



Government of **Western Australia**
School Curriculum and Standards Authority



ATAR course examination, 2025

Question/Answer booklet

MATHEMATICS APPLICATIONS

Section One: Calculator-free

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Place one of your candidate identification labels in this box.
Ensure the label is straight and within the lines of this box.

↓

WA student number: In figures

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In words

Time allowed for this section

Reading time before commencing work: five minutes
Working time: fifty minutes

Number of additional
answer booklets used
(if applicable):

Materials required/recommended for this section

To be provided by the supervisor

This Question/Answer booklet
Formula sheet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener,
correction fluid/tape, eraser, ruler, highlighters

Special items: nil

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.



Structure of this paper

Section	Number of questions available	Number of questions to be answered	Working time (minutes)	Marks available	Percentage of examination
Section One: Calculator-free	5	5	50	51	35
Section Two: Calculator-assumed	8	8	100	100	65
Total					100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2025: Part II Examinations*. Sitting this examination implies that you agree to abide by these rules.
2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.
3. You must be careful to confine your answers to the specific question asked and to follow any instructions that are specified to a particular question.
4. Show all your working clearly. Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat any question, ensure that you cancel the answer you do not wish to have marked.
5. It is recommended that you do not use pencil, except in diagrams.
6. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.
7. The Formula sheet is not to be handed in with your Question/Answer booklet.

Section One: Calculator-free**35% (51 Marks)**

This section has **five** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Working time: 50 minutes.

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

Question 1

(10 marks)

When people become ill, their body responds with a change to their white blood cell count (WBCC) measured in '000s cells per microlitre (cells/ μL).

The table below shows a person's white blood cell count after contracting an illness.

Let n represent the number of hours after contracting an illness.

Time (n hours)	1	2	3	4	5	6
WBCC '000s (cells/ μL)	8.4	8.7	9			

- (a) The person's white blood cell count is increasing at a constant rate each hour. Show that this rate is 300 cells/ μL . (1 mark)
- (b) Complete the table above. (1 mark)
- (c) Determine a simplified rule for the n^{th} term to model the person's white blood cell count after contracting an illness. (2 marks)
- (d) Determine the white blood cell count in the person's body after 12 hours, if the white blood cell count maintains the same rate of increase. (2 marks)

After an illness is diagnosed, a person receives the appropriate medication to aid their recovery. An indirect effect of the medication will be an overall reduction in the person's white blood cell count.

A person becomes ill and is given medication. Their white blood cell count ('000s cells/ μ L) follows the recursive rule $T_m = -0.5T_{m-1} + 20$, $T_0 = 20$, where m is the number of hours after the person is given the medication.

- (e) (i) Determine the white blood cell count in this person at the end of the second hour. (2 marks)

- (ii) Determine if the given medication, in the long run, can ensure this person's white blood cell count does not fall below 13 000 cells per microlitre. (2 marks)

Question 2

(11 marks)

John surveyed 300 people to collect data on the amount of money spent on a T-shirt (T-shirt price) and the age of the person the T-shirt was purchased for. The information is displayed in the table below. John concluded there is a possible relationship between the T-shirt price and the age of the recipient.

		T-shirt price (\$)			Total
		10–19	20–39	40–59	
Age (years)	4–10	21		3	
	11–17		48	39	108
	18–24	15	54		156
Total			114	129	300

- (a)
- Complete the two-way table above.
- (2 marks)

To see if John’s conclusion is reasonable, the following analyses were conducted.

- (b)
- Assuming age is the explanatory variable,
- (i)

show that the percentage of T-shirts purchased for 4–10-year-olds with a price of 40–59 dollars is 8.3 correct to one decimal place.

(1 mark)
- (ii)

complete the two-way percentaged table below. All percentages, apart from the totals, are correct to one decimal place.

