

IB Diploma

MATHEMATICS AI

SL P1
2021 — 2025

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1 - (MATHAI/11_SL_Summer_2021_Q1) - *Algebra-functions - Roots*

[Maximum mark: 4]

Katya approximates π , correct to four decimal places, by using the following expression.

$$3 + \frac{1}{6 + \frac{13}{16}}$$

(a) Calculate Katya's approximation of π , correct to four decimal places. [2]

(b) Calculate the percentage error in using Katya's four decimal place approximation of π , compared to the exact value of π in your calculator. [2]

2 - (MATHAI/11_SL_Summer_2021_Q4) - *Algebra-functions - Roots*

[Maximum mark: 7]

The price of gas at Leon's gas station is \$1.50 per litre. If a customer buys a minimum of 10 litres, a discount of \$5 is applied.

This can be modelled by the following function, L , which gives the total cost when buying a minimum of 10 litres at Leon's gas station.

$$L(x) = 1.50x - 5, \quad x \geq 10$$

where x is the number of litres of gas that a customer buys.

(a) Find the total cost of buying 40 litres of gas at Leon's gas station. [2]

(b) Find $L^{-1}(70)$. [2]

The price of gas at Erica's gas station is \$1.30 per litre. A customer must buy a minimum of 10 litres of gas. The total cost at Erica's gas station is cheaper than Leon's gas station when $x > k$.

(c) Find the minimum value of k . [3]

3 - (MATHAI/12_SL_Summer_2021_Q7) - *Algebra-functions - Roots*

[Maximum mark: 5]

A function is defined by $f(x) = 2 - \frac{12}{x+5}$ for $-7 \leq x \leq 7$, $x \neq -5$.

(a) Find the range of f . [3]

(b) Find the value of $f^{-1}(0)$. [2]

4 - (MATHAI/10_SL_Winter_2021_Q5) - Algebra-functions - Roots

[Maximum mark: 7]

Let the function $h(x)$ represent the height in centimetres of a cylindrical tin can with diameter x cm.

$$h(x) = \frac{640}{x^2} + 0.5 \text{ for } 4 \leq x \leq 14.$$

- (a) Find the range of h . [3]

The function h^{-1} is the inverse function of h .

- (b) (i) Find $h^{-1}(10)$.
 (ii) In the context of the question, interpret your answer to part (b)(i).
 (iii) Write down the range of h^{-1} . [4]

5 - (MATHAI/10_SL_Winter_2021_Q6) - Algebra-functions - Roots

[Maximum mark: 5]

Inspectors are investigating the carbon dioxide emissions of a power plant. Let R be the rate, in tonnes per hour, at which carbon dioxide is being emitted and t be the time in hours since the inspection began.

When R is plotted against t , the total amount of carbon dioxide produced is represented by the area between the graph and the horizontal t -axis.

The rate, R , is measured over the course of two hours. The results are shown in the following table.

t	0	0.4	0.8	1.2	1.6	2
R	30	50	60	40	20	50

- (a) Use the trapezoidal rule with an interval width of 0.4 to estimate the total amount of carbon dioxide emitted during these two hours. [3]

The real amount of carbon dioxide emitted during these two hours was 72 tonnes.

- (b) Find the percentage error of the estimate found in part (a). [2]

6 - (MATHAI/11_SL_Summer_2022_Q5) - Algebra-functions - Roots

[Maximum mark: 5]

The ticket prices for a concert are shown in the following table.

Ticket Type	Price (in Australian dollars, \$)
Adult	15
Child	10
Student	12

- A total of 600 tickets were sold.
- The total amount of money from ticket sales was \$7816.
- There were twice as many adult tickets sold as child tickets.

Let the number of adult tickets sold be x , the number of child tickets sold be y , and the number of student tickets sold be z .

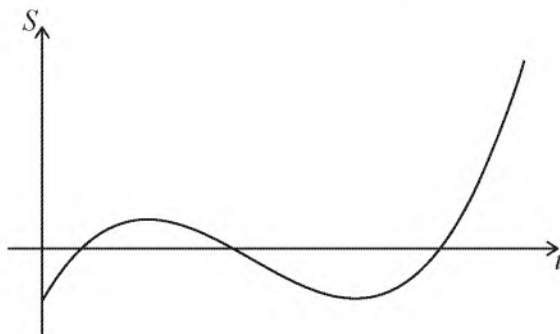
(a) Write down three equations that express the information given above. [3]

(b) Find the number of each type of ticket sold. [2]

7 - (MATHAI/12_SL_Summer_2022_Q9) - Algebra-functions - Roots

[Maximum mark: 8]

The graph below shows the average savings, S thousand dollars, of a group of university graduates as a function of t , the number of years after graduating from university.



