



BAULKHAM HILLS HIGH SCHOOL

2025

YEAR 12 ASSESSMENT TASK 3

Mathematics Advanced

General Instructions

- Reading time – 5 minutes.
- Working time – 1 hour.
- Write using black or blue pen.
- NESA-approved calculators may be used.
- Answer all questions in the answer booklet provided.
- Show all necessary working in Questions 6-12.
- Marks may be deducted for careless or badly arranged work.
- A reference sheet is provided.

Total marks – 42

The exam consists of 18 pages.

This paper consists of TWO sections.

Section I– Page 5 - 7 (5 marks)

Questions 1 - 5

- Attempt Questions 1 – 5
- Answer on the space provided.
- Allow about 8 minutes for this section.

Section II – Pages 8 – 18 (37 marks)

- Attempt questions 6 - 12
- Allow about 52 minutes for this section.



BAULKHAM HILLS HIGH SCHOOL

YEAR 12 ASSESSMENT TASK 3 2025

NESA#: _____

Teacher: _____

Mathematics Advanced Section I – Multiple Choice

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9
A ☐ B ☒ C ☐ D ☐

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ☒ B ☒ C ☐ D ☐

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.

A ☒ B ☒ C ☐ D ☐
correct

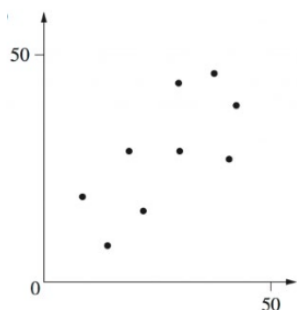
- Start Here →
1. A ☐ B ☐ C ☐ D ☐
 2. A ☐ B ☐ C ☐ D ☐
 3. A ☐ B ☐ C ☐ D ☐
 4. A ☐ B ☐ C ☐ D ☐
 5. A ☐ B ☐ C ☐ D ☐
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Section I - 5 marks

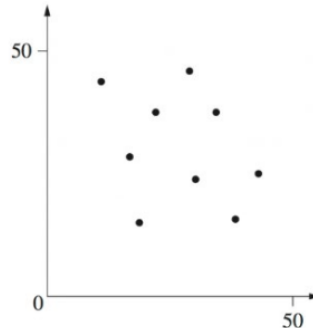
Use the multiple-choice answer sheet for questions 1-5.

1. Which graph best shows data with a correlation coefficient closest to -0.1 ?

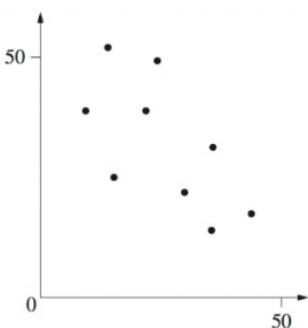
A.



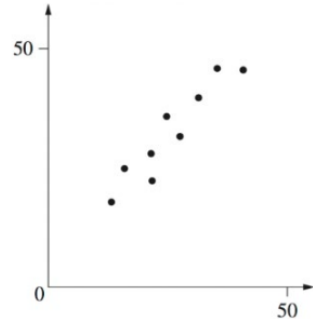
B.



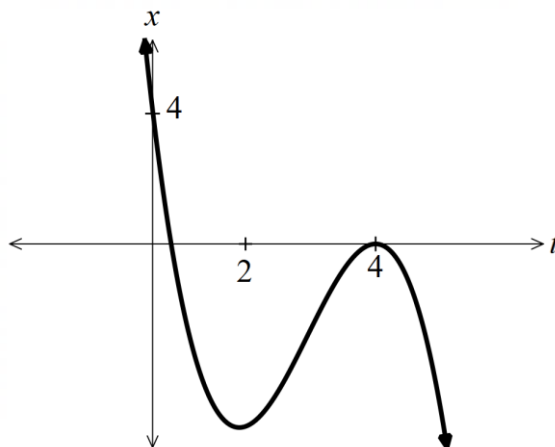
C.



D.