(2 marks)

		T-shirt price (\$)			Total
		10–19	20–39	40–59	
Age (years)	4–10		33.3		
	11–17	19.4		36.1	
	18–24		34.6	55.8	100

- (c) Assuming T-shirt price is the explanatory variable, complete the two-way percentaged table below. All percentages, apart from the totals, are correct to one decimal place. (2 marks)

		T-shirt price (\$)		
		10–19	20–39	40–59
Age (years)	4–10	36.8	10.5	
	11–17			30.2
	18–24		47.4	67.4
	Total		100	

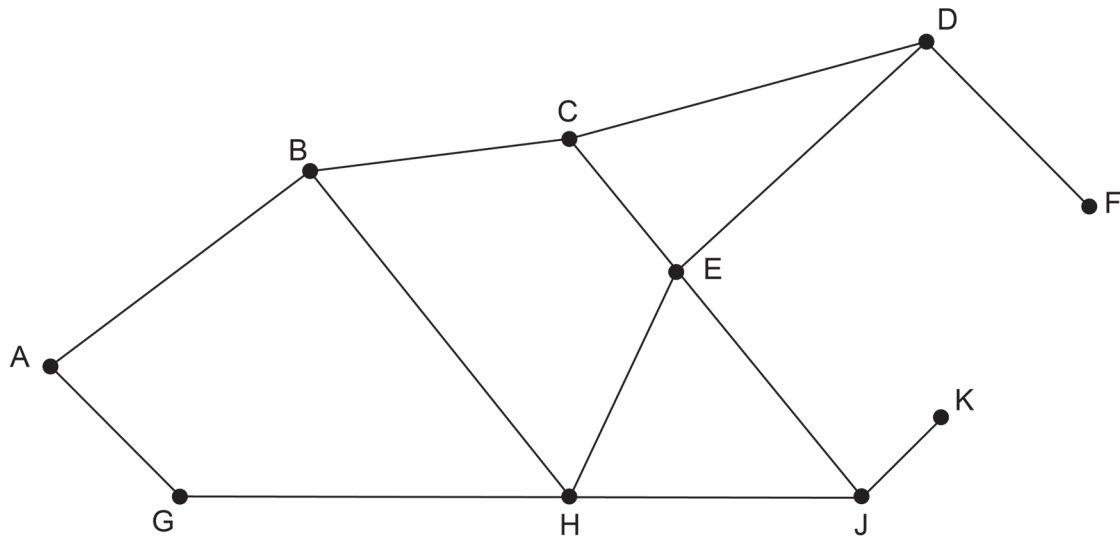
- (d) (i) State an association that can be observed from the two-way percentaged table in part (b)(ii) on page 6. (1 mark)
- (ii) State an association that can be observed from the two-way percentaged table in part (c). (1 mark)
- (e) On the basis of your answers to part (d), explain whether John's conclusion is reasonable. (2 marks)

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Question 3

(9 marks)

A bus service provides passengers with a convenient way of travelling around the city. The graph below shows the roads (edges) used by buses when travelling between bus stops (vertices).



- (a) Explain why this is a simple graph.

(2 marks)

- (b) Select **three** terms from those listed below that could be used to accurately describe the graph shown above. Circle the correct terms.

(3 marks)