- (a) Write down one feature of this graph which suggests a cubic function might be appropriate to model this scenario. [1]

The equation of the model can be expressed in the form $S = at^3 + bt^2 + ct + d$, where a , b , c and d are real constants.

The graph of the model must pass through the following four points.

t	0	1	2	3
S	-5	3	-1	-5

- (b) (i) Write down the value of d .
 (ii) Write down three simultaneous equations for a , b and c .
 (iii) Hence, or otherwise, find the values of a , b and c . [4]

A negative value of S indicates that a graduate is expected to be in debt.

- (c) Use the model to determine the total length of time, in years, for which a graduate is expected to be in debt after graduating from university. [3]

8 - (MATHAI/11_SL_Summer_2023_Q6) - *Algebra-functions - Roots*

[Maximum mark: 5]

When the brakes of a car are fully applied the car will continue to travel some distance before it completely stops. This stopping distance, d , in metres is directly proportional to the square of the speed of the car, v , in kilometres per hour (km h^{-1}).

When a car is travelling at a speed of 50 km h^{-1} it will travel 12.3 m after the brakes are fully applied before it completely stops.

- (a) Determine an equation for d in terms of v . [2]

The police can use this equation to estimate if cars are exceeding the speed limit.

A car is found to have travelled 33 m, after fully applying its brakes, before it completely stopped.

- (b) Use your equation from part (a) to estimate the speed at which this car was travelling before the brakes were applied. [2]

- (c) After the brakes have been fully applied, identify one other variable besides speed that could affect stopping distance. [1]

9 - (MATHAI/12_SL_Summer_2023_Q1) - *Algebra-functions - Roots*

[Maximum mark: 5]

Zaha is designing a bridge to cross a river. She believes that the weight of the steel needed for this bridge is approximately 53 632 000 kg.

The exact weight of the steel needed for the bridge is 55 625 000 kg.

- (a) Find the percentage error in Zaha's approximation. [2]

Zaha's design is used to build five identical bridges.

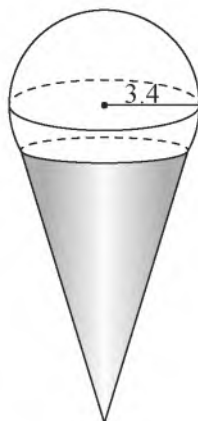
- (b) (i) Find the weight of the steel needed for these five bridges, **to three significant figures**.
(ii) Write down your answer to part (b)(i) in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$. [3]

10 - (MATHAI/12_SL_Summer_2023_Q8) - Algebra-functions - Roots

[Maximum mark: 5]

Ruhi buys a scoop of ice cream in the shape of a sphere with a radius of 3.4 cm. The ice cream is served in a cone, and it may be assumed that $\frac{1}{5}$ of the volume of the ice cream is inside the cone. This is shown in the following diagram.

diagram not to scale



- (a) Calculate the volume of ice cream that is not inside the cone.

[3]

The cone has a slant height of 11 cm and a radius of 3 cm.

The outside of the cone is covered with chocolate.

