South Australian
Certificate of Education

Essential Mathematics
2025

Question booklet

Topic 2: Measurement (Questions 1 to 3) 30 marks

Topic 4: Statistics (Questions 4 to 6) 30 marks

Topic 5: Investments and loans (Questions 7 to 9) 30 marks

- Answer ***all*** questions
- Write your answers in this question booklet
- You may write on pages 10, 21, and 24 if you need more space
- Allow approximately 40 minutes for ***each*** topic

Examination information

Materials
- Question booklet
- SACE registration number label

Instructions
- Show appropriate working and steps of logic in this question booklet
- Use black or blue pen
- You may use a sharp dark pencil for diagrams and graphical representations
- Approved calculators may be used — complete the box below

Total time: 130 minutes
Total marks: 90

The SACE Board of South Australia acknowledges that this examination was created on Kaurna Land. We acknowledge First Nations Elders, parents, families, and communities as the first educators of their children, and we recognise and value the cultures and strengths that First Nations students bring to the classroom. We respect the unique connection and relationship that First Nations peoples have to Country, and their ever-enduring cultural heritage.

Attach your SACE registration number label here	**Graphics calculator** 1. Brand _____ Model _____ 2. Brand _____ Model _____

Government of South Australia

Question 1 (11 marks)

A team of scientists is conducting research about the evidence of wombats in a section of a national park. This section is called the wombat zone. The measurements of the wombat zone are shown in Figure 1.

Wombat zone

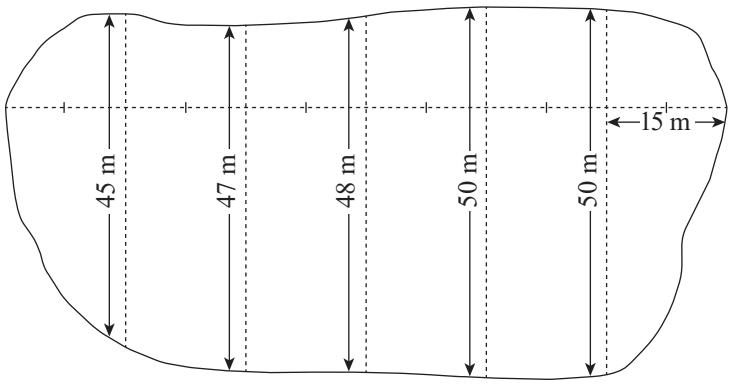


Figure 1 [*This diagram is not drawn to scale.*]

(a) Using Simpson's Rule, show that the approximate area of the wombat zone is $3830\ \text{m}^2$.

(3 marks)

(b) A valid scientific method to monitor animal populations involves overlaying the habitat they live in with a grid, and then looking for evidence of the animal in each **whole** square of the grid overlay.

Wombat zone

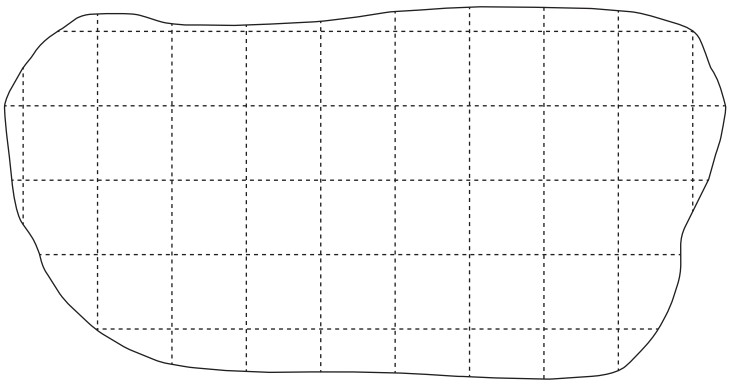


Figure 2

Each whole square is $10\ \text{m} \times 10\ \text{m}$.

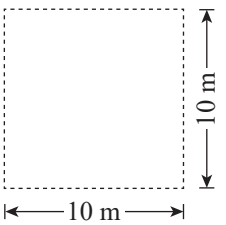


Figure 3

[*These diagrams are not drawn to scale.*]

(i) Using the information from Figure 2 and Figure 3, calculate the area of the wombat zone that will be monitored by the scientists.

(Note: use only **whole** squares)

(2 marks)

For the data to be considered comprehensive, the area of the wombat zone that will be monitored needs to cover at least 75% of the whole wombat zone from part (a).