complete

connected

directed

planar

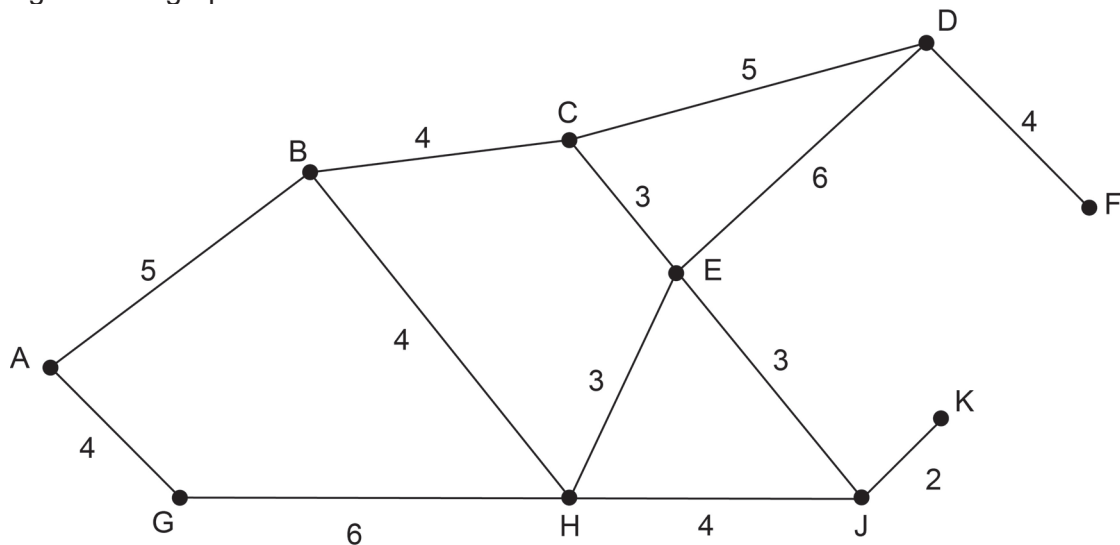
Eulerian

semi-Eulerian

Hamiltonian

semi-Hamiltonian

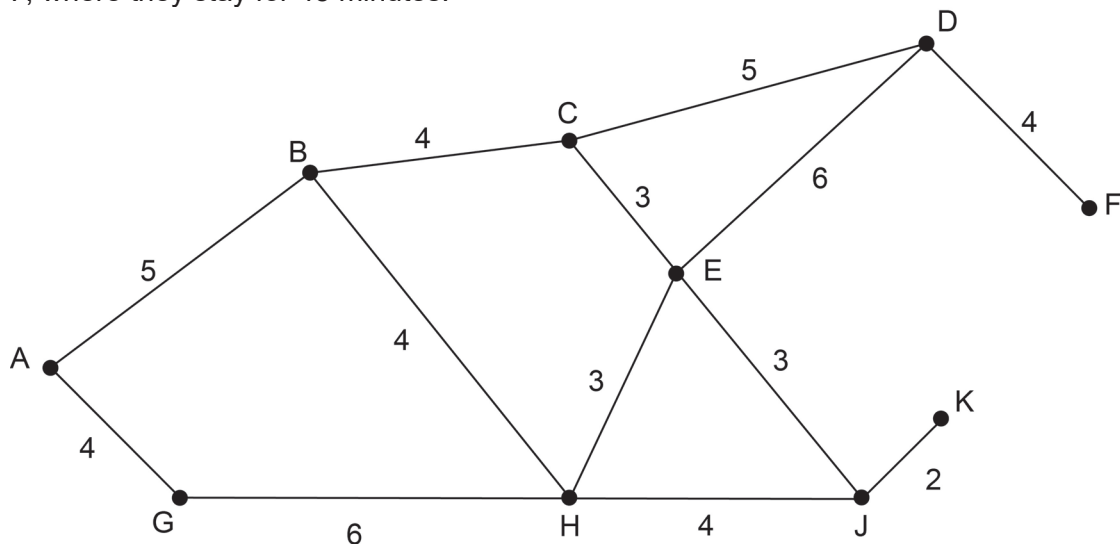
The average times, in minutes, taken for buses to travel between the bus stops are shown on the edges of the graph below.



A tourist visiting the city wants to travel from stop A to stop K in the shortest possible time.

- (c) Determine the shortest possible time for this journey and the bus route they should take. (2 marks)

The tourist leaves from stop K, and travels to stop B. On the way, they visit an attraction at stop F, where they stay for 45 minutes.



- (d) Determine the shortest possible time for this journey and the bus route they should take. (2 marks)

Question 4

(8 marks)

A company employs four sales representatives, who are based in different cities and regularly travel to promote the company's products. The next promotional campaign will require all four sales representatives to each travel to a different city. The cost, in hundreds of dollars, for each sales representative to travel to each of the four cities, is shown in the table below.

		Sales representative			
		Jordan	Kylie	Li	Mikal
Travel cost to the city (\$'00)	Adelaide	24	16	18	19
	Brisbane	15	13	14	22
	Perth	16	13	10	17
	Sydney	13	16	15	15

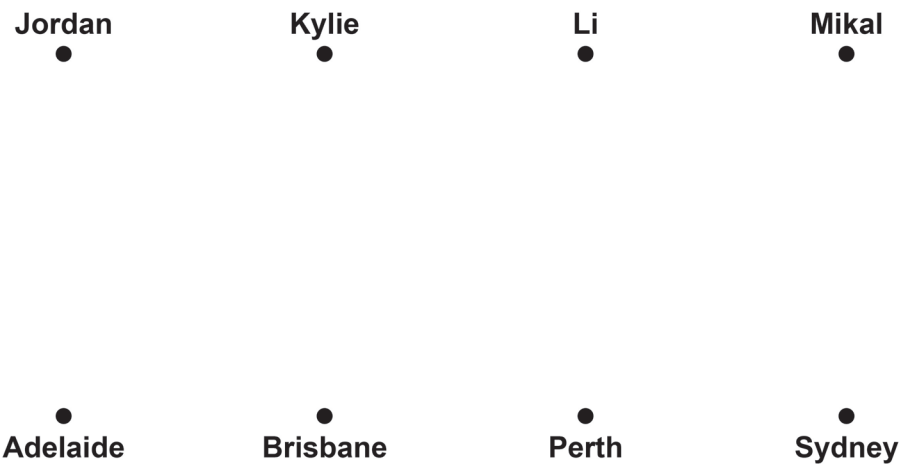
The company director wants to assign the sales representatives in a way that minimises the total cost to the company.

