Write your student exam number in the boxes								

Northern Beaches Secondary College - Manly Campus

2026 Higher School Certificate Trial Examination

Mathematics Advanced

General Instructions

- Reading time – 10 minutes
- Working time – 3 hours
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided
- For questions in Section II, show relevant mathematical reasoning and/ or calculations

Total Marks:

100

Section I – 10 marks (pages 1-7)

- Attempt Questions 1–10
- Allow about 15 minutes for this section

Section II – 90 marks (pages 8-39)

- Attempt Questions 11–35
- Allow about 2 hours and 45 minutes for this section

MC	Booklet 1	Booklet 2	Booklet 3	Booklet 4	Total
/10	/23	/21	/23	/23	/100

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Section I

10 marks

Attempt Questions 1 – 10

Allow about 15 minutes for this section.

Use the multiple-choice answer sheet for Questions 1–10.

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1. The numbers 5, x, 13, 17, … form an arithmetic sequence.

What is the sum of the first four terms?

A. 35

B. 39

C. 42

D. 44

2. Two students, Pema and Sonakshi, sit different tests. Pema scores 75 in a test with a mean of 60 and a standard deviation of 10. Sonakshi scores 80 in a test with a mean of 70 and a standard deviation of 5.

Who performed better relative to their group?

A. Pema

B. Sonakshi

C. They performed equally well.

D. It is not possible to tell without knowing the total marks for each test.

3. What is $\int \frac{1}{(x+2)^2}\,dx$?

A. $-\frac{1}{x+2}+C$

B. $\frac{1}{x+2}+C$

C. $\ln|x+2|+C$

D. $-\frac{1}{(x+2)^3}+C$

4. The stem-and-leaf display below shows the distribution of the ages of 24 members of a committee.

Stem	Leaf
2	x
3	2 2 3 7 8 8
4	3 3 4 5 5 6 7 9
5	1 1 y 6
6	0 5 8
7	0 1

The range and interquartile range of the distribution are 42 and 18 respectively.

What are the values of x and y ?

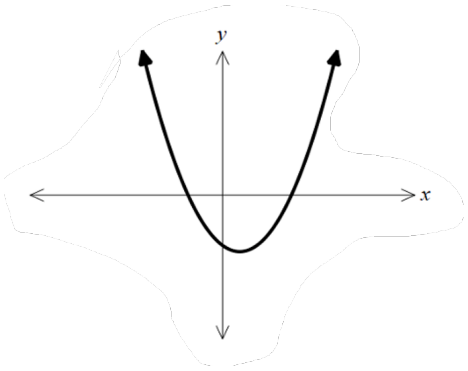
A. $x = 8$ and $y = 5$

B. $x = 8$ and $y = 6$

C. $x = 9$ and $y = 5$

D. $x = 9$ and $y = 6$

5. The diagram below shows the graph of $y = x^2 + bx + c$, where b and c are constants.



Which of the following are true?

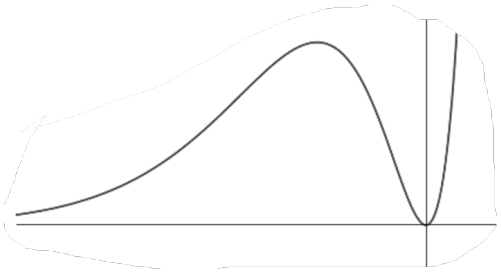
A. $b > 0$ and $c > 0$

B. $b > 0$ and $c < 0$

C. $b < 0$ and $c > 0$

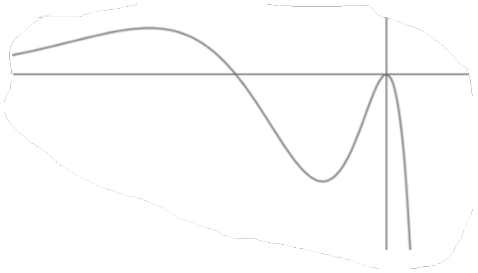
D. $b < 0$ and $c < 0$

6. The diagram shows the graph of $y = f(x)$.

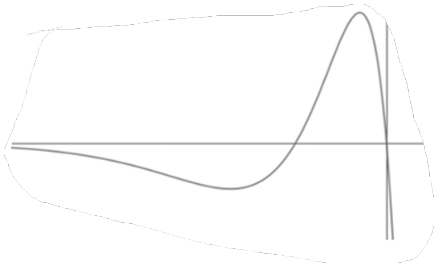


Which of the following could be the graph of $y = f'(x)$?

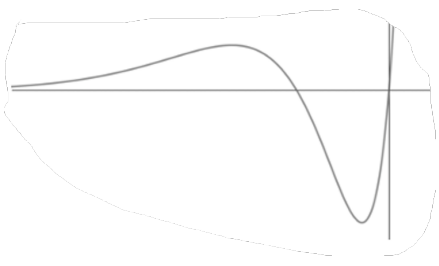
A.



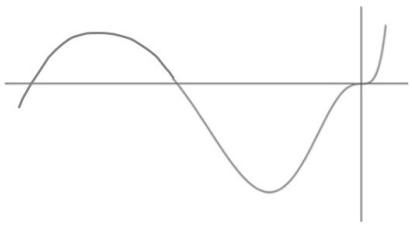
B.



C.



D.



7. Box A contains 3 red balls and 2 white balls while Box B contains 6 red balls and 1 white ball. Zev draws a ball randomly from Box A and then puts it into Box B.

If Zev draws a ball randomly from Box B afterwards, what is the probability that he draws a red ball?

A. $\frac{9}{20}$

B. $\frac{21}{40}$

C. $\frac{33}{40}$

D. $\frac{9}{10}$

8. A raffle has a first prize of \$200 and a second prize of \$50. A ticketholder can win either first prize, second prize, or nothing. The probability of winning first prize is 0.05 and the probability of winning second prize is 0.1.

If tickets costs \$10 each, what is the expected gain when buying a single ticket?