(ii) Using a calculation, show that the data would be considered comprehensive.

(1 mark)

(iii) When using the overlay grid method, which of the following strategies would ensure the scientists covered a larger area than calculated in part (b)(i)?

Tick *one* option below.

- ☐ Increase the size of the squares to $15\ \text{m} \times 15\ \text{m}$.
- ☐ Decrease the size of the squares to $5\ \text{m} \times 5\ \text{m}$.
- ☐ Survey only every second square.

(1 mark)

Question 1 continues on page 4.

(c) The scientists plan to mark out the wombat zone with tape. The perimeter formed by the tape is shown in Figure 4.

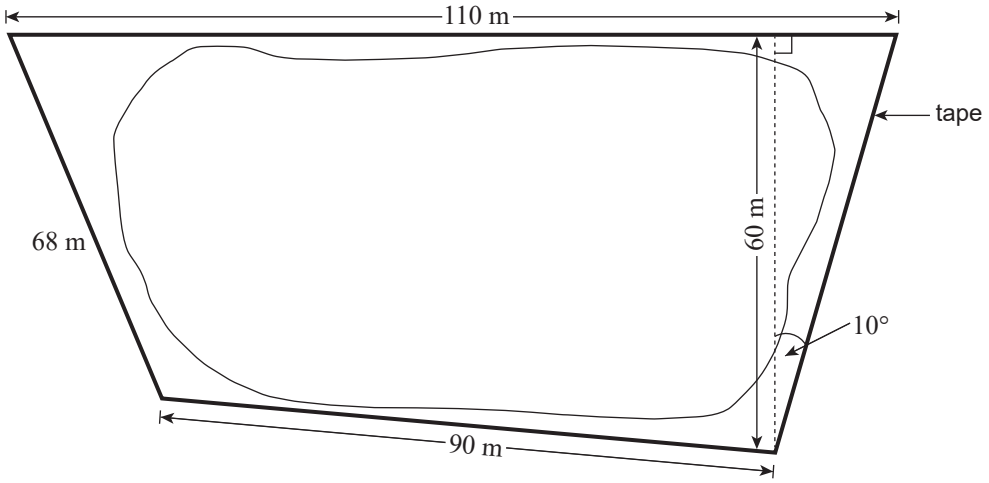


Figure 4 [*This diagram is not drawn to scale.*]

(i) Show that the total length of tape required is approximately 330 m.

(3 marks)

The scientists order 350 m of tape.

(ii) State *one* reason why the scientists may have ordered more tape than was calculated in your answer to part (c)(i).

(1 mark)

Question 2 (6 marks)

A potter uses a tool to shape cups out of clay. The tool consists of a cylindrical piece with a handle on top. The design of the tool can be seen in Figure 5.

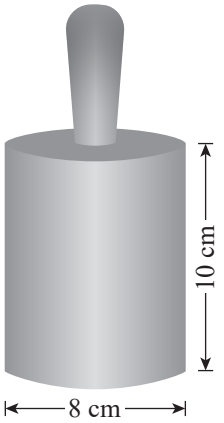


Figure 5

[*This diagram is not drawn to scale.*]

(a) Show that the volume of the cylindrical piece of the tool is approximately $502.7\ \text{cm}^3$.

(2 marks)

Question 2 continues on page 6.

To form a cup, the clay will be moulded around the cylindrical piece of the tool with a thickness of 0.5 cm, as shown in Figure 6.

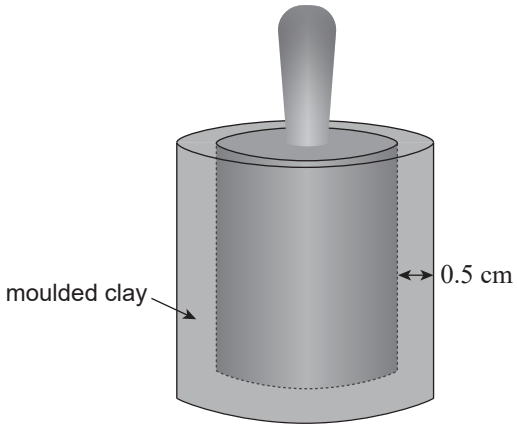


Figure 6

[*This diagram is not drawn to scale.*]

(b) Show that the external circumference of the moulded cup is approximately 28 cm.

