Rossmoyne Senior High School

Semester One Examination, 2022

Question/Answer booklet

MATHEMATICS METHODS UNIT 3

SOLUTIONS

Section Two: Calculator-assumed

WA student number: In figures

In words

Time allowed for this section

Reading time before commencing work: ten minutes
Working time: one hundred 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 (retained from Section One)

To be provided by the candidate

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

Special items: drawing instruments, templates, notes on two unfolded sheets of A4 paper, and up to three calculators, which can include scientific, graphic and Computer Algebra System (CAS) calculators, are permitted in this ATAR course examination

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	7	7	50	55	35
Section Two: Calculator-assumed	12	12	100	95	65
				Total	100

Instructions to candidates

1. The rules for the conduct of examinations are detailed in the school handbook. 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 specific 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 Two: Calculator-assumed **65% (95 Marks)**

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

Working time: 100 minutes.

Question 8 **(8 marks)**

A small body moving in a straight line has an initial velocity of 15 cm/s as it leaves point P. The acceleration of the body at time t seconds is $6 - 1.5t$ cm^2/s, $t \geq 0$.

(a) Determine the displacement of the body relative to P after 2 seconds. (4 marks)

Solution
$v = \int 6 - 1.5t \, dt = 6t - 0.75t^2 + c$ $t = 0, v = 15 \Rightarrow c = 15$ $v(t) = 6t - 0.75t^2 + 15$ $x(2) - x(0) = \int_0^2 v(t) \, dt$ OR $x(t) = 3t^2 - 0.25t^3 + 15t$ $= 40 \text{ cm}$
Specific behaviours
✓ antidifferentiates acceleration, with constant (+ c) ✓ obtains expression for velocity ✓ integral for change in displacement OR displacement function ✓ correct displacement

(b) Determine the maximum velocity of the body. (2 marks)

Solution
$a = 0 \Rightarrow t = 4$ $v(4) = 27 \text{ cm/s}$
Specific behaviours
✓ indicates time ✓ correct maximum velocity F/T from part (a), answer only ok

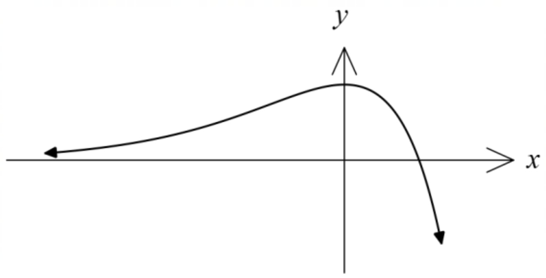
(c) Determine the maximum displacement of the body relative to P. (2 marks)

Solution
$v = 0 \Rightarrow t = 10$ $x(10) - x(0) = \int_0^{10} v(t) \, dt = 200 \text{ cm}$
Specific behaviours
✓ indicates time ✓ correct maximum displacement F/T from part (a), answer only ok

Question 9 **(7 marks)**

Let $f(x) = (5 - x)e^{0.2x}$.

The graph of $y = f(x)$ is shown at right.



(a) Use calculus to determine the coordinates of the stationary point and justify that the stationary point is a local maximum. (5 marks)

Solution
$f'(x) = -\dfrac{xe^{0.2x}}{5}$ ***or*** $f'(x) = -\dfrac{xe^{\frac{x}{5}}}{5}$ ***or*** $f'(x) = -0.2xe^{0.2x}$ $f'(x) = 0 \text{ when } -\dfrac{xe^{0.2x}}{5} = 0 \Rightarrow x = 0, \text{and } f(0) = 5.$ $f''(x) = -\dfrac{xe^{0.2x} + 5e^{0.2x}}{25}$ $f''(0) = -{}^{1}/_{5}$, and so $f''(0) < 0$, curve concave down.   Hence the stationary point is a local maximum and is located at $(0, 5)$.
Specific behaviours
✓ obtains first derivative   ✓ sets first derivative equal to zero and solves for x ✓ obtains second derivative   ✓ shows second derivative at stationary point is less than zero   ✓ concludes stationary point is a maximum and states coordinates