A. \$0

B. \$5

C. \$15

D. \$25

9. A vessel initially contains 100 litres of water. It is being emptied at a rate of $\frac{dV}{dt} = -\left(2 + \frac{20}{t+1}\right)$ where V is the volume in litres after t minutes.

Which of the following gives the exact volume of water (in litres) remaining in the vessel after five minutes?

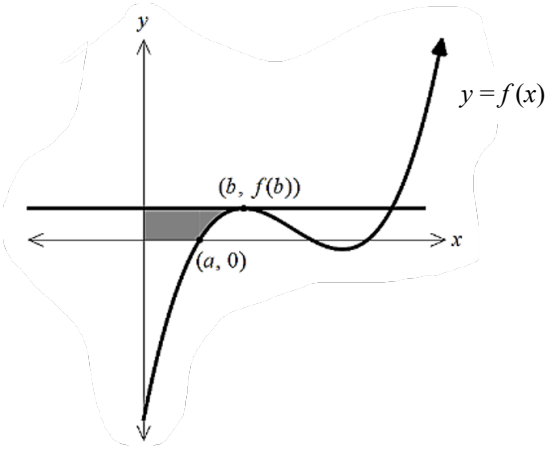
A. $10 + 20 \ln 6$

B. $90 - 20 \ln 6$

C. $90 + 20 \ln 6$

D. $110 + 20 \ln 6$

10. Part of the graph of $y = f(x)$ is shown below. The horizontal line is a tangent to the local maximum at $(b, f(b))$. The shaded area is bounded by the graph of $y = f(x)$, the coordinates axes and the horizontal line as shown below.



Which of the following is the correct expression for the area of the shaded region?

A. $af(b) - \int_a^b f(x)dx$

B. $af(b) + \int_a^b f(x)dx$

C. $bf(b) - \int_a^b f(x)dx$

D. $\int_0^b f(x)dx - bf(b)$

End of Section I

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Mathematics Advanced

Section II Answer Booklet 1

Attempt Questions 11 – 19 (23 marks)

Instructions

- Write your Student Number at the top of this page.
- 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 space is provided at the end of this booklet. If you use this space, clearly indicate which question you are answering.

Question 11 (3 marks)

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Evaluate $\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} 4\sin(2x)dx$

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Question 12 (2 marks)

Determine algebraically whether the function given by $f(x) = x\sin x$ is even, odd or neither. **2**

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Question 13 (3 marks) **3**

Evaluate $\int_2^3 \frac{1}{\sqrt{3x-4}}\,dx$

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Question 14 (3 marks)

Find the equation of the tangent to the curve $y = x^2e^x$ at the point where $x = 2$. **3**

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Question 15 (2 marks)

Consider the functions given by $f(x) = \ln(2x - 1)$ and $g(x) = x + 2$.

Find value(s) of x such that $f(g(x)) = 2\ln 3$ **2**

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Question 16 (2 marks)

In an arithmetic sequence, the 6^{th} term is 36 and the 9^{th} term is 28.

Find the first term. **2**

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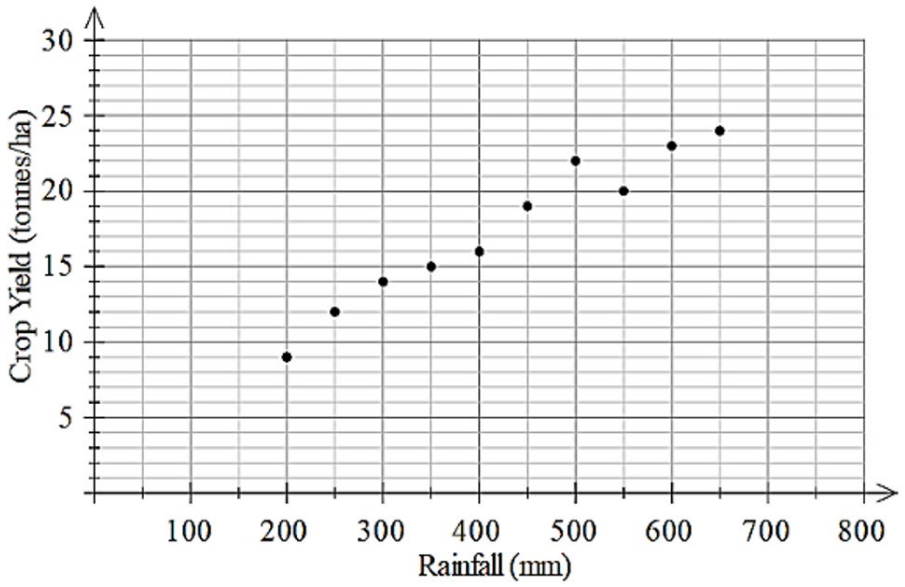
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Question 17 (3 marks)

The relationship between the amount of rainfall (mm) in a growing season and the crop yield (tonnes per hectare) on a farm is investigated.

A scatterplot of the data is shown.



The equation of the least squares regression line is:

$$\text{crop yield} = 3.7 + 0.032 \times \text{rainfall}$$

a) Draw the graph of this least squares regression line on the scatterplot. **1**

b) Interpret the slope of the regression line in terms of crop yield and rainfall. **1**

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c) Given the crop yield is 17.2 tonnes/ha, what was the amount of rainfall? **1**

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Question 18 (2 marks)

The table shows future value interest factors for an annuity of $1, where deposits are made at the end of each period.

Period \ Rate	0.00350	0.00525	0.01050	0.04200
8	8.09869	8.14855	8.30026	9.28015
32	33.79833	34.74607	37.79904	65.01190
64	71.59481	75.83041	90.60013	307.53876
96	113.86239	124.40923	164.35744	1212.28514

Heidi wants to save some money for her daughter using an annuity. She wishes to have a future value of $40 000 after 8 years. Heidi will deposit a fixed amount into an investment account at the end of each month. The account pays 4.2% per annum, compounded monthly.