(2 marks)

The potter is hoping to enter the cups into a competition.

The requirements for entry into the competition are:

- each entry must have 4 cups.
- the total capacity of all 4 cups combined must be at least 1.7 L.

During the process to harden the cups, they shrink by 15%. Each finished cup has an average volume of approximately 430 cm^3.

(c) Use a calculation to show whether the cups the potter has made would meet the capacity requirement.

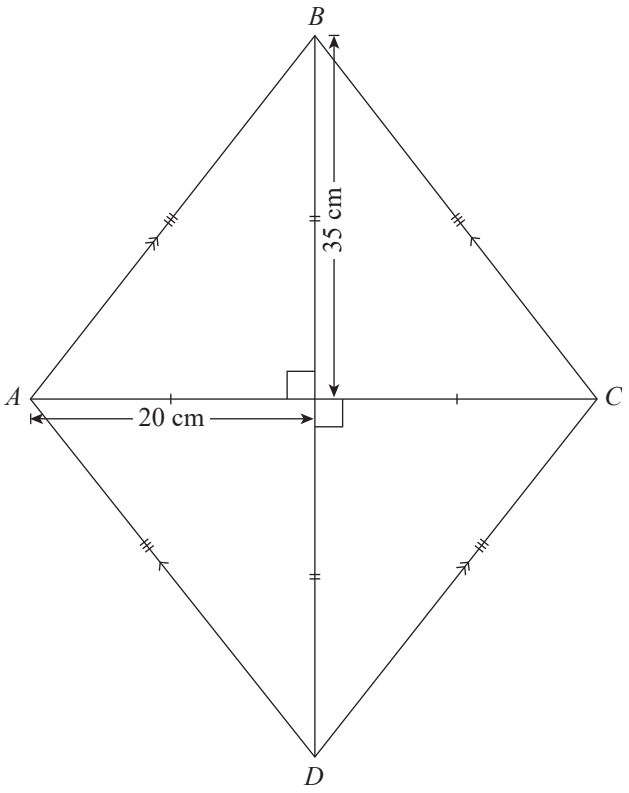
(2 marks)

Question 3 (13 marks)

Ella is designing a kite to enter a kite flying competition, and is considering different design options for the frame.

Her first design (Design A) will be made using two rods which will cross over, and four smaller rods to create the perimeter.

Design A is shown in the diagram below.



Design A [*This diagram is not drawn to scale.*]

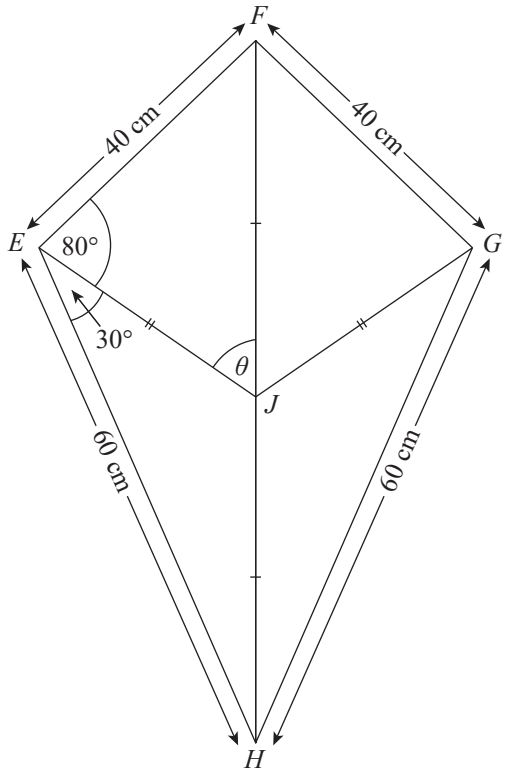
(a) (i) Calculate the size of angle ABC.

(2 marks)

(ii) Calculate the area of the kite for Design A.

(2 marks)

Ella is also considering a different design (Design B), as shown in the diagram below.