(b) Use calculus to determine the coordinates of the point of inflection. (2 marks)

Solution
$f''(x) = 0 \text{ when } -\dfrac{xe^{0.2x} + 5e^{0.2x}}{25} = 0 \Rightarrow x = -5$ $f(-5) = {}^{10}/_{e} \quad (\approx 3.68)$ Hence the point of inflection is at $(-5, {}^{10}/_{e})$.
Specific behaviours
✓ sets second derivative equal to zero and solves for x ✓ states coordinates of point of inflection

Question 10 **(4 marks)**

Rahul has been offered a sales position at a car dealership. His weekly pay will consist of a retainer of $260 and a commission of $600 for each new car sold. The following table shows the probability of him selling specific numbers of cars every week.

N	0	1	2	3	4	5	6
$P(N = n)$	0.1	0.32	0.2	0.15	0.1	0.08	0.05

(a) Explain why the table above is considered a PDF. (2 marks)

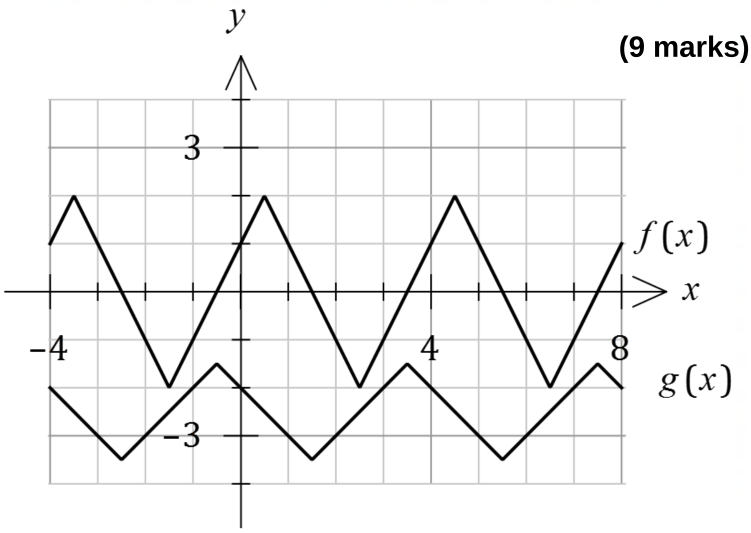
Solution
Probabilities add up to 1 Probabilities are all positive or $0 \le P(N = n) \le 1$
Specific behaviours
✓ states they add to 1 ✓ states they are all positive

(b) Calculate Rahul's expected weekly pay. (2 marks)

Solution
$E(N) = 0.32 + (2 \times 0.2) + (3 \times 0.15) + (4 \times 0.1) + (5 \times 0.08) + (6 \times 0.05)$ $= 2.27$ Weekly pay = $260 + 2.27(600) = $1622
Specific behaviours
✓ correct value for E(N) ✓ correct value for weekly pay

Question 11 **(9 marks)**

The graphs of the continuous functions $y = f(x)$ and $y = g(x)$ are shown at right.



(a) Evaluate the derivative of $g(x)f(x)$ at $x = 2$. (3 marks)

Solution
$$\begin{aligned}\frac{d}{dx}\big(g(x)f(x)\big)_{x=2} &= g'(2)f(2) + g(2)f'(2)\\ &= (1)(-1) + (-3)(-2)\\ &= 5\end{aligned}$$
Specific behaviours
✓ indicates correct value of $g'(2)$ ✓ indicates correct value of $f'(2)$ ✓ correctly evaluates derivative

(b) Evaluate the derivative of $g\big(f(x)\big)$ at $x = -3$. (3 marks)

Solution
$$\begin{aligned}\frac{d}{dx}g\big(f(x)\big)_{x=-3} &= g'\big(f(-3)\big) \times f'(-3)\\ &= g'(1) \times f'(-3)\\ &= -1 \times -2\\ &= 2\end{aligned}$$
Specific behaviours
✓ indicates correct application of chain rule ✓ indicates correct value of $g'\big(f(-3)\big)$ ✓ correctly evaluates derivative