Using the table provided, determine how much Heidi needs to deposit each month. **2**

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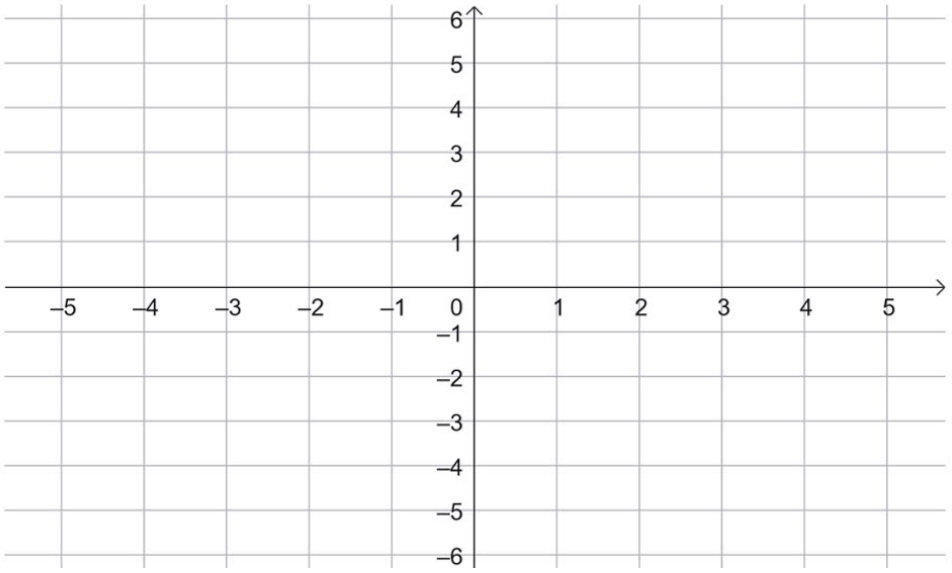
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Question 19 (3 marks)

Sketch the graph of $y = 5 - |3x - 6|$, indicating intercepts on the grid below. **3**



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If you use this space, clearly indicate which question you are answering.

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Mathematics Advanced

Section II Answer Booklet 2

Attempt Questions 20 – 24 (21 marks)

Instructions

- Write your Student Number at the top of this page.
- 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 space is provided at the end of this booklet. If you use this space, clearly indicate which question you are answering.

Question 20 (4 marks)

a) Sketch the graph of $y = \log_{10} x$, showing all important features. **2**

b) Use the trapezoidal rule with four function values to approximate the area bounded by the curve $y = \log_{10} x$ and the x-axis, from $x = 1$ to $x = 4$. **2**

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Question 21 (3 marks)

Scientists are monitoring a population of quolls. Their lengths are normally distributed with a mean length of 50cm and a standard deviation of 2.3cm. A scientist captures one of the quolls at random.

The table below shows values of $P(Z \leq z)$, where Z is the standard normal random variable, for values of z between 0 and 1.39.

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177

Using the table, find the probability that the quoll is longer than 49cm but shorter than 52cm, correct to three decimal places. **3**

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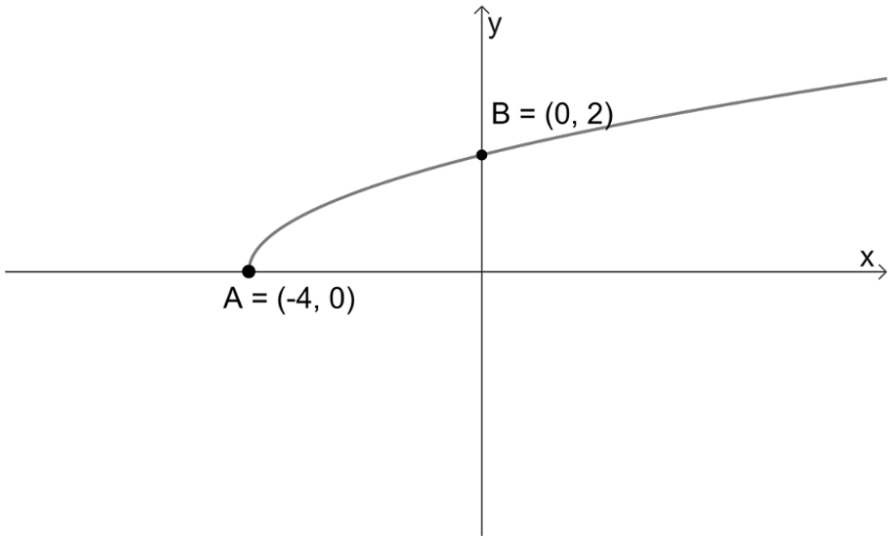
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Question 22 (3 marks)

Consider the graph of $y = f(x)$ as shown.



On the same set of axes, sketch the graph of $y = f(-2x) - 1$, clearly indicating coordinates of A′ and B′ , the images of points A and B. **3**

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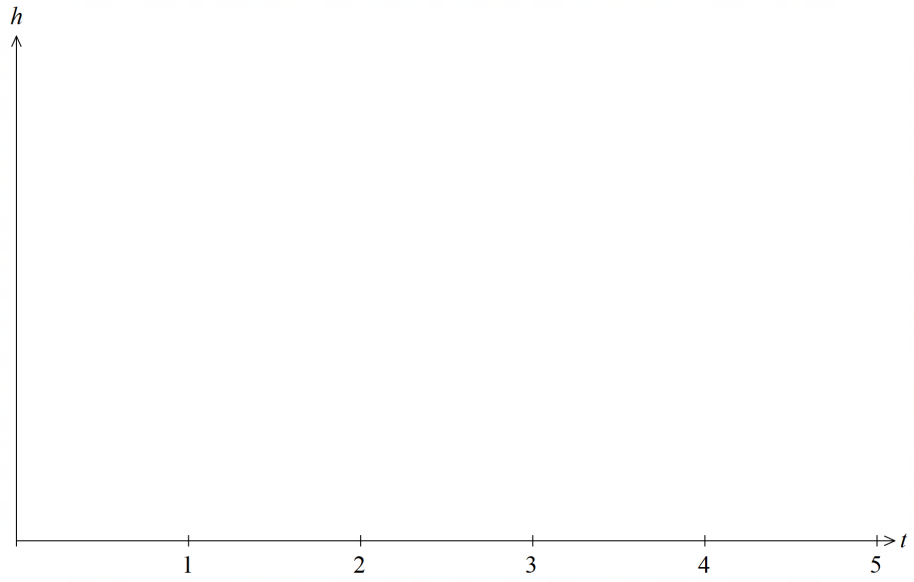
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Question 23 (5 marks)