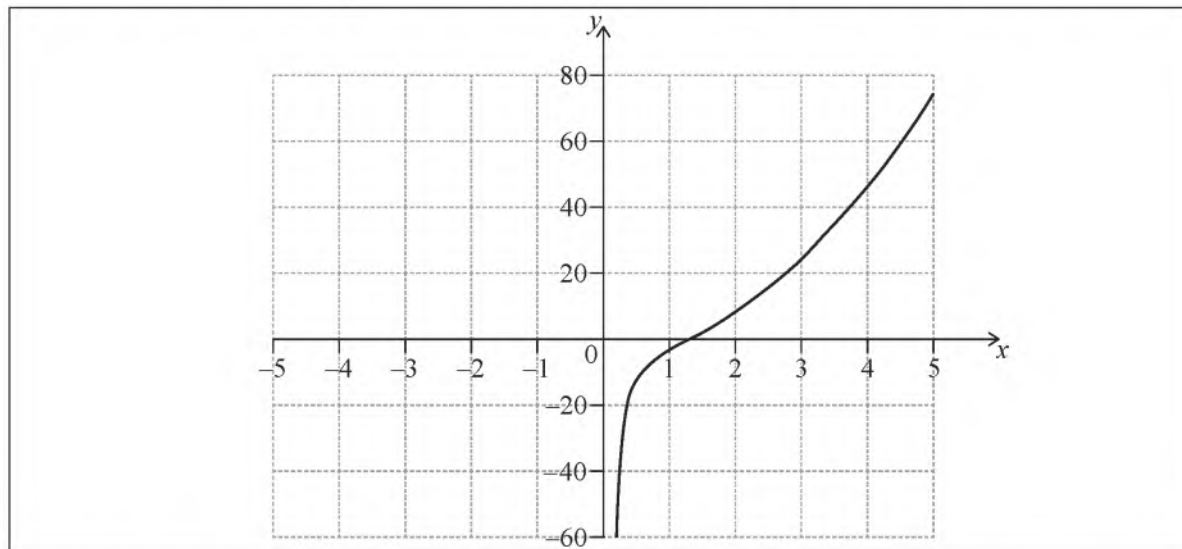
- (b) Calculate the surface area of the cone that is covered with chocolate. Give your answer correct to the nearest cm^2 .

[2]

11 - (MATHAI/12_SL_Summer_2023_Q11) - Algebra-functions - Roots

[Maximum mark: 7]

Consider $f(x) = 3x^2 - \frac{5}{x}$, $x \neq 0$. The graph of f for $0 < x \leq 5$ is shown on the following axes.



- (a) (i) Sketch the graph of f , for $-5 \leq x < 0$, on the same axes.
- (ii) Write down the x -coordinate of the local minimum point. [4]
- (b) Use your graphic display calculator to find the solutions to the equation $f(x) = 20$. [2]
- (c) Write down the equation of the vertical asymptote for the graph of f . [1]

12 - (MATHAI/11_SL_Winter_2023_Q6) - Algebra-functions - Roots

[Maximum mark: 4]

Consider the following function:

$$h(x) = \frac{2}{\sqrt{x-1}} + \frac{1}{2}, \text{ for } x > 1.$$

- (a) Find $h^{-1}(1)$. [2]
- (b) Find the domain of $h^{-1}(x)$. [2]

13 - (MATHAI/11_SL_Summer_2024_Q4) - Algebra-functions - Roots

[Maximum mark: 7]

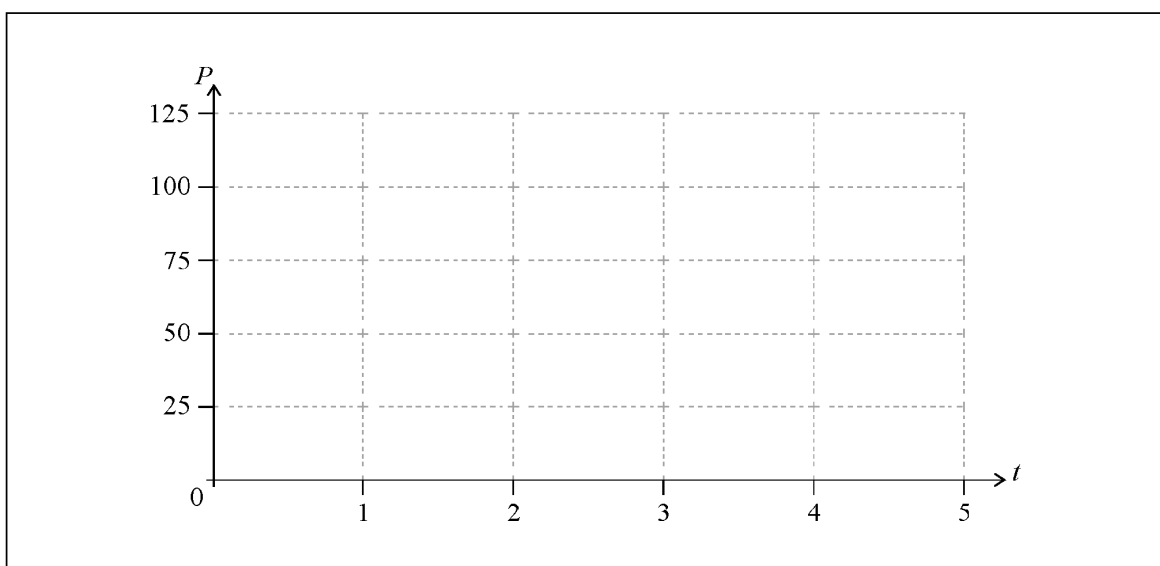
A cell phone starts charging at 07:00. While being charged, the percentage of power, P , in the phone is modelled by the function $P = 100 - 60 \times a^{-t}$, where t is the number of hours after 07:00.