(c) Evaluate the derivative of $\dfrac{f'(x)}{g(x)}$ at $x = 5$. (3 marks)

Solution
$$\begin{aligned}\frac{d}{dx}\left(\frac{f'(x)}{g(x)}\right)_{x=5} &= \frac{f''(5)g(5) - f'(5)g'(5)}{\big(g(5)\big)^2}\\ &= \frac{(0)(-3) - (-2)(-1)}{(-3)^2}\\ &= -{}^{2}/_{9}\end{aligned}$$
Specific behaviours
✓ indicates correct application of quotient rule ✓ indicates correct value of $f''(0)$ ✓ correctly evaluates derivative

Question 12 **(10 marks)**

A full water tank takes 38 seconds to empty. The volume V litres of water in the tank, t seconds after emptying began, is changing at a rate given by

$$\frac{dV}{dt} = \sqrt[3]{9t+1} - 7, \qquad 0 \leq t \leq 38.$$

(a) Determine the initial rate of change of volume. (1 mark)

Solution
$\frac{dV}{dt}\Big\|_{x=0} = \sqrt[3]{9(0)+1} - 7 = -6\ \mathrm{L/s}$
Specific behaviours
✓ correct rate of change

(b) Use the increments formula to estimate the volume of water that empties from the tank during the first one-third of a second. (3 marks)

Solution
$\delta V \approx \frac{dV}{dt}\delta t$ $\approx -6 \times {}^{1}/_{3} \approx -2$ An estimated 2 L empties from the tank.
Specific behaviours
✓ shows use of the increments formula   ✓ states δt ✓ correct estimate

(c) Determine the initial volume of water in the tank. (3 marks)

Solution
$V(0) - V(38) = \int_{38}^{0} \sqrt[3]{9t+1} - 7\, dt$ $= 66$ Hence tank initially contained 66 L.
Specific behaviours
✓ writes correct integral   ✓ evaluates total change   ✓ states correct initial volume

Solution
$V(0) - V(38) = -\int_{0}^{38} V'(t)\, dt$ $V(0) = -\int_{0}^{38} V'(t)\, dt$ $= 66$ Hence tank initially contained 66 L.
Specific behaviours
✓ writes correct integral   ✓ evaluates total change   ✓ states correct initial volume

(d) Determine the time, to the nearest 0.01 second, when the tank is half full. (3 marks)

Solution
$V = \int \sqrt[3]{9t+1} - 7\,dt = \frac{1}{12}(9t+1)^{\frac{4}{3}} - 7t + c$ But when $t = 0, V = 66$ and so $c = {}^{791}/_{12} = 61.91\overline{6}$ $\frac{1}{12}(9t+1)^{\frac{4}{3}} - 7t + \frac{791}{12} = \frac{66}{2}$ $t = 8.85$ s
Specific behaviours
✓ obtains antiderivative ✓ evaluates constant of integration ✓ solves for time

Solution
$Solve\ \int_0^k \left(\frac{dV}{dt}\right) dt = -33, k$ $t = 8.85$ s
Specific behaviours
✓ Sets up integral with correct bounds ✓ integral equal to **negative** 33 ✓ solves for time

Question 13 **(6 marks)**

A bag contains three blue and six green balls. Two balls are drawn at random and in succession from the bag. At each draw, if the ball is blue it is replaced in the bag, and otherwise the ball is not replaced. Let X be the number of blue balls drawn.
Construct a probability distribution table for X, using exact values.

x	$P(X=x)$
0	$\frac{5}{12}$
1	$\frac{17}{36}$
2	$\frac{1}{9}$

Solution
$P(X=2)=\frac{3}{9}\times\frac{3}{9}=\frac{1}{9}$ $P(X=0)=\frac{6}{9}\times\frac{5}{8}=\frac{5}{12}$ $P(X=1)=1-\frac{1}{9}-\frac{5}{12}=\frac{17}{36}$
Specific behaviours
✓ calculates $P(X=0)$ ✓ ✓calculates $P(X=1)$ ✓ calculates $P(X=2)$ ✓ constructs table with correct conventions ✓ completes table using exact values