Cadel is riding his bicycle at a steady speed along a straight road. The height h (cm) of one of the pedals in terms of time t (seconds) is given by the equation:

$$h = 40 + 19\sin(\pi t)$$

a) Sketch the graph of height vs. time for the first five seconds. **3**



b) How long will the pedal take to complete a revolution? **1**

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c) If Cadel cycled faster, how would the equation above change? **1**

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Question 24 (6 marks)

A competition offers three options for the first prize, each of which pays the winner a monthly sum for 24 months:

OPTION 1:	\$14 000 per month.
OPTION 2:	\$2500 in the first month, then each successive month pays \$1000 more than the previous month.
OPTION 3:	\$400 in the first month, then each successive month pays 25% more than the previous month.

a) Determine which option will pay the most over the 24 months. **4**

b) The amount won in the first month for Option 3 is to be altered, so the total prize over the 24 months is $400 000.

Calculate the new initial amount, correct to the nearest dollar. **2**

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Mathematics Advanced

Section II Answer Booklet 3

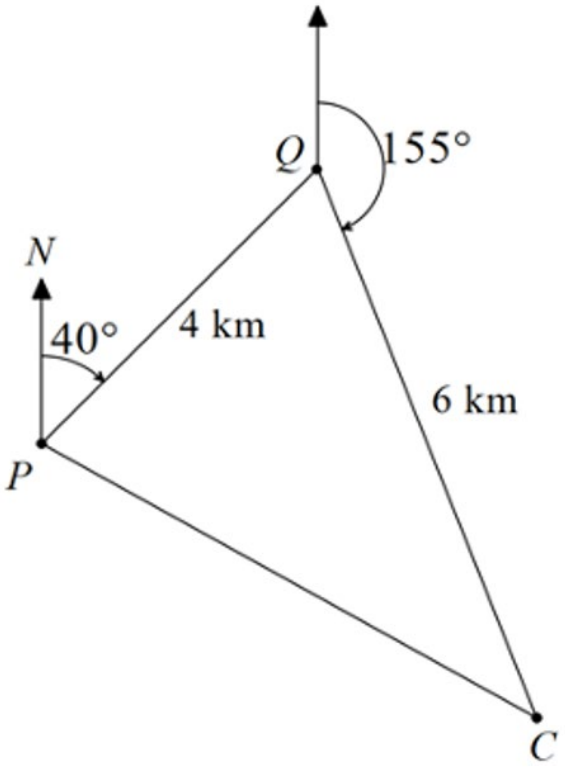
Attempt Questions 25 – 30 (23 marks)

Instructions

- Write your Student Number at the top of this page.
- 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 space is provided at the end of this booklet. If you use this space, clearly indicate which question you are answering.

Question 25 (6 marks)

Two hikers, Rita and Sam, leave a point P at the same time and walk to a campsite, C.



Rita walks 4 km on a bearing of 040° to point Q, then a further 6 km on a bearing of 155° to arrive at the campsite.

Sam walks directly from point P to the campsite.

a) Show that $\angle PQC = 65°$ **1**

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b) If Rita walks at a speed of 10 km h^{-1} and Sam walks at 6 km h^{-1}, determine who arrives at the campsite first and how long they must wait for the other person to arrive. **3**

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c) On what bearing, to the nearest degree, must they walk to return directly to point *P*? **2**

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Question 26 (3 marks)

The limiting sum of a geometric series is 500, and the sum of the first three terms is 244.

Find the sum of the first 10 terms. Give your answer correct to two decimal places. **3**

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Question 27 (2 marks)

The wait time X (seconds) that a customer waits for their coffee at the Calculus Café can be modelled by the probability density function:

$$f(x) = \begin{cases} \frac{1}{60} e^{-\frac{x}{60}} & x \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

The service is considered "Unacceptable" if the wait time exceeds 5 minutes.

What percentage of customers experience "Unacceptable" wait times? **2**

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Question 28 (4 marks)

A cybersecurity system sends automatic alerts when suspicious activity is detected. Each independent scan has a probability of 0.12 of triggering an alert.

a) What is the probability that no alerts are triggered in the first three scans? Give your answer correct to four decimal places. **1**

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b) The system continues scanning until it triggers its first alert.

Find the minimum number of scans required so that the probability that at least one alert has been triggered is greater than 0.75. **3**

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Question 29 (3 marks)

Solve $2\sin\left(3x+\frac{\pi}{2}\right)=1$ for $0 \leq x \leq \pi$ **3**

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Question 30 (5 marks)

The velocity v of a particle in metres per second at time t seconds is given by

$$v = 15\sin(3t) + 2t \quad (t \geq 0)$$

Initially the particle is 10 metres to the right of the origin.

a) Find the first time when the acceleration of the particle is zero, correct two decimal places. **2**

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b) Find the displacement of the particle after 4 seconds. **3**

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Mathematics Advanced

Section II Answer Booklet 4

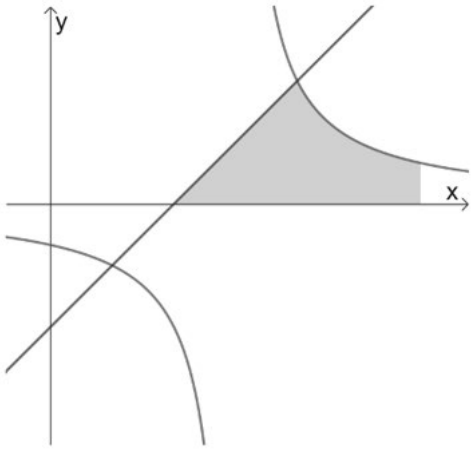
Attempt Questions 31 – 35 (23 marks)

Instructions

- Write your Student Number at the top of this page.
- 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 space is provided at the end of this booklet. If you use this space, clearly indicate which question you are answering.