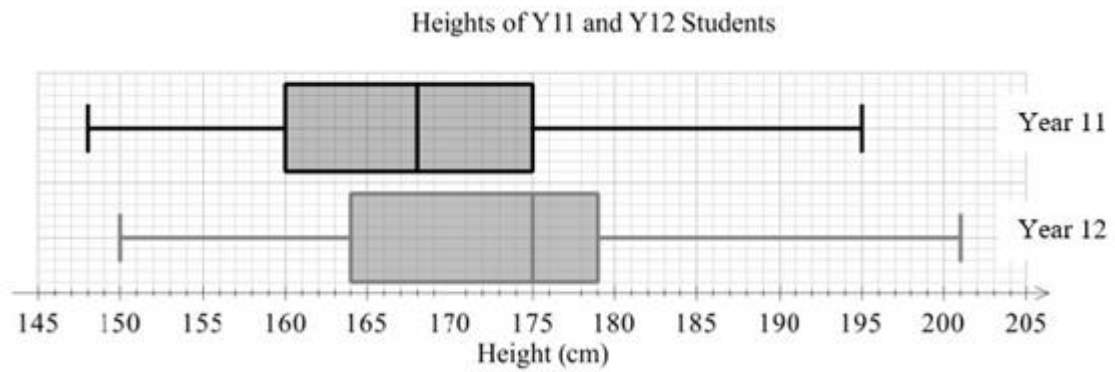
2. The displacement, x metres, from the origin of a particle moving in a straight line at any time, t seconds, is shown in the graph below.



When is the particle at rest?

- (A) $t = 0$.
(B) $t = 1$ and $t = 4$.
(C) $t = 2$ and $t = 4$.
(D) $t = 1$, $t = 2$ and $t = 4$.

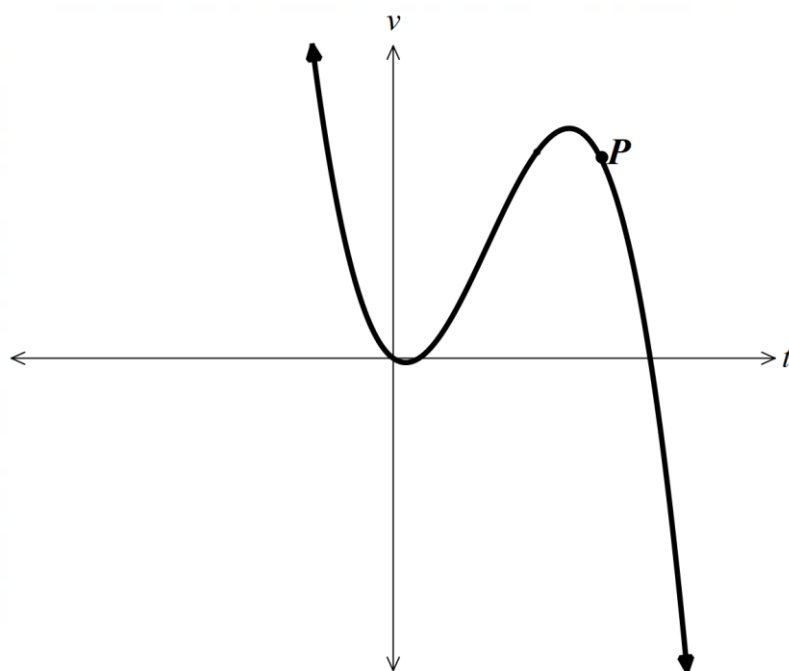
3. The box-plot below shows the height of students in Year 11 and Year 12 at a particular school.



There are the same number of students above 175 cm in Year 11 as there are students above 175 cm in Year 12. If there are 140 students in Year 11, how many students are there in Year 12?

- (A) 35
- (B) 50
- (C) 65
- (D) 70
4. Which statement is true for an ungrouped data set with no outliers?
- (A) The largest possible range is 2 times the interquartile range.
- (B) The largest possible range is 3 times the interquartile range.
- (C) The largest possible range is 4 times the interquartile range.
- (D) The largest possible range is 5 times the interquartile range.

5. The graph shows the velocity of a particle moving along the x -axis as a function of time.



Which statement describes the motion of the particle at the point P ?

- (A) The particle is moving left at increasing speed.
- (B) The particle is moving left at decreasing speed.
- (C) The particle is moving right at increasing speed.
- (D) The particle is moving right at decreasing speed.