Question 14 **(10 marks)**

The following table shows the probability distribution of a discrete random variable X, where k is a constant.

x	-2	0	1	3
$P(X=x)$	$4k^2$	0.15	$2k$	0.1

(a) Determine the value of k. (3 marks)

Solution

$$4k^2 + 0.15 + 2k + 0.1 = 1$$
$$4k^2 + 2k - 0.75 = 0$$
$$k = \frac{1}{4} = 0.25 \ \ (k \geq 0)$$

Specific behaviours

✓ indicates sum of probabilities is 1
✓ forms equation
✓ solves and states single value of k

(b) Determine $E(X)$. (2 marks)

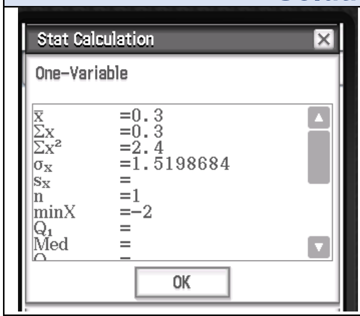
Solution

$$E(X) = (-2)(0.25) + (0)(0.15) + (1)(0.5) + (3)(0.1)$$
$$= \frac{3}{10} = 0.3$$

Specific behaviours

✓ indicates correct method
✓ correct expected value

Solution



Specific behaviours

✓ indicates use of classpad
✓ correct expected value

(c) Given that $\mathrm{Var}(X) = 2.31$, determine the following for the discrete random variable Z:

(i) $E(Z)$ when $Z = 5X - 3$. (1 mark)

Solution

$$E(Z) = 5E(X) - 3 = 5(0.3) - 3 = -\frac{3}{2} = -1.5$$

Specific behaviours

✓ correct value

(ii) $\mathrm{Var}(Z)$ when $Z = \frac{X}{3} + 2$. (2 mark)

Solution

$$\mathrm{Var}(Z) = \left(\frac{1}{3}\right)^2 \mathrm{Var}(X) = \frac{1}{9}(2.31) = \frac{77}{300} = 0.25\overline{6}$$

Specific behaviours

✓ indicates correct method
✓ correct value

(iii) The standard deviation of Z when $Z = 5(2 - X)$. (2 mark)

Solution

$$\sigma_Z = 5\sqrt{\mathrm{Var}(X)} = 5\left(\frac{\sqrt{231}}{10}\right) = \frac{\sqrt{231}}{2} \approx 7.6$$

Specific behaviours

✓ indicates correct method
✓ correct value

Question 15 **(8 marks)**

The concentration of a drug in the plasma of a monkey, C micrograms per litre, t hours after being administered, can be modelled by $C = C_0 e^{kt}$, where C_0 and k are constants.
Each dose of the drug immediately increases the existing concentration by $430\ \mu\text{g/L}$ ($C_0 = 430$), and the concentration of the drug is known to halve every 2 hours and 40 minutes.

A monkey, with no existing trace of the drug, was administered a first dose at $8{:}00$ am.

(a) Use the model to determine the rate of change of concentration of the drug in the monkey's plasma later that morning at $10{:}40$ am. (4 marks)

Solution
$0.5 = e^{2.\overline{6}k} \to k = \dfrac{-3\ln(2)}{8} = -0.25993$
$\dfrac{dC}{dt} = kC_0e^{kt} = kC$
At $10{:}40$ am, $t = 2\text{h }40\text{m}$ and so $C = 430 \div 2 = 215$.
$\dfrac{dC}{dt} = -0.26(215)$ $= -55.9\ \mu\text{g/L/h}$
Specific behaviours
✓ correctly forms equation for k using half life   ✓ solves for k ✓ indicates expression for rate of change   ✓ correctly calculates rate of change