Question 31 (7 marks)

The graphs of $y = \dfrac{1}{2x-3}$ and $y = x - 1$ intersect at two points, as shown in the diagram.



a) Find the x-coordinates of the points of intersection of the two graphs. **2**

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b) Hence or otherwise, solve the inequality $x - 1 \leq \dfrac{1}{2x-3}$ **2**

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c) Find the area of the shaded region bounded by $y=\frac{1}{2x-3}$, $y=x-1$, the x-axis and the line $x = 3$. **3**

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Question 32 (3 marks)

a) Find $\frac{d}{dx}(x\sin x)$ **1**

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b) Hence or otherwise, find $\int x\cos x\ dx$ **2**

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Question 33 (4 marks)

The normal to the curve $y = 3x^2 - ax + 2b$ at the point (1, 5) has the equation $x + 2y - 11 = 0$. **4**

Find the values of a and b.

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Question 34 (4 marks)

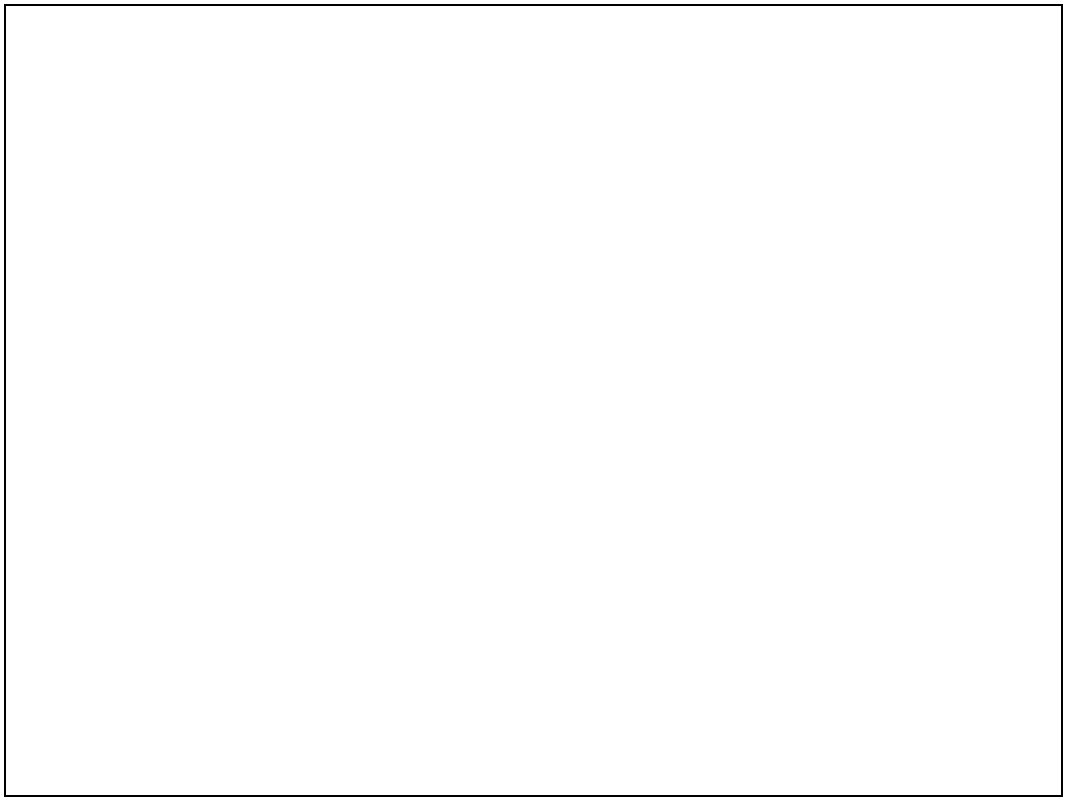
A cricket player hits a ball with an angle of elevation $\theta°$, where θ is normally distributed with a mean of $30°$ and a standard deviation of $15°$.

The horizontal distance travelled by the ball before hitting the ground is given by $d = 80\sin(2\theta)$, where d is in metres.

Find the probability that the ball travels more than 40 metres horizontally in the air before landing. **4**

Question 35 (5 marks)

Sketch the curve $y = e^{x^2 + \frac{x^3}{3}}$ by finding all stationary points and their nature. Indicate coordinates correct to two decimal places where appropriate. **5**



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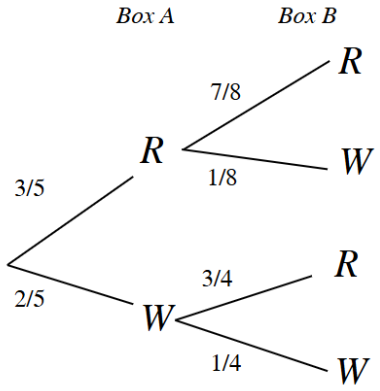
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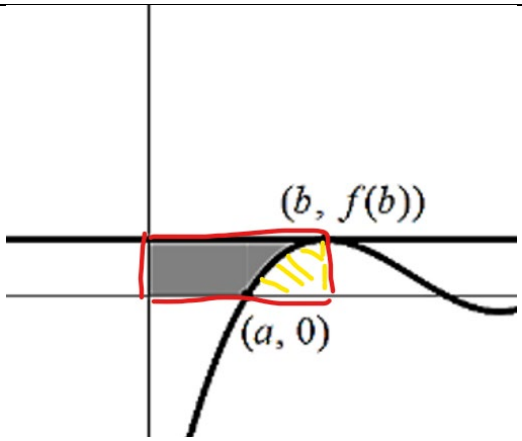
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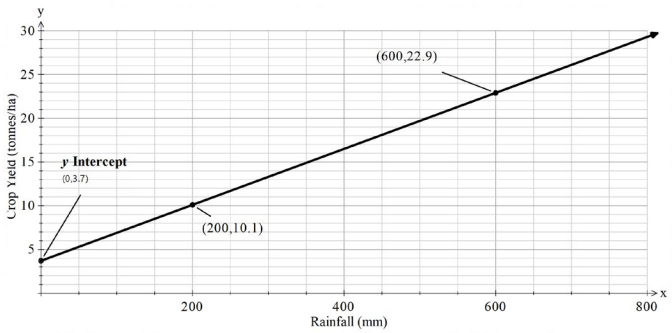
End of Paper