End of Section I

Section II

37 marks

Attempt Questions 6 – 12

Allow about 52 minutes for this section

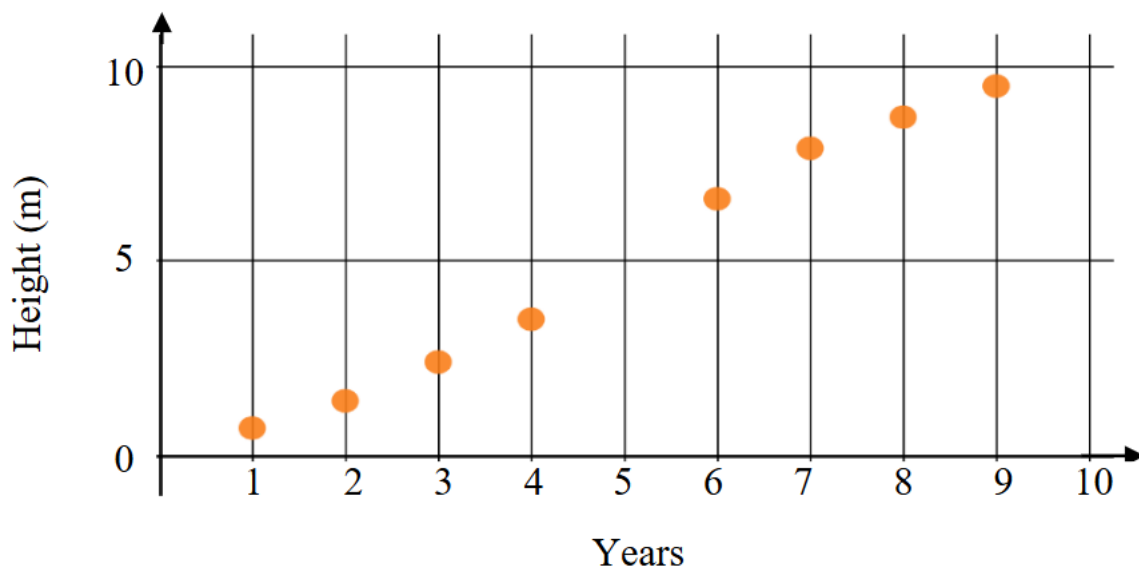
Instructions:

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/or calculations.
- Extra writing paper is available. If you use extra paper, write your NESA number, your teacher's name on the paper and indicate clearly which question you are answering.

Question 6 (4 marks)

Sam is an agricultural scientist studying the growth of a particular tree over several years. The data she recorded is shown in the table and graph below.

Years since planting, t	1	2	3	4	6	7	8	9
Height of tree, H metres	0.7	1.4	2.4	3.5	6.6	7.9	8.7	9.5



- (a) What is the correlation coefficient for this data (correct to 4 decimal places)?

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Question 6 continued on next page

- (b) Find the equation of the least-squares line of best fit for the height in terms of years. 1

Answer using values A and B correct to 2 decimal places, where $H = A + Bt$.

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- (c) Hence, determine approximately, how many years it will take for the tree to reach a height of 20 metres. Answer correct to 1 decimal place. 1

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- (d) What is the limitation of this model? 1

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Question 7 (5 marks)

The fish population, F , in a pond is increasing according to the law of natural growth, $\frac{dF}{dt} = kF$, for some constant k .

- (a) If F_0 is the fish population for $t = 0$, show that $F = F_0 e^{kt}$ satisfies the given equation $\frac{dF}{dt} = kF$. **1**

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- (b) Find the value of k if the population of the fish triples every two years. **2**

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- (c) If the number of fish in a lake grew to 21,000 after 6 years, what was the initial number of fish? **2**

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Question 8 (5 marks)

The average monthly temperature, $T^{\circ}\text{Celsius}$, for a town in NSW can be modelled by the formula $T = 7\sin(nx + 1.5) + 13$, where n is a constant and x is the month of the year (i.e. $x = 1$ for January, $x = 2$ for February etc).

- (a) According to the model, what is the maximum and minimum average monthly temperatures in this town? 2

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- (b) The period of the function is 12. Determine the value of n correct to 2 decimal places. 1

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- (c) Which month has the lowest average monthly temperature? 2