Design B

[*This diagram is not drawn to scale.*]

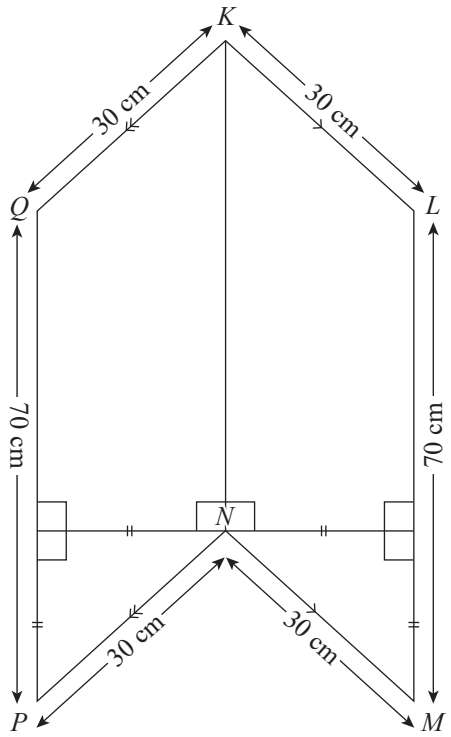
(b) (i) Show that the length of FH is approximately 83 cm.

(2 marks)

(ii) Calculate the size of angle EJF (θ).

(2 marks)

Ella considers another design (Design C) created by joining two identical parallelogram-shaped frames together. Design C can be seen in the diagram below.



Design C

[*This diagram is not drawn to scale.*]

(c) Determine the area of Design C.

(3 marks)

One of the rules for the kite flying competition is that the area of the kite *must not exceed* $2\ m^2$.

(d) State whether kite Design C would meet the rules of this competition. Justify your answer with a calculation.

(2 marks)

You may write on this page if you need more space to finish your answers to any questions.
Make sure to label each answer carefully (e.g. 3(a)(ii) continued).

Question 4 (6 marks)

A local school with students from Year 7 to Year 12 is considering launching a new mental health support program for students.

To understand the needs of the students, the school conducts a survey. Year 12 students are invited to stay after school to complete the survey.

(a) Identify a source of bias in this sampling method **and** explain its potential impact on the results.

(2 marks)

(b) Other than conducting a stratified sample, state *one* change that could be made to the sampling method to make the results more reliable.

(1 mark)

There are 800 girls and 925 boys in the school.

(c) The school wants to ensure proportional representation of boys and girls. Calculate how many girls should be included in a stratified sample of 50 students.

(2 marks)

(d) State *one* reason why the school would **not** choose to conduct a census.

(1 mark)

Question 5 (11 marks)

A supermarket conducted a study on the amount of money (in dollars) customers spend on groceries in a single visit. They collected data from 2018 and 2024.

Table 1: Amount of money (in dollars) spent on groceries for 2018

2018	131	143	132	155	140	148	122	154	139	140

Table 2: Amount of money (in dollars) spent on groceries for 2024

2024	141	156	149	167	152	179	148	159	148	186

(a) Complete the ordered stem-and-leaf plot below for the 2024 data.

2018				*Stem*	*2024*			
			2	**12**				
	9	2	1	**13**				
8	3	0	0	**14**				
		5	4	**15**				
				16				
				17				
				18				

Key: 13 | 2 = 132

(2 marks)

(b) Complete Table 3 below.

Table 3

Statistical measure	*2018*	*2024*
mean	140.40	
median		154.00
standard deviation	10.34	
IQR		19.00

(2 marks)

(c) *Circle the appropriate **bolded** word* to complete the sentences below.