- (a) Show use of the Hungarian algorithm to determine the minimum cost. (4 marks)

Minimum cost: _____

See next page

- (b) Draw the weighted bipartite graph, showing the assignment of sales representatives that minimises the total cost. (2 marks)



A spare graph is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it on the spare graph.

Mikal has asked to travel to Brisbane for the next promotional campaign, to visit family while he is there. The company director has approved the request.

- (c) Complete the table below to show the updated assignment of sales representatives and state the associated minimum cost to the company. (2 marks)

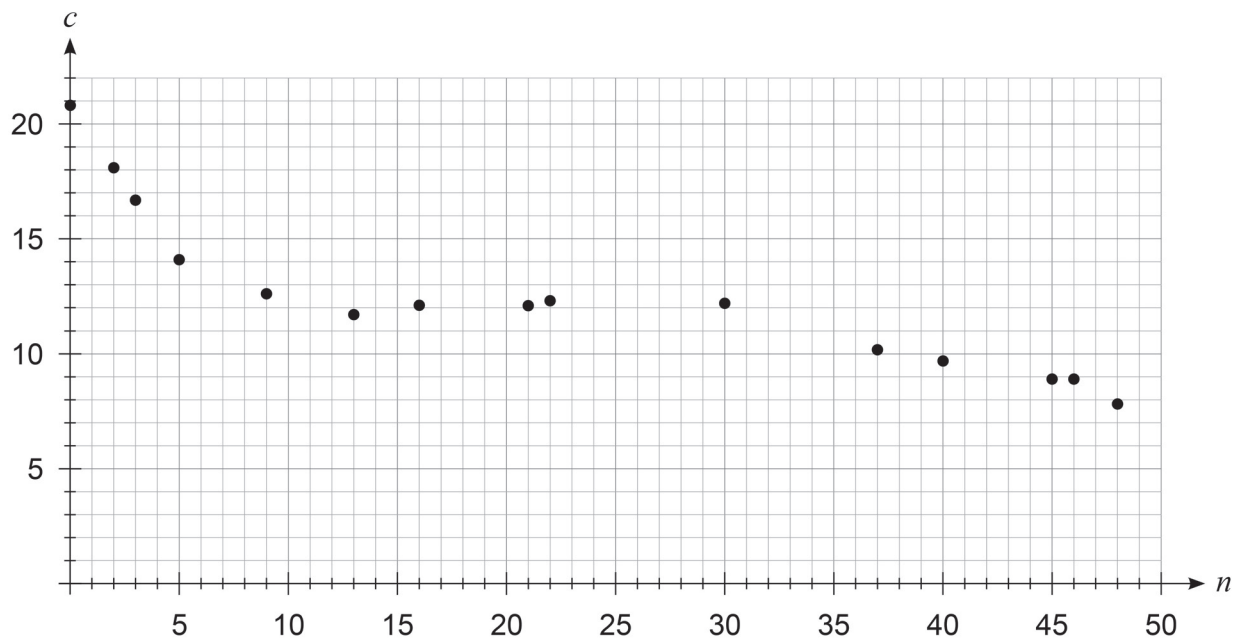
Sales representative	Jordan	Kylie	Li	Mikal
City				Brisbane

Minimum cost: _____

Question 5

(13 marks)

The average fuel consumption, c (L/100 km), of cars manufactured since 1975 was recorded, with n being the number of years since 1975. The results are shown in the scatterplot below.