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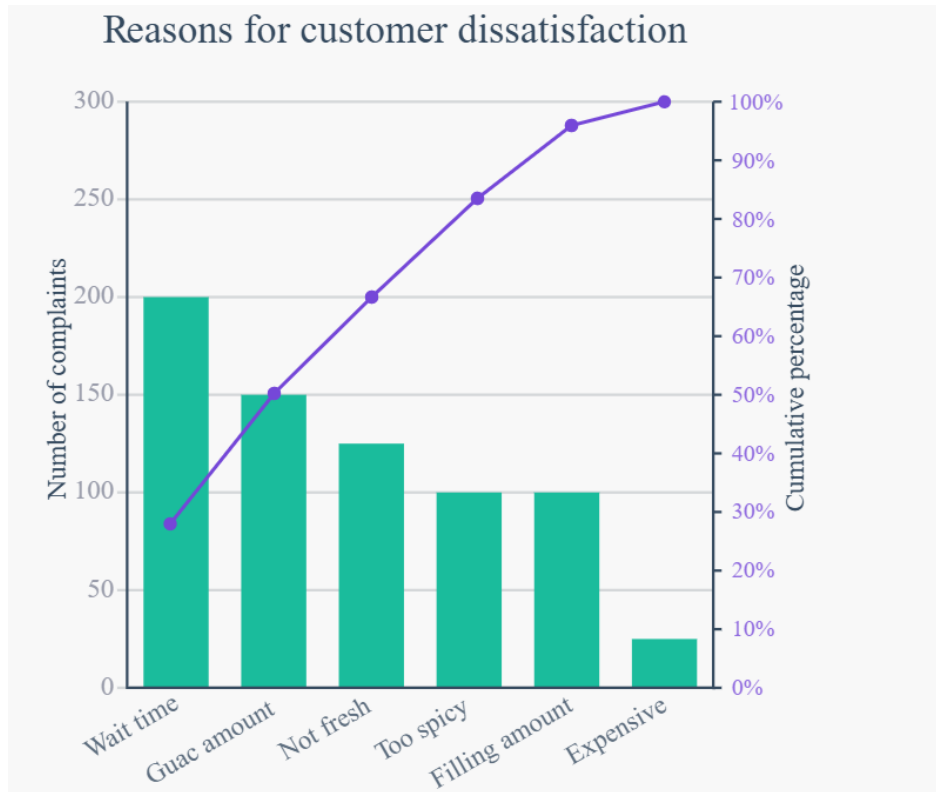
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Question 9 (3 marks)

At Perfect Burritos, the owners ask their dissatisfied customers why they are not happy with their experience.

They created a Pareto chart for last month's feedback.



- (a) How many customers in total expressed dissatisfaction last month? 1

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- (b) What percentage of customer complaints is made up by the three most frequent complaints? 1

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- (c) Perfect burritos want to significantly improve customer satisfaction in the next month. What single change would improve customer satisfaction the most? 1

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Question 10 (6 marks)

A particle, initially at rest at the origin, is moving in a straight line with velocity v m/s so that $v = 5t(4 - t)$ where t is the time in seconds. Find:

- (a) The acceleration of the particle after 4 seconds.

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- (b) An expression for the displacement, x metres, of the particle in terms of t .

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- (c) The total distance travelled in the first 6 seconds.

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Question 11 (7 marks)

A new home loan package is offered by Greenfield Home Loans with the following features:

Stage	Term	Special Features	Interest Rate
Introductory Stage	0-2 years (2 years)	No monthly repayments.	6% per annum compounded monthly
Secondary Stage	2-10 years (8 years)	Monthly repayments start. At the end of this period, the loan amount must be reduced to the original loan amount.	9% per annum compounded monthly
Final stage	Variable (but not exceeding 20 years)	Borrower determines the size of monthly repayments, with the loan to be repaid in full within 20 years	12% per annum compounded monthly

Anna and Carl decide to borrow \$500 000 for their first home, following the above terms of the package.

- (a) Show that the amount owing at the end of the introductory stage, to the nearest dollar, is \$563 580.

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Question 11 continued next page

- (b) The principal for the Secondary Stage will be \$563 580. Assume that the first monthly repayment, M , is paid after one month into the Secondary Stage. Find M , to the nearest cent, if the amount owing at the end of the Secondary Stage is to be \$500 000.

[illegible]

Question 11 continued next page

(c) At the start of the Final Stage, Anna and Carl decide that they can afford to repay \$6500 per month.

(i) Determine how many months it will take for the loan to be repaid in full.

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(ii) The last monthly repayment of \$6500 is more than required. How much should be refunded to Anna and Carl?

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Question 12 (7 marks)

Mahi invests \$20 000 into superannuation fund at the end of each year to save for her retirement. The interest is compounded monthly at a rate of 6% p.a.

- (a) Show that after three years, the value of Mahi’s superannuation fund is \$63776.75. **3**

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Question 12continued next page

- (b) After 10 years, just after her 10th deposit of \$20 000, Mahi withdraws \$100 000 to buy an apartment. Given that she continues to invest \$20 000 at the end of each year, find the balance of Mahi's superannuation fund after a further 5 years.

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

End of Exam

Baulkham Hills High School

Task 3 Examination 2025

Marking Guideline – Yr 12 Mathematics Advanced

Section I (5 marks)

Award 1 mark to each correct answer.