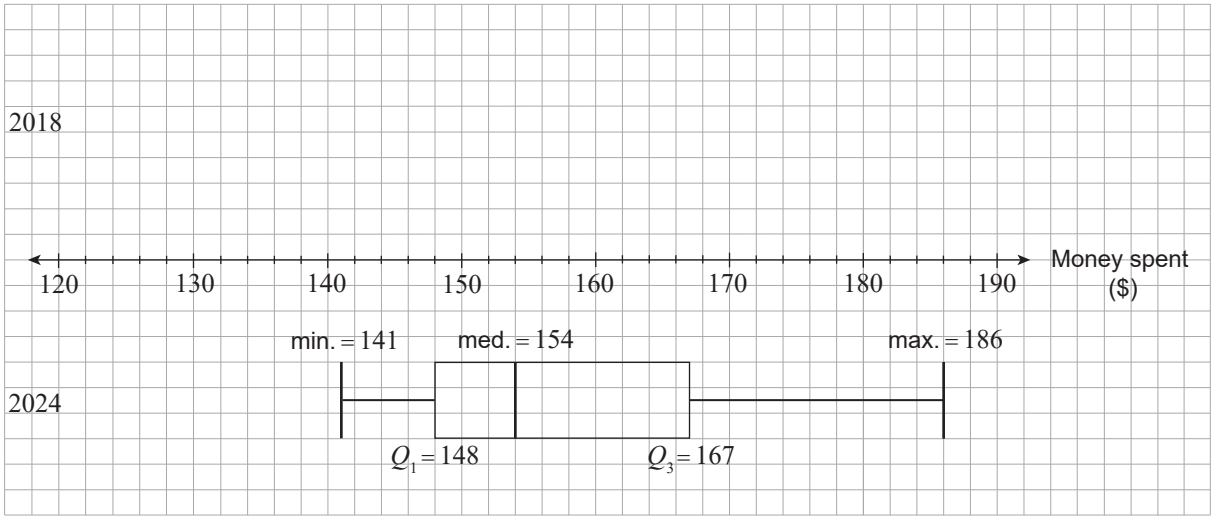
(i) The mean and median amount of money spent in 2018 is **lower** / **higher** than the mean and median amount of money spent in 2024. (1 mark)

(ii) The amount of money spent was more consistent in **2018** / **2024**. (1 mark)

(iii) The statistical value that supports your response to part (c)(ii) is **mean** / **median** / **standard deviation**. (1 mark)

(d) (i) Using the axis below, *draw and label* a box-and-whisker plot for the 2018 data.

Amount of money (in dollars) spent on groceries for 2018 and 2024



(2 marks)

(ii) Complete the following sentence:

75% of the 2018 data is less than _____% of the 2024 data. (1 mark)

(e) State *one* reason why the comparison of the money spent in 2018 and 2024 is not reasonable.

(1 mark)

Question 6 (13 marks)

A group of students is conducting a study on how the average number of hours spent on mobile phones each day affects their academic performance (measured as a score out of 100). Data were collected from 10 students over the course of 1 month.

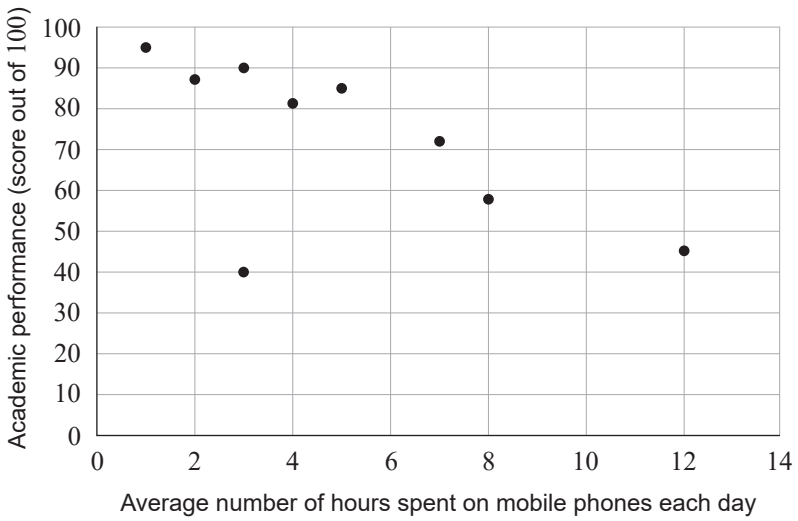
The data for the 10 students are shown in Table 4 below.

Table 4

Student	*Average number of hours spent on mobile phones each day*	*Academic performance (Score out of 100)*
1	3	90
2	4	81
3	2	87
4	6	75
5	5	85
6	7	72
7	8	58
8	3	40
9	1	95
10	12	45

(a) Plot the data for student 4 on the graph below.

Average number of hours spent on mobile phones and academic performance



(1 mark)

(b) Calculate the coefficient of determination (r^2) and interpret its value by completing the sentence below.

The strength of the relationship between _____ (dependent variable)

and _____ (independent variable) is _____.

(2 marks)

(c) State the outlier in the data.

(1 mark)

The outlier was found to be an error and removed from the data.

(d) State the effect on the strength of the relationship after the outlier was removed from the data.

(1 mark)

(e) Pearson's Correlation coefficient (r) is -0.967.

Explain the meaning of this value by describing the association between the two variables.