- (a) Find the percentage of power in the phone at 07:00. [2]

The percentage of power in the phone reaches 75% at 08:00.

- (b) Find the value of a . [2]

- (c) Draw the graph of $P = 100 - 60 \times a^{-t}$ on the following set of axes. [2]



- (d) State a mathematical reason why the model predicts the percentage of power in the phone will never reach 100%. [1]

14 - (MATHAI/11_SL_Summer_2024_Q5) - Algebra-functions - Roots

[Maximum mark: 6]

Maan deposited \$100 000 into a savings account with a nominal annual interest rate of $I\%$ **compounded monthly**. At the end of the eighth year, the amount in the account had increased to \$150 000.

- (a) Find the value of I . [3]

Maan withdraws the \$150 000 and places it in an annuity, earning a nominal annual interest rate of 6.1% **compounded monthly**. At the end of each month, Maan will receive a payment of \$1000.

- (b) Find the amount of money remaining in the annuity at the end of 10 years. Express your answer to the nearest dollar. [3]

15 - (MATHAI/11_SL_Summer_2024_Q10) - Algebra-functions - Roots

[Maximum mark: 8]

When studying big cats, researchers use a model in which the mass (m kilograms) of an animal is directly proportional to the cube of its shoulder height (h metres).



Cheetah



Lion

A cheetah has a mass of 64 kg and shoulder height of 0.8 metres.

- (a) (i) Use the model to find an expression for m in terms of h .
- (ii) Hence find the mass of a different cheetah, with a shoulder height of 0.75 metres. [4]

'Rubner's law' states that the energy needs of an animal (E) are directly proportional to the square of h .

The energy needs of a lion of mass 220 kg are k times the energy needs of a cheetah of mass 64 kg.

- (b) Find the value of k . [4]

16 - (MATHAI/12_SL_Summer_2024_Q4) - Algebra-functions - Roots

[Maximum mark: 6]

At a particular building site, the number of square metres of bricks, n , that can be laid in one working day varies directly with the number of bricklayers, B .

Five bricklayers can lay an area of 60 m^2 of bricks in one working day.

- (a) Calculate the area that can be laid by 7 bricklayers in one working day. [3]

At another building site, the time, t hours, it takes to lay bricks varies inversely with the number of bricklayers, B .

Five bricklayers take 8 hours to lay an area of 60 m^2 .

- (b) Calculate how long it takes 12 bricklayers to lay an area of 60 m^2 . [3]

ANSWERS

1 - (MATHAI/11_SL_Summer_2021_Q1) - Algebra-functions - Roots

$$(a) \quad \pi \approx 3 + \frac{1}{6 + \frac{13}{16}}$$

$$= 3.14678... \left(\frac{343}{109}, 3 \frac{16}{109} \right)$$

$$= 3.1468$$

(A1)

A1

Note: Award **A1** for correct rounding to 4 decimal places.
Follow through within this part.

[2 marks]

$$(b) \quad \left| \frac{3.1468 - \pi}{\pi} \right| \times 100$$

(M1)

Note: Award **M1** for substitution of their final answer in part (a) into the percentage error formula. Candidates should use the exact value of π from their GDC.

$$= 0.166(\%) \quad (0.165754...)$$

A1

[2 marks]

2 - (MATHAI/11_SL_Summer_2021_Q4) - Algebra-functions - Roots

$$(a) \quad L(40) = 1.50 \times 40 - 5$$

(M1)

$$= \$ 55$$

A1

[2 marks]

$$(b) \quad 70 = 1.50x - 5$$

(M1)

$$(x =) 50 \text{ litres}$$

A1

[2 marks]

$$(c) \quad 1.30x$$

(A1)

$$1.30x < 1.50x - 5$$

(M1)

Note: Award **M1** for a graph showing two intersecting linear functions, provided one function has a y -intercept of 0 and the other function has a negative y -intercept.

$$(\text{minimum value of } k =) 25$$

A1

Note: Accept $x > 25$.