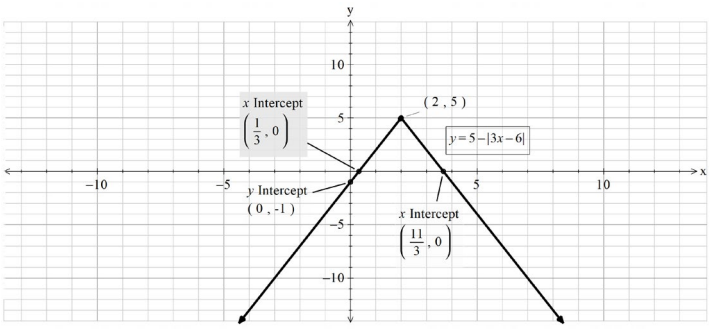
Section II extra writing space

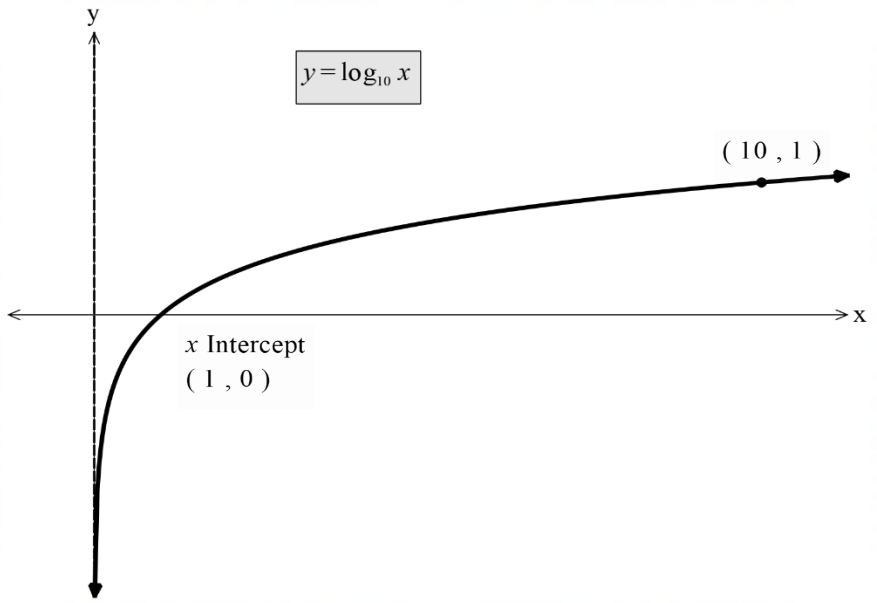
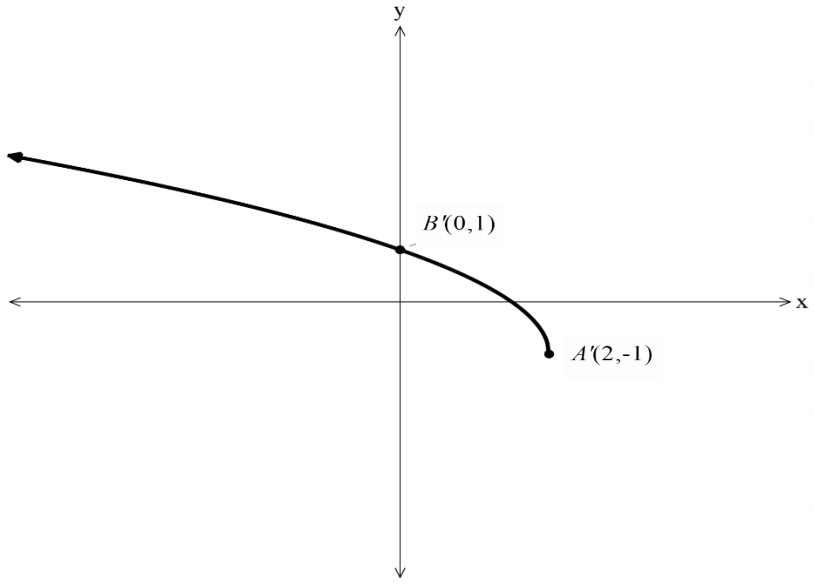
If you use this space, clearly indicate which question you are answering.