(2 marks)

(f) Find the equation of the least squares regression line (line of best fit) after the outlier has been removed.

Tick the box for the correct equation below.

☐ $y = -4.6x + 100.99$

☐ $y = 4.6x + 100.99$

☐ $y = -100.99x - 4.6$

(1 mark)

(g) (i) Calculate the predicted academic performance score if the average number of hours spent on a mobile phone per day was 23.

(1 mark)

(ii) Discuss the reliability of your answer to part (g)(i).

(2 marks)

(h) Calculate the predicted average number of hours spent on a mobile phone if the academic performance score was 79.

(2 marks)

Question 7 (10 marks)

When their first child is born, a couple open an investment account with the aim of saving at least $\$40\,000$ for school fees over 12 years.

The couple want to factor in the increase in the cost of school fees due to inflation.

(a) Calculate the inflated cost of school fees at the end of 12 years if inflation averages 3.1% per annum.

(2 marks)

The couple have a choice of two accounts.

Account A	***Account B***
Interest rate of 4.6% per annum, compounded monthly	Interest rate of 4.95% per annum simple interest
Minimum opening balance of $\$0$	Minimum opening balance of $\$25\,000$
Regular monthly deposits must be paid	No monthly deposits
One withdrawal allowed each year	No withdrawals allowed

The couple decide to save $\$60\,000$ over 12 years to cover the cost of school fees.

(b) (i) Calculate the minimum monthly deposit they would need to make in Account A to save the $\$60\,000$. Assume the opening balance is $\$0$.

(2 marks)

(ii) Show that the couple earned almost $\$15\,000$ interest in Account A.

(1 mark)

(c) (i) Calculate the opening balance (principal) required in Account B to accumulate the same amount of interest as earned in Account A.

(2 marks)

(ii) State whether the couple's opening balance in Account B will satisfy the requirements of the account.

(1 mark)

(d) Discuss whether it is reasonable to choose Account B to save the $\$60\,000$ for school fees.

(2 marks)

Question 8 (11 marks)

A couple are considering a loan of $\$595\,000$ to purchase a new home. The loan interest rate is 5.75% per annum, compounded monthly.

(a) (i) Show the minimum monthly payment required to repay the loan in 25 years is approximately $\$3750$.

(2 marks)

(ii) Calculate the interest paid over the 25 years.

(1 mark)

The couple want to pay more than the minimum monthly payments for the first 7 years.

(b) Calculate the outstanding balance if they make payments of $\$4000$ each month for 7 years.

(2 marks)

(c) Calculate how long (in years) it will take for the couple to repay the remainder of the loan if they return to making the minimum monthly payments after 7 years.

(3 marks)

(d) Calculate the interest saved over the entire loan by paying the increased payments for the first 7 years.

(2 marks)

(e) State the effect on the loan if the couple were only able to make the increased payments for 3 years, rather than 7 years.

(1 mark)

Question 9 begins on page 22.

You may write on this page if you need more space to finish your answers to any questions.
Make sure to label each answer carefully (e.g. 7(b)(i) continued).

Question 9 (9 marks)

Ruby earns $\$112\,000$ each year. Ruby and her employer make a total contribution of $\$4060$ into Ruby's superannuation fund each quarter.

(a) Show that Ruby's voluntary contribution each quarter is $\$700$ if her employer contributes 12% of her income.

(2 marks)

Ruby's superannuation fund is generating a return of 7.8% per annum, compounded quarterly.

(b) Calculate Ruby's superannuation fund balance if the quarterly contributions of $\$4060$ are deposited for 30 years.

(2 marks)

(c) (i) State *one* assumption made for Ruby to achieve the superannuation fund balance that you calculated in part (b).

(1 mark)

(ii) For the assumption you stated in part (c)(i), explain a change that may occur **and** discuss the effect that change would have on the superannuation fund balance that you calculated in part (b).

(2 marks)

At retirement, Ruby plans to roll over $\$1\,500\,000$ of her superannuation fund balance into a flexible pension account. The flexible pension account returns 6.9% per annum, compounded monthly.

(d) Calculate how long (in months) Ruby's superannuation fund balance will last if she withdraws $\$9500$ every month.

(2 marks)

You may write on this page if you need more space to finish your answers to any questions.
Make sure to label each answer carefully (e.g. 9(c)(i) continued).