[3 marks]

3 - (MATHAI/12_SL_Summer_2021_Q7) - Algebra-functions - Roots

(a) $(f(-7) =) 8$ and $(f(7) =) 1$

(A1)

range is $f(x) \leq 1$, $f(x) \geq 8$

A1A1

Note: Award at most **A1A1A0** if strict inequalities are used.

[3 marks]

(b) **EITHER**sketch of f and $y = 0$ or sketch of f^{-1} and $x = 0$

(M1)

OR

finding the correct expression of $f^{-1}(x) = \frac{-2-5x}{x-2}$

(M1)

OR

$$f^{-1}(0) = \frac{-2-5(0)}{0-2}$$

(M1)

OR

$$f(x) = 0$$

(M1)

THEN

$$f^{-1}(0) = 1$$

A1

[2 marks]

4 - (MATHAI/10_SL_Winter_2021_Q5) - Algebra-functions - Roots

(a) $h(4) = \frac{640}{4^2} + 0.5$ **OR** $h(14) = \frac{640}{14^2} + 0.5$

(M1)

Note: Award **(M1)** for substituting 4 or 14 into h . This can be implicit from seeing 3.77 (3.76530...) or 40.5.

$$3.77 \leq h(x) \leq 40.5 \quad (3.76530... \leq h(x) \leq 40.5)$$

A1A1

Note: Award **A1** for both correct endpoints seen, **A1** for the endpoints in a correct interval.

[3 marks]

(b) (i) $h(x) = 10$ **OR** $h^{-1}(x) = \sqrt{\frac{640}{x-0.5}}$ **OR** $h^{-1}(10) = \sqrt{\frac{640}{10-0.5}}$

(M1)

$$(x =) 8.21 \text{ cm } (8.20782...)$$

A1

(ii) a tin that is 10 cm high will have a diameter of 8.21 cm (8.20782...)

A1

Note: Condone a correct answer expressed as the converse.

(iii) $4 \leq h^{-1} \leq 14$

A1

Note: Accept $4 \leq y \leq 14$. Do not **FT** in this part.

[4 marks]

Total: [7 marks]

5 - (MATHAI/10_SL_Winter_2021_Q6) - Algebra-functions - Roots

(a) attempt at using trapezoidal rule formula

(M1)

$$\frac{1}{2} \left(\frac{2-0}{5} \right) (30 + 50 + 2(50 + 60 + 40 + 20))$$

(A1)

(total carbon =) 84 tonnes

A1

[3 marks]

$$(b) \left| \frac{84 - 72}{72} \right| \times 100\%$$

(M1)

Note: Award **(M1)** for correct substitution of final answer in part (a) into percentage error formula.

$$= 16.7\% \text{ (16.6666...)\%}$$

A1

[2 marks]

Total: [5 marks]

6 - (MATHAI/11_SL_Summer_2022_Q5) - Algebra-functions - Roots

$$(a) \quad x + y + z = 600$$

A1

$$15x + 10y + 12z = 7816$$

A1

$$x = 2y$$

A1

Note: Condone other labelling if clear, e.g. a (adult), c (child) and s (student).
Accept equivalent, distinct equations e.g. $2y + y + z = 600$.

[3 marks]

$$(b) \quad x = 308, y = 154, z = 138$$

A1A1

Note: Award **A1** for all three correct values seen, **A1** for correctly labelled as x , y or z .
Accept answers written in words: e.g. 308 adult tickets.

[2 marks]

7 - (MATHAI/12_SL_Summer_2022_Q9) - Algebra-functions - Roots

- (a) *Accept any one of the following (or equivalent):*
 one minimum and one maximum point
 three x -intercepts or three roots (or zeroes)
 one point of inflexion

R1

Note: Do not accept "S shape" as a justification.