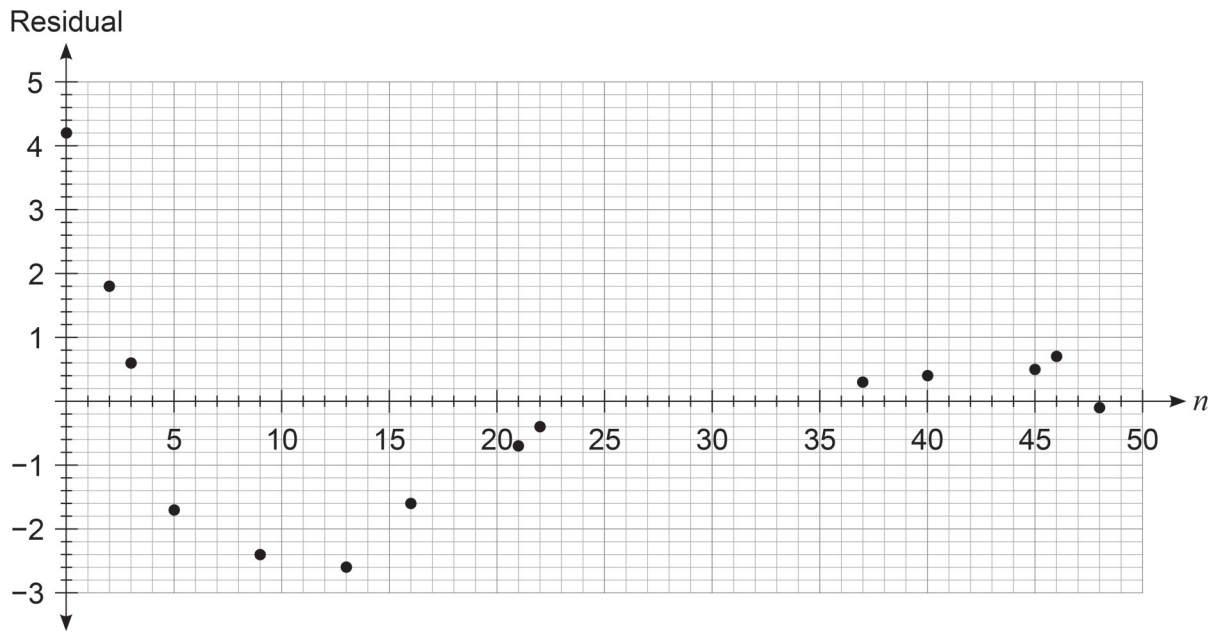


For these data, the equation of the least-squares line is $\hat{c} = -0.18n + 16.7$ and the correlation coefficient (r_{nc}) is -0.88 .

- (a) Use the equation of the least-squares line to predict the average fuel consumption for a car manufactured in the year 2000. (2 marks)
- (b) Comment on your prediction in part (a). (2 marks)
- (c) Draw the least-squares line for these data on the scatterplot above. (2 marks)

A spare graph is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it on the spare graph.

The incomplete residual plot for these data is drawn below. The residual for 2005 is missing.



The average fuel consumption for cars manufactured in 2005 was 12.2 L/100 km.

- (d) Determine the residual for 2005 and plot it on the residual plot above. (3 marks)

A spare graph is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it on the spare graph.

- (e) Assess the appropriateness of fitting a linear model to these data. (2 marks)

Additional records from the year 1995 show an average fuel consumption of 10.2 L/100 km.

- (f) If this data was added to the scatterplot on page 12, determine if the correlation coefficient would become stronger, weaker or stay the same. Justify your response. (2 marks)

Supplementary page

Question number: _____

Supplementary page

Question number: _____

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Supplementary page

Question number: _____

Spare graph for Question 4(b)