Solution
$0.5 = e^{2.\overline{6}k} \to k = \dfrac{-3\ln(2)}{8} = -0.25993$
$\dfrac{dC}{dt} = kC_0e^{kt}$
At $10{:}40$ am, $C_o = 430$
$\dfrac{dC}{dt} = \dfrac{-3\ln(2)}{8} \times e^{\frac{-3\ln(2)}{8}\times 2.\dot{6}} \times 430$ $= -55.9\ \mu\text{g/L/h}$
Specific behaviours
✓ correctly forms equation for k using half life   ✓ solves for k ✓ indicates expression for rate of change   ✓ correctly calculates rate of change

An additional dose is administered every time the concentration falls to $130\ \mu\text{g/L}$.

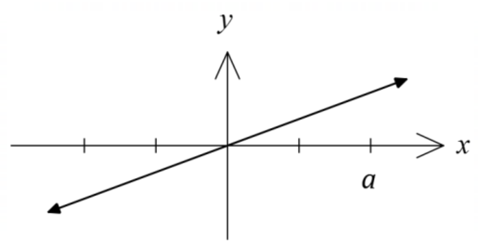
(b) Determine the expected time of day, to the nearest minute, that the third dose will be administered to the monkey. (4 marks)

Solution
Time until second dose is given: $430e^{-0.26t} = 130 \to t = 4.602$.
New $C_0 = 130 + 430 = 560 \to C = 560e^{-0.26t}$.
Time from second to third dose: $560e^{-0.26t} = 130 \to t = 5.618$.
Total time: $T = 4.602 + 5.618 = 10.22 = 10\text{h }13\text{m}$. Hence third dose will be given at $8{:}05 + 10{:}13 = 6{:}18$ pm.
Specific behaviours
✓ time until second dose administered   ✓ indicates new equation for concentration   ✓ time between second and third doses   ✓ correct time of day

Question 16 **(7 marks)**

(a) Consider the function $f(x) = mx$, where m is a constant.
The graph of $y = f(x)$ is shown at right, a is a constant and

$$\int_0^a f(x)\,dx = 5.$$



Determine the value of

(i) $\int_{-a}^{a} f(x)\,dx.$ (1 mark)

Solution
$\int_{-a}^{a} f(x)\,dx = \int_{-a}^{0} f(x)\,dx + \int_0^a f(x)\,dx = -5 + 5 = 0$
Specific behaviours
✓ correct value

(ii) $\int_0^a 2f(x-a)\,dx.$ (2 marks)

Solution
$\int_0^a 2f(x-a)\,dx = 2\int_{-a}^{0} f(x)\,dx = 2(-5) = -10$
Specific behaviours
✓ uses linearity to move constant outside integral **or** uses diagram to show transformation ✓ correct value Answer only ok

(b) The polynomial function $g(x)$ is such that $\int_{-2}^{3} g(x)\,dx = 8.$

Determine the value of $\int_{-2}^{1} (2x + g(x))\,dx + \int_1^3 (g(x) - 1)\,dx.$ (4 marks)

Solution
$I = \int_{-2}^{1} \big(2x + g(x)\big)\,dx + \int_1^3 \big(g(x) - 1\big)\,dx$ $= \int_{-2}^{1} (2x)\,dx + \int_{-2}^{1} \big(g(x)\big)\,dx + \int_1^3 \big(g(x)\big)\,dx - \int_1^3 (1)\,dx$ $= [x^2]_{-2}^{1} + \int_{-2}^{3} \big(g(x)\big)\,dx - [x]_1^3$ $= 1 - 4 + 8 - (3 - 1)$ $= 3$
Specific behaviours
✓ uses linearity to obtain four integrals ✓ uses additivity to combine integrals of $g(x)$ ✓ evaluates $2x$ integral correctly ✓ correct value

Question 17 **(10 marks)**

A bus is scheduled to arrive at a particular bus stop at 8:41 am.
It is equally likely to arrive during any minute between 8:39am and 8:46am.