[1 mark]

- (b) (i) $(d =) -5$

A1

- (ii) $8 = a + b + c$
 $4 = 8a + 4b + 2c$
 $0 = 27a + 9b + 3c$

A2

Note: Award **A2** if all three equations are correct.
 Award **A1** if at least one is correct. Award **A1** for three correct equations that include the letter " d ".

- (iii) $a = 2, b = -12, c = 18$

A1**[4 marks]**

- (c) equating found expression to zero

(M1)

$$0 = 2t^3 - 12t^2 + 18t - 5$$

$$t = 0.358216..., 1.83174..., 3.81003...$$

(A1)

(so total time in debt is $3.81003... - 1.83174... + 0.358216 \approx$)
 2.34 (2.33650...) years

A1**[3 marks]**

8 - (MATHAI/11_SL_Summer_2023_Q6) - Algebra-functions - Roots

- (a) attempt to set up a direct variation equation that includes a constant, k , or the calculation of a constant using 12.3 and 50

(M1)

e.g., $d = kv^2$ OR $12.3 = k \times 50^2$

$(k =) 0.00492 \left(\frac{1}{203.252...} \right)$

$d = 0.00492v^2$ OR $d = \frac{v^2}{203}$

A1**[2 marks]**

- (b) substituting 33 for d in their part (a)

(A1)

$33 = 0.00492 \times v^2$ OR $33 = \frac{v^2}{203.252...}$

$(v =) 81.9 \text{ (km h}^{-1}\text{)} \text{ (81.8982... (km h}^{-1}\text{))}$

A1**[2 marks]**

- (c) Award **R1** for a reasonable variable that exists after the brakes are applied such as:

- | | |
|----------------------------|----------------------------|
| • road material | • gradient/incline of road |
| • weather conditions | • traction |
| • condition/type of brakes | • wind resistance |
| • weight/type of vehicle | • friction |

R1

Note: Do not accept a variable that refers to the timing of the brakes being applied such as:

- slow reaction time
- inexperienced driver

[1 mark]

9 - (MATHAI/12_SL_Summer_2023_Q1) - Algebra-functions - Roots

- (a) attempt to substitute into percentage error formula

(M1)

$$\left| \frac{53632000 - 55625000}{55625000} \right| \times 100$$

$$3.58\% \quad (3.58292\ldots\%)$$

A1

Note: Award (M1)A0 for a final answer of -3.58% or 0.0358 .

[2 marks]

- (b) (i) 278 000 000

A1

(ii) 2.78×10^8

A1A1

Note: Award A1 for correct mantissa, consistent with their answer in part (b)(i).
Award A1 for a correct exponent, consistent with their answer in part (b)(i).
Award A0A0 for answers such as 27.8×10^7 .

[3 marks]

10 - (MATHAI/12_SL_Summer_2023_Q8) - Algebra-functions - Roots

- (a) EITHER

$$\frac{4}{3}\pi(3.4)^3$$

(A1)

multiplying their volume by $\frac{4}{5}$

(M1)

OR

$$\frac{4}{3}\pi(3.4)^3$$

(A1)

Subtracting $\frac{1}{5}$ of their volume

(M1)

$$\left(\frac{4}{3}\pi(3.4)^3 - \frac{1}{5} \times \frac{4}{3}\pi(3.4)^3 \right)$$

Note: The M1 can be awarded for a final answer of $32.9272\ldots$ seen without working.

THEN

$$132 \text{ cm}^3 \quad (131.708\ldots \text{ cm}^3)$$

A1

[3 marks]

- (b)
- $\pi \times 3 \times 11$

(A1)