Answers: 1B 2C 3D 4C 5D

Q	Suggested solutions	
1		B
2	Particle will be at rest when $\frac{dx}{dt} = 0$ It will be at rest when $t = 2$ and $t = 4$.	C
3	Number of year 11 students above $175\text{ cm} = 25\%$ of 140 $= 35$ As 50% of year 12 students are above 175 cm 50% of number of year 12 students $= 35$ $\therefore$ Number of students in year 12 above $175\text{ cm} = 70$	D
4	$IQR = Q_3 - Q_1$ Without outliers, the data can be approximately $= \text{Range} = \text{Max} - \text{Min}$ $= 4 \times IQR$	C
5	At P , v is below x – axis $\therefore v < 0$ hence moving left Tangent at P is positive $\therefore \ddot{x} > 0$ hence moving left and solving down	D

Section II (43 marks)

In all questions, award full marks for correct answers with necessary working.

Use the suggested solutions in conjunction with the marking criteria.

Q	Suggested Solutions	Marking Criteria
6(a)	$r=0.9952$ 1 – correct solution	
b	$H = -0.8458... + 1.1866t$ $\therefore H = -0.85 + 1.19t$ 1 – correct solution	
c	When $H = 20$ $20 = -0.85 + 1.19t$ $t = \frac{20.85}{1.19} = 17.52$ $\therefore$ after 17.5 years 1 – correct solution(Ignore Decimal place)	
d	As t increases, its growth may not continue in a linear fashion.(or equivalent reasoning) 1 – correct solution	
7a	$F = F_0 e^{kt}$ $\frac{dF}{dt} = F_0 \times k e^{kt}$ $= k F_0 e^{kt}$ $\frac{dF}{dt} = kF$ 1 – correct solution	

b	$When\ t = 0, \quad F = F_o$ $t = 3, \quad F = 3F_o$ $For\ t = 2 \quad 3F_o = F_o e^{2k}$ $e^{2k} = 3$ $\ln e^{2k} = \ln 3$ $\therefore k = \frac{\ln 3}{2} = 0.549306\dots$ 2 – correct solution 1 – getting the expression $e^{2k} = 3$
c	$t = 6 \quad F = 21000$ $\therefore 21000 = F_o e^{0.549306 \times 6}$ $F_o = 777.78$ $\approx 778 \text{ fish}$ 2 – correct solution (correct rounding up) 1 – finding the correct F_o
8a	$-1 \leq \sin(nx + 1.5) \leq 1$ $-7 \leq \sin(nx + 1.5) \leq 7$ $6 \leq \sin(nx + 1.5) + 13 \leq 20$ $\therefore \text{max temp} = 20^\circ C \quad \text{min temp} = 6^\circ C$ 2 – correct solution 1 – either of max or min temperature is correct
b	$Period = \frac{2\pi}{n}$ $\frac{2\pi}{n} = 12$ $\frac{\pi}{6} = n = 0.52(2\ dp)$ 1-correct solution

c	Since function reaches min at $\sin \theta = -1$ $\therefore \sin(0.52n + 1.5) = -1$ $0.52n + 1.5 = \frac{3\pi}{2}$ $0.52n = 4.7124 - 1.5$ $n = 6.17$ $\therefore$ Just after 6 months. $\therefore$ lowest monthly temperature occurs around July. 2 – correct solution(If they got n=6.17 and June as a month 2 marks) 1 – working towards solution
9a	Number of dissatisfied customers = $200 + 150 + 100 + 25 + 125$ $= 700$ 1 – correct solution
b	$\% = \left(\frac{200 + 150 + 125}{700} \times 100 \right) \% = 67.86\% = 68\%$ 1 – correct solution
c	Reducing wait time (or equivalent reasoning) 1 – correct solution
10a	$v = 5t(4 - t) = 20t - 5t^2$ $\frac{dv}{dt} = a = 20 - 10t$ at $t = 4$, $a = -20 \text{ m/s}^2$ 2 – correct solution 1 – correctly finding the expression for a.
b	$x = \int v dt = \int (20t - 5t^2) dt$ $= \frac{20t^2}{2} - \frac{5t^3}{3} + C$ $t = 0, x = 0$ $0 = 0 - 0 + C \therefore C = 0$ Hence $x = 10t^2 - \frac{5}{3}t^3$ 2 - correct solution 1 – correct integration to find x.

