii) Draw this line on the scatter plot in part (a) clearly showing the points used. [2]

(iii) What increase in median weight can be expected for each additional year? [1]

gradient $= 0.22$ kg/m

$\therefore$ in a year expect $0.22 \times 12 = 2.64$ kg/y

(d) At 40 months, the residual value is -2.1 . Determine the value of the original data point for median weight at 40 months. [3]

$\hat{w} = 0.22(40) + 6.07$

$= 14.83$

resid $= w - \hat{w}$

$-2.1 = w - 14.83$

$\therefore w = 12.73$

$\therefore$ original data point ≈ 12.7 kg

5. (7 marks)

Australian Consumption of Electricity by State/Territory

		2012-13	2013-14	2014-15	Total
New South Wales	GWh	74600	72400	73600	220600
	% of GWh	33.8%	32.8%	33.4%	100%
Victoria	GWh	51100	49700	**A**	150800
	% of GWh	**B**	33%	33.2%	100%
Queensland	GWh	59200	58100	60500	177800
	% of GWh	33.3%	32.7%	34%	100%
Western Australia	GWh	33600	36700	37600	107900
	% of GWh	31.1%	34%	34.8%	100%
South Australia	GWh	16000	16000	15700	47700
	% of GWh	33.5%	33.5%	32.9%	100%
Tasmania	GWh	11900	11900	11900	35700
	% of GWh	33.3%	33.3%	33.3%	100%
Northern Territory	GWh	3400	3500	3000	9900
	% of GWh	34.3%	35.4%	30.3%	100%
Australia	GWh	249800	248300	252300	750400
	% of GWh	33.3%	33.1%	33.6%	100%

Note: As percentages have been rounded correctly to one decimal place, totals of percentages may not add to exactly 100%

(a) Determine the values of A and B for the Victorian data. [2]

$51100 + 49700 + A = 150800$

$\Rightarrow A = 50000$

$\frac{51100}{150800} \times 100\% = B$

$\Rightarrow B = 33.88\%$

$\approx 33.9\%$

(b) Compare the percentages of electricity used in Western Australia with the percentage of electricity used in South Australia over the different time periods. [3]

In 2012-13, SA used more electricity, 33.5% against WA 31.1%

In 2013-14, WA used slightly more electricity, 34% against SA 33.5%

In 2014-15, WA used more electricity, 34.8% against SA 32.9%

(c) Describe the association between the amount of electricity consumed in Western Australia and time period. [2]

As the time period increases, the amount of electricity that WA uses also increases.

6. (10 marks)

Researchers monitoring the population of numbats in the Darling Ranges produced the following table, which includes predictions and residuals associated with the line of regression of Population (p) against Year (t).

Year (t)	1998	1999	2000	2001	2002
Population (p)	100		81	75	**c**
Predicted ($\hat{p}$)	97.6		83.2	**b**	68.8
Residual	2.4	-1.4	**a**	-1	2.2

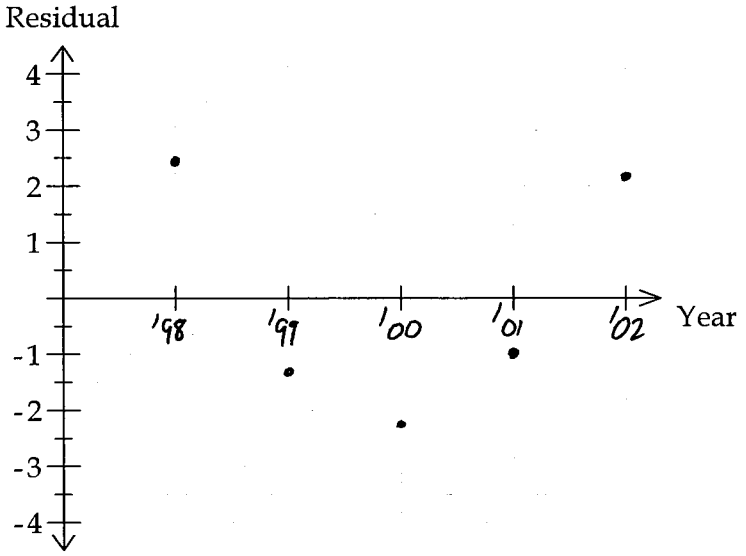
(a) Calculate the missing values, **a**, **b** and **c**, in the table. [3]

$81 - 83.2 = a \Rightarrow a = -2.2$

$75 - b = -1 \Rightarrow b = 76$

$c - 68.8 = 2.2 \Rightarrow c = 71$

(b) Construct a residual plot for this data on the graph below. [1]



(c) Comment on the residual plot. [2]

There is a pattern in the residual.

∴ a linear model is not appropriate

(d) The equation of the least-squares regression line for the graph showing Year (t) and Population (p) is

$$\hat{p} = -7.2t + 14483.2$$

(i) Use the regression line to predict the number of numbats in the Darling Ranges in 1999. [2]

$\hat{p} = -7.2(1999) + 14483.2$

$= 90.4$

≈ 90 numbats

(ii) Comment on the reliability of the prediction in part (d) (i). [2]

Prediction is not reliable as a linear model is not appropriate due to the pattern in the residual plot.