$$103.672\ldots (\text{cm}^2) \quad \text{OR} \quad 33\pi(\text{cm}^2)$$

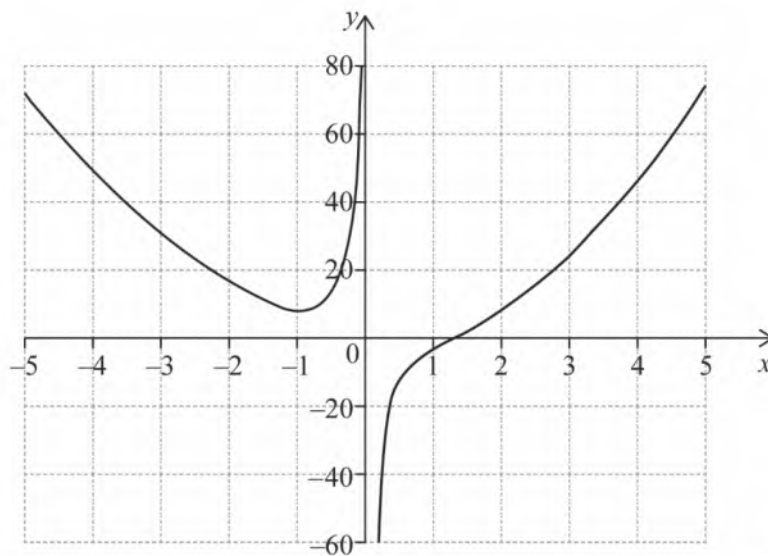
$$104 (\text{cm}^2)$$

A1

[2 marks]

11 - (MATHAI/12_SL_Summer_2023_Q11) - Algebra-functions - Roots

(a) (i)

**A1A1A1**

Note: Award **A1** for correct shape (curve must be smooth) in the second quadrant only, **A1** for asymptotic behaviour, **A1** for minimum point in approximately correct position AND left-most point around $(-5, 76)$ (allow a tolerance of half a square for these two points).

(ii) -0.941 ($-0.941035\dots$)**A1****[4 marks]**(b) -2.45 ($-2.44651\dots$), -0.252 (-0.252412), 2.70 ($2.69892\dots$)**A2**

Note: Award **A2** for all three correct, **A1** for two correct and **A0** otherwise. Award at most **A1** if additional solutions are seen. Award **A1A0** for a final answer given as coordinates $(-2.45, 20)$, $(-0.252, 20)$, $(2.70, 20)$ or $(2.7, 20)$. Award **A1A0** for three correct answers given in 2 sf.

[2 marks](c) $x = 0$ **A1****[1 mark]**

12 - (MATHAI/11_SL_Winter_2023_Q6) - Algebra-functions - Roots

(a) setting $h(x) = 1$
 $(h^{-1}(1)) = 17$

(M1)

A1

[2 marks]

(b) $x > \frac{1}{2}$

A1A1

Note: Award **A1** for $\frac{1}{2}$ seen, **A1** for completely correct answer.

[2 marks]

13 - (MATHAI/11_SL_Summer_2024_Q4) - Algebra-functions - Roots

(a) correct substitution of $t = 0$
 $100 - 60 \times a^0$
 $= 40$ (%)

(A1)

A1

[2 marks]

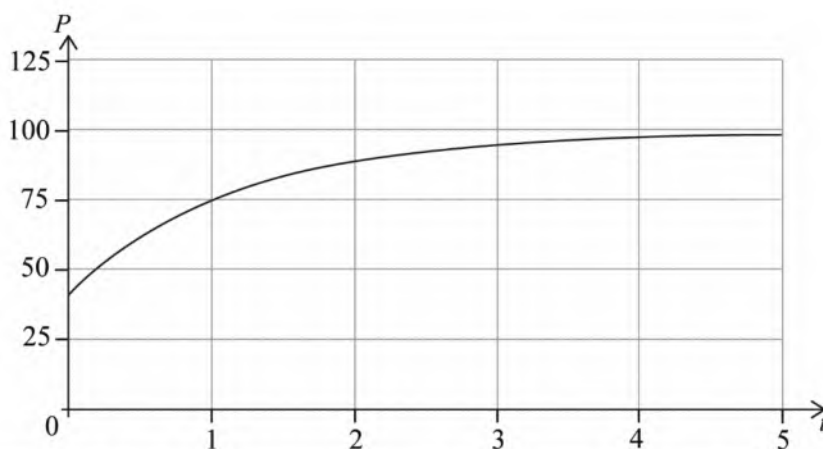
(b) correct substitution of $P = 75$ and $t = 1$
 $75 = 100 - 60 \times a^{-1}$
 $a = 2.4$

(A1)

A1

[2 marks]

(c)



A1A1

Note: Award **A1** for correct general shape (increasing, concave down) passing through (1, 75) and continuing on, **A1** for a curve starting from (0, 40), finishing around (5, 100).