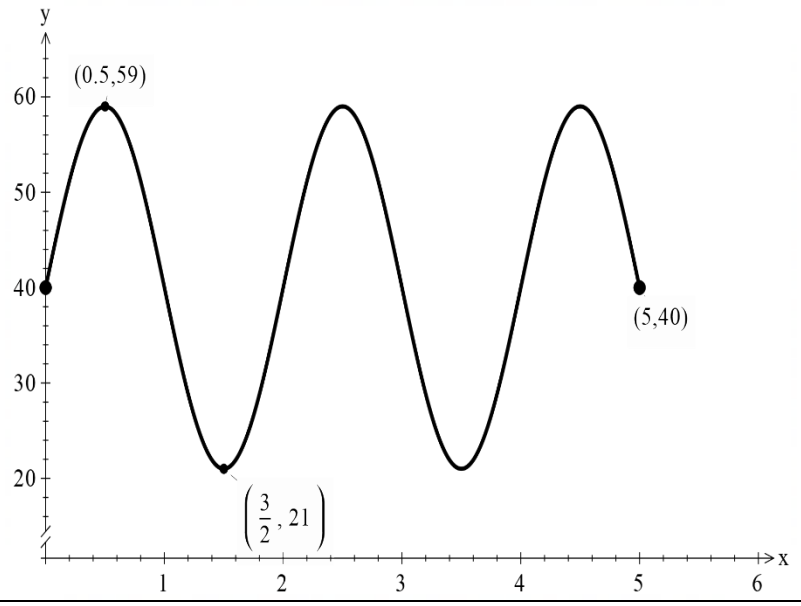
2026 Year 12 Mathematics Advanced Trial marking guidelines		
Q	**Solution**	**Marking allocation**
1	$5+9+13+17=44$	D
2	$z_{\text{Pema}}=\dfrac{75-60}{10}=1.5$ $z_{\text{Sonakshi}}=\dfrac{80-70}{5}=2$	B
3	$\int (x+2)^{-2}dx=-(x+2)^{-1}=-\dfrac{1}{x+2}+C$	A
4	Range = 42 = 71 – 29, so $x = 9$ $Q_1 = 38$ IQR = 18 = 56 – 38, so $Q_3 = 56$, so $y = 6$	D
5	The y-intercept is below the x-axis, so $c < 0$ The axis of symmetry is to the right of the y-axis, so $-\dfrac{b}{2a}=-\dfrac{b}{2}>0$ $\therefore \quad b<0$	D
6	As $x \to -\infty$, $y' \to 0^+$, eliminating B and D For $x > 0$, $y' > 0$, eliminating A	C
7	 $P(R)=\dfrac{3}{5}\times\dfrac{7}{8}+\dfrac{2}{5}\times\dfrac{3}{4}=\dfrac{33}{40}$	C
8	<table><tr><td>x</td><td>\$190</td><td>\$40</td><td>-\$10</td></tr><tr><td>$P(X=x)$</td><td>0.05</td><td>0.1</td><td>0.85</td></tr></table> $E(X)=190\times0.05+40\times0.1-10\times0.85=\$5$	B
9	$\dfrac{dV}{dt}=-2-\dfrac{20}{t+1}$ $V=-2t-20\ln(t+1)+C \quad (t>0)$ when $t=0$, $V=100$: $100=-0-20\ln 0+C$ $C=100$ $V=-2t-20\ln(t+1)+100$ $V(5)=-10-20\ln 6+100$ $V(5)=90-20\ln 6$	B

10	 Area = rectangle − area under curve $= b \times f(b) - \int_a^b f(x)$	C
11	$\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} 4\sin(2x)dx$ $= \left[-\frac{4}{2}\cos(2x)\right]_{\frac{\pi}{6}}^{\frac{\pi}{2}}$ $= (-2\cos(\pi)) - \left(-2\cos\left(\frac{\pi}{3}\right)\right)$ $= (-2 \times -1) - \left(-2 \times \frac{1}{2}\right)$ $= 2 + 1$ $= 3$	3mks correct solution with working 2 mks correct derivative and correct substitution 1 mk correct derivative Possible carry error if incorrect derivative evaluated correctly
12	$f(x) = x\sin x$ $f(-x) = -x\sin(-x)$ $f(-x) = -x \times -\sin x$ note: $\sin(-x) = -\sin x$ as sin x is odd $\therefore\ f(-x) = x\sin x$ $\therefore$ even function $\because f(x) = f(-x)$	2 mks correct solution but must show working and state conclusion 1mk working with substitution into f(-x) to get -xsin(-x)
13	$\int_2^3 \frac{1}{\sqrt{3x-4}}\,dx$ $= \int_2^3 (3x-4)^{-\frac{1}{2}}\,dx$ $= \left[\frac{2}{3}(3x-4)^{\frac{1}{2}}\right]^3, 2$ $= \frac{2}{3}\left((9-4)^{\frac{1}{2}} - (6-4)^{\frac{1}{2}}\right)$ $= \frac{2}{3}\left(\sqrt{5} - \sqrt{2}\right)$	3mks correct solution with working 2 mks correct primitive and correct substitution into integral 1mk rewrites correctly in index form and attempts derivative

14	Find $\frac{dy}{dx}$ using product rule $y' = x^2e^x + e^x \times 2x$ $= x^2e^x + 2xe^x$ at $x=2$ $y' = 4e^2 + 4e^2 = 8e^2$ Eqn of tangent using $y - y_1 = m(x - x_1)$ at $x=2, y=4e^2$ $y - 4e^2 = 8e^2(x-2)$ $y - 4e^2 = 8e^2x - 16e^2$ $y = 8e^2x - 12e^2$ or $8e^2x - 12e^2 - y = 0$	3mks correct solution with properly set out working 2mks correct derivative and point at x=2 1mk uses product rule and makes progress
15	$f(x) = \ln(2x-1)$ and $g(x) = x+2$ $f(g(x)) = \ln(2(x+2)-1)$ $= \ln(2x+4-1)$ $= \ln(2x+3)$ given $f(g(x)) = 2\ln(3)$ $= \ln(3^2) = \ln(9)$ $\therefore \ln(2x+3) = \ln(9)$ $2x = 6$ $x = 3$	2 mks correct solution with working 1mk correctly finds *f(g(x))* attempts to evaluate equation
16	$T_6 = a + 5d = 36$ ① $T_9 = a + 7d = 28$ ② ② – ① $3d = -8$ $d = -\frac{8}{3}$ Use ① $a + 5\left(-\frac{8}{3}\right) = 36$ $a - \frac{40}{3} = 36$ $a = \frac{148}{3}$ or $49\frac{1}{3}$	2 mks correct solution with working 1mk correct use of equations to find common difference "d"
17 a	It is Not line of best fit!! it is c. yield =3.7 + 0.032 x rainfall Must use values; e.g. Y intercept = 3.7 R=200 gives c.y. =10.1 R=600 gives =22.9 etc  	1 mk correct line drawn **accurately with at least one point shown and values along the line correct** **Incorrect y intercept of 4 or more not accepted. It is clearly y=3.7**