c	$v = 20t - 5t^2$ $\text{total distance } d = \int_0^4 (20t - 5t^2) dt + \left \int_4^6 (20t - 5t^2) dt \right $ $= \left[10t^2 - \frac{5}{3}t^3 \right]_0^4 + \left \left[10t^2 - \frac{5}{3}t^3 \right]_4^6 \right $ $= \frac{160}{3} + \left -\frac{160}{3} \right = \frac{320}{3} = 106.6 \dot{m}$ 2 - correct solution 1 - correctly finding the expression for the total distance in terms of t.
11a	$A_{24} = 500000 \left(1 + \frac{0.06}{12} \right)^{24}$ $= 500000 (1.005)^{24}$ $= \$563580 \text{ to nearest dollar}$ 1 - correct solution
b	$A_1 = 563580(1.0075) - M$ $A_1 = A \times 1.0075 - M$ $= 563580(1.0075)^2 - M(1.0075 + 1)$ $A_3 = 563580(1.0075)^3 - M(1.0075^3 + 1.0075 + 1)$ $A_n = 563580(1.0075)^n - M(1.0075^{n-1} + 1.0075^{n-2} + \dots + 1)$ After 8 years owes \$500000 $8 \text{ years} = 8 \times 12 = 96$ $\therefore A_{96} = 500000$ $A_{96} = 563580(1.0075)^{96} - M(1.0075^{95} + 1.0075^{94} + \dots + 1)$ $500000 = 563580(1.0075)^{96} + M \left(\frac{1.0075^{96} - 1}{0.0075} \right)$ $500000 = 1154731.026 + M \left(\frac{1.0075^{96} - 1}{0.0075} \right)$ $M = \frac{654731.026}{139.856}$ $= \$4681.46$ 3 - correct solution 2 - correct expression for A_{96} and recognising that $A_{96} = 500000$ 1 - correct expression for A_n

C(i)	$r = 12\% \text{ } pa = 1\% pm, P = 500000$ $A_n = 500000(1.01)^n - M(1 + 1.01 + \dots 1.01^{n-1})$ <i>but</i> $A_n = 0$ $0 = 500000(1.01)^n - 6500(1 + 1.01 + \dots 1.01^{n-1})$ $0 = 500000(1.01)^n - 6500 \left(\frac{1.01^n - 1}{0.01} \right)$ $0 = 500000(1.01)^n - 650000(1.01^n - 1)$ $150000(1.01)^n = 650000$ $1.01^n = \frac{13}{3}$ $n \ln 1.01 = \ln \left(\frac{13}{3} \right)$ $n = 147.365$ Hence 148 full payments are made. 2 – correct solution 1 – progressing towards solution
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C(ii)	$A_{148} = 500000(1.01)^{148} - 6500 \left(\frac{1.01^{148} - 1}{0.01} \right)$ $= 500000(1.01)^{148} - 650000(1.01)^{148} + 650000$ $= -4115.71$ $\therefore$ Refund is 4115.71 1 – correct solution
12a	Let A_n be the amount after n months $r = 6\% \div 12$ $= 0.005$ $A_{12} = 20000$ $A_{24} = 20000(1.005)^{12} + 20000$ $A_{36} = 20000(1.005)^{24} + 20000(1.005)^{12} + 20000$ $= \$63776.7517\dots$ $= \$63776.75$ (nearest cent) 3 – correct solution 2 – Correctly finding A_{24} 1 – correct value of r and recognising $A_{12} = 20000$

b

From (a)

$$A_{36} = 20000(1.005)^{24} + 20000(1.005)^{12} + 20000 \\ = 20000(1 + 1.005^{12} + 1.005^{24})$$

$$\therefore A_{120} = 20000(1 + 1.005^{12} + 1.005^{24} + \dots 1.005^{108}) \\ = 20000 \left(\frac{1.005^{120} - 1}{1.005^{12} - 1} \right) \\ = \$265402.27$$

After 10 years and after withdrawal
value = \$165702.27

After 5 years

$$\text{value} = 165702.27(1.005)^{60} + \text{new annuity}$$

New annuity

$$A_{60} = 20000(1 + 1.005^{12} + \dots 1.005^{48}) \\ = 20000 \left(\frac{1.005^{60} - 1}{1.005^{12} - 1} \right) \\ = 113120.15$$

$\therefore$ value after 5 more years

$$= 165702.27(1.005)^{60} + 113120.15 \\ = \$336627.68 \text{ (nearest cent)}$$

4– correct solution

3 – correct expression for A_{60}

2– correct answer for A_{12}

1– finding the correct expression for A_3