Jordan
●

Kylie
●

Li
●

Mikal
●

●
Adelaide

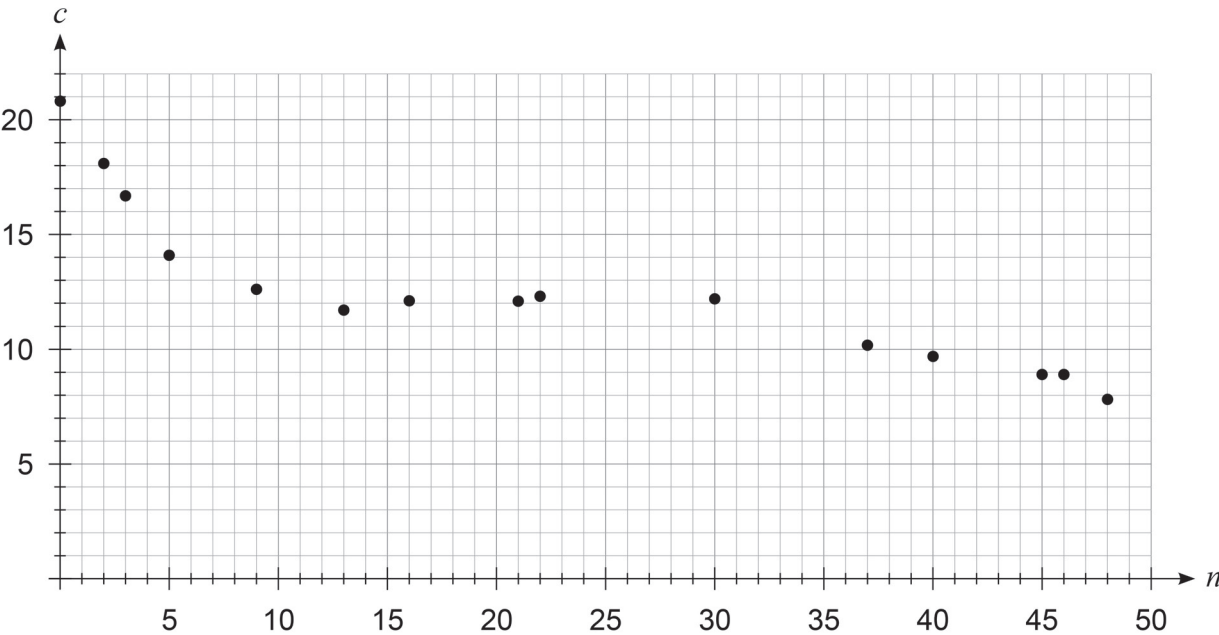
●
Brisbane

●
Perth

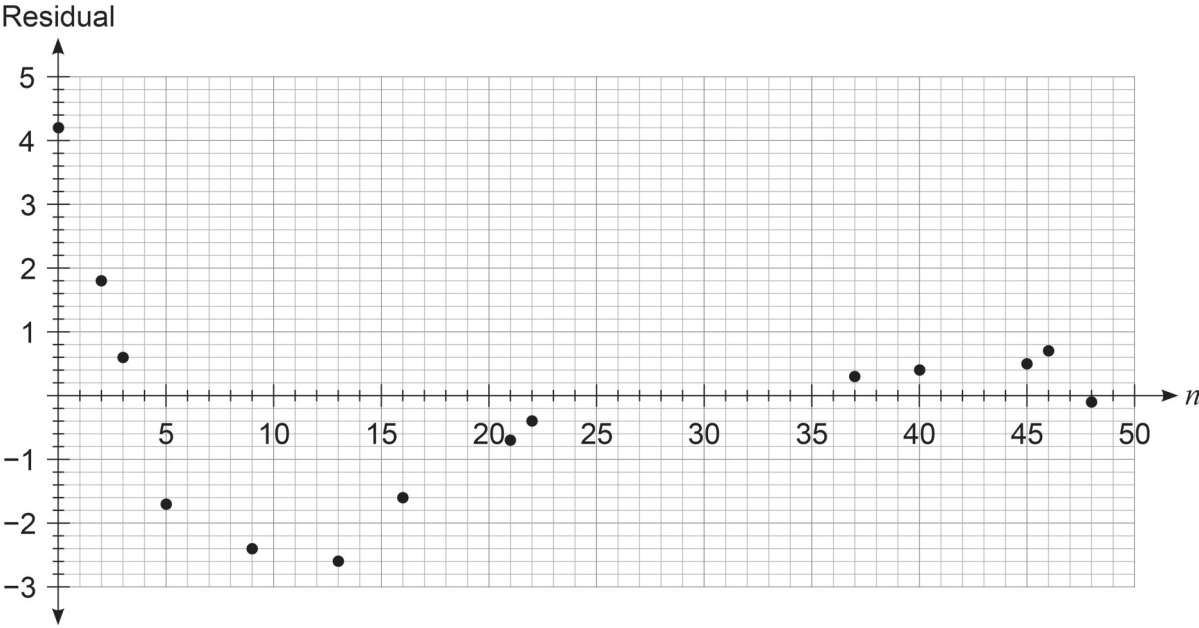
●
Sydney

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Spare graph for Question 5(c)



Spare graph for Question 5(d)



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*Published by the School Curriculum and Standards Authority of Western Australia
303 Sevenoaks Street
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