T is defined as the number of whole minutes that the bus arrives earlier or later than the scheduled time.

(a) Explain why T is defined as a discrete random variable **and** why the domain of T is {–2, –1, 0, 1, 2, 3, 4, 5}. (2 marks)

Solution
DRV because domain is integer values Domain is the integer values made up from 2 minutes before 8:41 and the five minutes after 8:41 am.
Specific behaviours
✓ reasonable explanation for DRV ✓ reasonable explanation for Domain

(b) Write down the probability distribution for *T*. (2 marks)

Solution

t	-2	-1	0	1	2	3	4	5
$P(T=t)$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$

Specific behaviours

✓ table mostly correct
✓ table correct
Do not penalise for using x instead of t, just comment

(c) Determine the probability that a bus:

(i) arrives on time. (1 mark)

Solution
$\frac{1}{8}$
Specific behaviours
✓ correct value

(ii) arrives at 8:42 am, if it is late. (2 marks)

Solution
$P(8{:}42\ \vert late) = \dfrac{\frac{1}{8}}{\frac{5}{8}} = \dfrac{1}{5}$
Specific behaviours
✓ correct use of conditional probability ✓ correct probability

(iii) arrives less than 3 minutes late, if it is not on time. (3 marks)

Solution
$P(less\ than\ 3\ late\ \vert not\ on\ time) = \dfrac{\frac{4}{8}}{\frac{7}{8}} = \dfrac{4}{7}$
Specific behaviours
✓ correct use of conditional probability ✓ includes T= -2, -1 when calculating probability ✓ correct probability

Question 18 **(10 marks)**

A small body moves in a straight line with velocity v cm/s at time t s given by

$$v(t) = 11 + 4\sin\left(\frac{\pi t}{10}\right) - 6\sin\left(\frac{\pi t}{5}\right), \qquad t \geq 0.$$

(a) By viewing the graph of the velocity function on your calculator, or otherwise, state the minimum velocity of the body for $t \geq 0$ to the nearest 0.01 cm/s, and hence explain why the distance travelled by the body in any interval of time will always be the same as the change in displacement of the body. (2 marks)

Solution
$v_{MIN} = 2.02\text{ cm/s}$ Distance travelled same as change in displacement as the velocity is always positive.
Specific behaviours
✓ states minimum velocity ✓ explanation

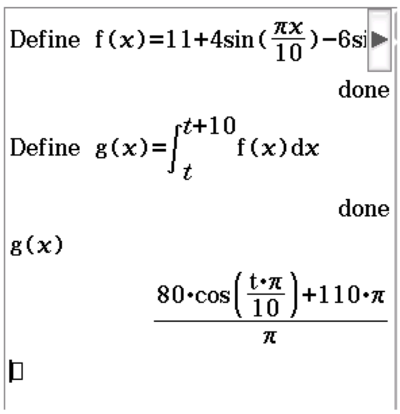
(b) Determine the distance travelled by the body between $t = 0$ and $t = 20$. (2 marks)

Solution
$x(20) - x(0) = \int_0^{20} v(t)\,dt$ $= 220\text{ cm}$
Specific behaviours
✓ writes correct integral ✓ correct distance

The distance travelled (x cm) by the body in any 10 second interval from $t = T$ to $t = T + 10$ is given by the function $x(T) = a + b\cos\left(\frac{\pi T}{10}\right)$.