[2 marks]

(d) EITHER
 has a horizontal asymptote at $P = 100$

A1

Note: Accept a description of the asymptote in words.

OR

equation is 100 minus a positive value and hence cannot equal 100

A1

Note: Award **A0** for a contextualized answer with no mathematical justification, e.g. "battery may degrade".

[1 mark]

14 - (MATHAI/11_SL_Summer_2024_Q5) - Algebra-functions - Roots

(a) EITHER

$$N = 96$$

$$PV = \mp 100000$$

$$FV = \pm 150000$$

$$P/Y = 12$$

$$C/Y = 12$$

(M1)(A1)

OR

$$N = 8$$

$$PV = \mp 100000$$

$$FV = \pm 150000$$

$$P/Y = 1$$

$$C/Y = 12$$

(M1)(A1)

OR

$$150000 = 100000 \left(1 + \frac{I}{100 \times 12} \right)^{12 \times 8}$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app (at least 3 entries, not necessarily correct) or an attempt to use a compound interest formula.
Award **A1** for all entries correct in financial app or correct substitution in compound interest formula.

THEN

$$I = 5.08 \text{ (5.07903...)}$$

A1

[3 marks]

(b) $N = 120$

$$I\% = 6.1$$

$$PV = \mp 150000$$

$$PMT = \pm 1000$$

$$P/Y = 12$$

$$C/Y = 12$$

(M1)(A1)

Note: Award **M1** for an attempt to use a financial app (at least 3 entries, not necessarily correct). Award **A1** for all entries correct in financial app (condone missing +/- sign if the correct final answer is seen).

$$FV = (\$) 110867$$

A1

Note: Answer must be correct to nearest dollar to award the final **A1**. Award **(M1)(A1)A0** for an unsupported final answer to a greater degree of accuracy eg. (\$) 110866.70...
Award **M1A1A0** for a truncated answer of 110866 if no working is shown.

[3 marks]

15 - (MATHAI/11_SL_Summer_2024_Q10) - Algebra-functions - Roots

$$(a) \quad (i) \quad m = ah^3 \quad (M1)$$

$$64 = a \times 0.8^3 \quad (\Rightarrow a = 125) \quad (A1)$$

$$m = 125h^3 \quad A1$$

Note: The final answer must be written as m in terms of h to award the final **A1**.

$$(ii) \quad m = (125(0.75)^3) = 52.7 \text{ (kg)} \quad (52.7343...) \quad A1$$

[4 marks]

(b) **EITHER (finding the height of the lion)**

$$(220 = 125h^3)$$

$$h = \sqrt[3]{1.76} \quad (1.20736...) \quad (A1)$$

$$E = k_1 h^2 \quad (\text{seen anywhere}) \quad (A1)$$

$$k = \frac{(\sqrt[3]{1.76})^2}{0.8^2} \quad (M1)$$

$$= 2.28 \quad (2.27769...) \quad A1$$

OR (finding a formula for E in terms of m)

$$(m = 125h^3)$$

$$E = k_1 h^2 \quad (A1)$$

$$E = k_2 m^{\frac{2}{3}} \quad (A1)$$

$$k = \frac{220^{\frac{2}{3}}}{64^{\frac{2}{3}}} \quad (M1)$$

$$= 2.28 \quad (2.27769...) \quad A1$$

[4 marks]

16 - (MATHAI/12_SL_Summer_2024_Q4) - Algebra-functions - Roots

(a) expressing one variable in terms of the other

(M1)

$$n = kB \quad \text{OR} \quad n \propto B$$

$$60 = 5k$$

$$k = 12$$

$$n = 12(7)$$

$$= 84$$

(A1)

A1

[3 marks]

(b) expressing t terms of reciprocal of B

(M1)

$$t = \frac{c}{B} \quad \text{OR} \quad t \propto \frac{1}{B}$$

$$8 = \frac{c}{5}$$

$$c = 40$$

(A1)

$$(t =) \frac{40}{12} \left(\frac{10}{3}, 3.33, 3.33333\ldots \right) \text{(hours)} \quad \text{OR} \quad 3 \text{ hours } 20 \text{ minutes}$$

A1

Note: Award at most **M1A1A0** for the use of $t = cB$ in part (b) if $n = \frac{k}{B}$ was seen and penalized in part (a).

[3 marks]

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