(c) Determine the value of the constant a and the value of the constant b. (2 marks)

Solution
$x(T) = \int_T^{T+10} v(t)\,dt$ $= 110 + \frac{80}{\pi}\cos\left(\frac{\pi T}{10}\right)$ Hence $a = 110$ and $b = \frac{80}{\pi}$.
Specific behaviours
✓ writes integral ✓ uses result to state both values



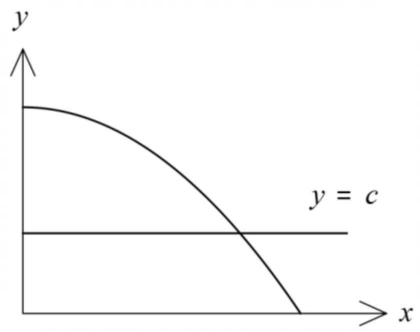
(d) During the first 35 seconds, there is a 10 second interval in which the distance travelled by the body is a minimum. Using calculus methods, determine when this interval occurs and justify that the distance is a minimum. (4 marks)

Solution
$x'(T) = -8\sin\left(\frac{\pi T}{10}\right)$ $x'(T) = 0 \text{ when } T = 0, 10, 20$ $x''(T) = -\frac{4\pi}{5}\cos\left(\frac{\pi T}{10}\right)$ $x''(0) = -\frac{4\pi}{5}, \quad x''(10) = \frac{4\pi}{5}$ Hence when the interval starts at $T = 10$ seconds, the distance is a minimum since at this time the first derivative of the distance function is zero and the second derivative is positive.
Specific behaviours
✓ obtains derivative and equates to zero ✓ indicates times when derivative is zero ✓ uses second derivative to identify first minimum ✓ states correct start time, with justification

Question 19 **(7 marks)**

The line $y = c$ divides the area in the first quadrant under the curve $y = 16 - x^2$ into two equal halves, as shown in the diagram.

Determine, with reasoning, the value of c.



Solution
Let the curve and line intersect when $x = a$, so that $c = 16 - a^2$.
Area above line is area between curve and line: $$A_A = \int_0^a (16 - x^2) - (16 - a^2)\,dx = \frac{2a^3}{3}$$
Area below line is rectangle plus area under curve: $$A_B = a(16 - a^2) + \int_a^4 (16 - x^2)\,dx = 16a - a^3 + \frac{a^3}{3} - 16a + \frac{128}{3} = \frac{128}{3} - \frac{2a^3}{3}$$
Require $A_A = A_B$ and so $$\frac{2a^3}{3} = \frac{128}{3} - \frac{2a^3}{3}$$ $$a = 2\sqrt[3]{4}$$
Hence $c = 16 - \left(2\sqrt[3]{4}\right)^2 = 16 - 8\sqrt[3]{2} \approx 5.921$.

Specific behaviours
✓ expresses c in terms of x-coordinate of intersection
✓ writes integral for upper area
✓ evaluates and simplifies integral
✓ writes expression for lower area
✓ evaluates and simplifies expression
✓ equates expressions and solves for a
✓ substitutes to obtain c

Solution
$c = 16 - x^2 \quad \Rightarrow x = \sqrt{16 - c}$
$$solve\ \frac{1}{2}\int_0^4 16 - x^2\,dx = \int_0^{\sqrt{16-c}} c\,dx + \int_{\sqrt{16-c}}^4 16 - x^2\,dx\,, c$$
Hence $c = 16 - 8\sqrt[3]{2} \approx 5.921$.

Specific behaviours
✓ expresses x in terms of c
✓ writes first integral from 0 to 4 with $\frac{1}{2}$
✓ writes second integral with correct bounds
✓ correct second integral
✓ writes third integral with correct bounds
✓ correct third integral
✓ obtains correct value for c

Solution
$$A = \int_0^4 (16 - x^2)\,dx = 42\frac{2}{3}\ unit^2$$
Half of area is $\frac{64}{3}\ unit^2$, Max TP = 16
$y = 16 - x^2 \quad \Rightarrow \quad x^2 = 16 - y \quad \Rightarrow x = \pm\sqrt{16 - y}$
$$solve(\int_c^{16} \sqrt{16 - y}\,dy = \frac{64}{3}, y)$$
Hence $c \approx 5.921$.

Specific behaviours
✓ writes integral for upper area
✓ evaluates integral
✓ states max TP
✓ rearranges equation to get $x =$
✓ writes integral for half area
✓ correct bounds
✓ obtains correct value for c

End of questions

Supplementary page

Question number: _________

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