17 b	Crop yield increase by 0.32 t/ha for each mm of rainfall. This is fully correct and expected in HSC, but also accepted increase in rainfall means increase in crop yield NOTE: The question was **not about correlation** it was interpretation of the slope and effect of rainfall on crop yield from the given equation.	1mk correct solution
17 c	$c.y. = 3.7 + 0.032 \times rain$ $17.2 = 3.7 + 0.032r$ $0.032r = 13.5$ $r = 421.875$ $r = 422\text{mm}$	1mk correct solution by use of the equation Approx answer of 400mm not accepted
18	$4.2\%p.a. = 0.35\%per\ "month = 0.0035$ 8yrs=96 months "from table get 113.86239 $40\,000 = x \times 113.86239$ $x = 40\,000 \div 113.86239$ $x = \$351.30$	2 mks correct solution with working 1 mk correct FV annuity vale from table or possible carry error for use of incorrect value with working shown
19	solve $3x - 6 = 0$ $x = 2 \ \therefore y = 5\ (2,5)$ *Abs* value graph flipped upside down $5 - \lvert 3x - 6 \rvert = 0$ $\lvert 3x - 6 \rvert = 5$ $3x - 6 = \pm 5$ $x = \frac{11}{3}, x = \frac{1}{3}$ at $x = 0$, $y = 5 - \lvert 3(0) - 6 \rvert$ $y = -1$  	3 mks correct V graph inverted with correct intercepts 2mks provides V shaped graph facing down with apex at (2,5) 1 mk provides V shape graph with some correct intercepts

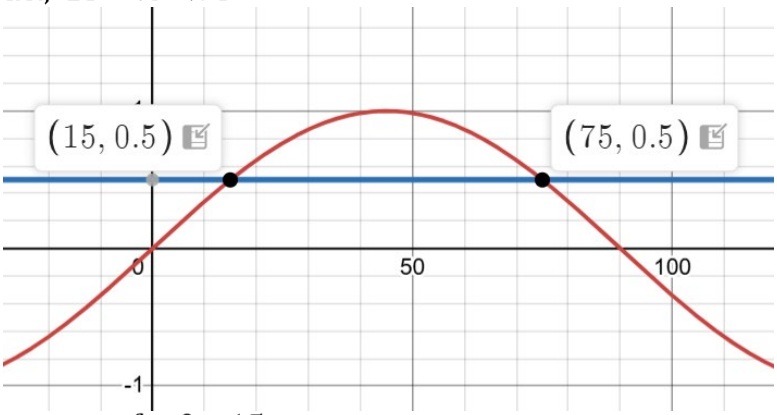
20a		2 marks – shows all key features including correct shape, x-intercept, asymptote at x=0 and one other point on the graph 1 mark – one feature missing.
20b	$A \approx \frac{4-1}{2\times 3}\left(\log_{10} 1 + \log_{10} 4 + 2(\log_{10} 2 + \log_{10} 3)\right)$ $\approx 1.079\ units^2$	2 marks – correct solution 1 mark – either multiplier out the front correct, or values in the bracket correct.
21	z score calculations $z_{49} = \frac{49-50}{2.3} = -0.43$ $z_{52} = \frac{52-50}{2.3} = 0.87$ From table $P(Z < 0.87) = 0.8078$ is the probability a quoll is less than 52cm $P(Z < 0.43) = 0.6664$ By symmetry $P(Z<0.43) = P(Z>-0.43)$ so $P(Z < -0.43) = 1 - 0.6664 = 0.3336$ is the probability a quoll is less than 49cm $P(-0.43 < Z < 0.87) = 0.8078 - 0.3336 = 0.4742$ is the probability a quoll is between 49 and 52 cm	3 marks – correct solution 2 marks – identitfies correct values from the table and attempts to use them to calculate probability 1 mark – correctly finds both z scores.
22		3 marks – correct co-ords of A', B' and correct shape. 2 marks – one feature missing or incorrect 1 mark – two features missing or incorrect

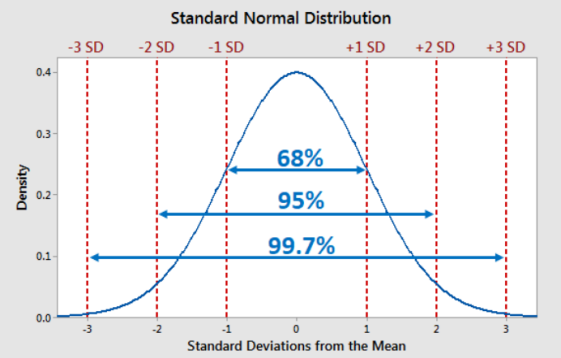
23a		3 marks – correctly shows amplitude, period, centre and shape and sketches for 5 seconds. 2 marks – one feature missing or incorrect 1 mark – two features missing or incorrect
23b	2 seconds	1 mark
23c	As the period would be shorter, the coefficient of *t* would increase to be greater than π. (*Markers note – many students described how the* ***graph*** *would change, instead of the* ***equation***).	1 mark
24a	*Option* 1: $14\,000 \times 24 = \$336\,000$ *Option* 2: $S_{24} = \frac{24}{2}(2 \times 2500 + 23 \times 1000) = \$336\,000$ *Option* 3: $S_{24} = \frac{400(1.25^{24} - 1)}{1.25 - 1} = \$337\,213$ $\therefore$ *Option 3 pays the most.*	4 marks – correct solution 3 marks – correct value for options 1 and 2, and attempts to use geometric series for option 3. 2 marks – options 1 and 2 correct 1 mark – option 1 correct
24b	$400\,000 = \frac{a(1.25^{24} - 1)}{0.25}$ $a = \frac{100000}{1.25^{24} - 1}$ $= 474.477\ldots$ $\approx \$474$	2 marks – correct solution answered to nearest dollar. 1 mark – uses sum of GP
25a	Angle PQC = 180 – 155 + 40 = 65 degrees	1 mark for correct answer with working.
25b	$PC = \sqrt{6^2 + 4^2 - 2 \times 4 \times 6 \times \cos(65°)}$ $PC = 5.632\ldots\text{km}$ Therefore Sam's time to campsite is $\frac{5.632}{6} = 0.939$ hours Rita's time to campsite is 1 hour So Sam arrives first and must wait roughly 3.68 mins or 3 mins 40 secs	3 marks for correct working and solution. 2 marks for correct working of PC and stating the times but does not state who arrives first or states who arrives first but does not state the time.

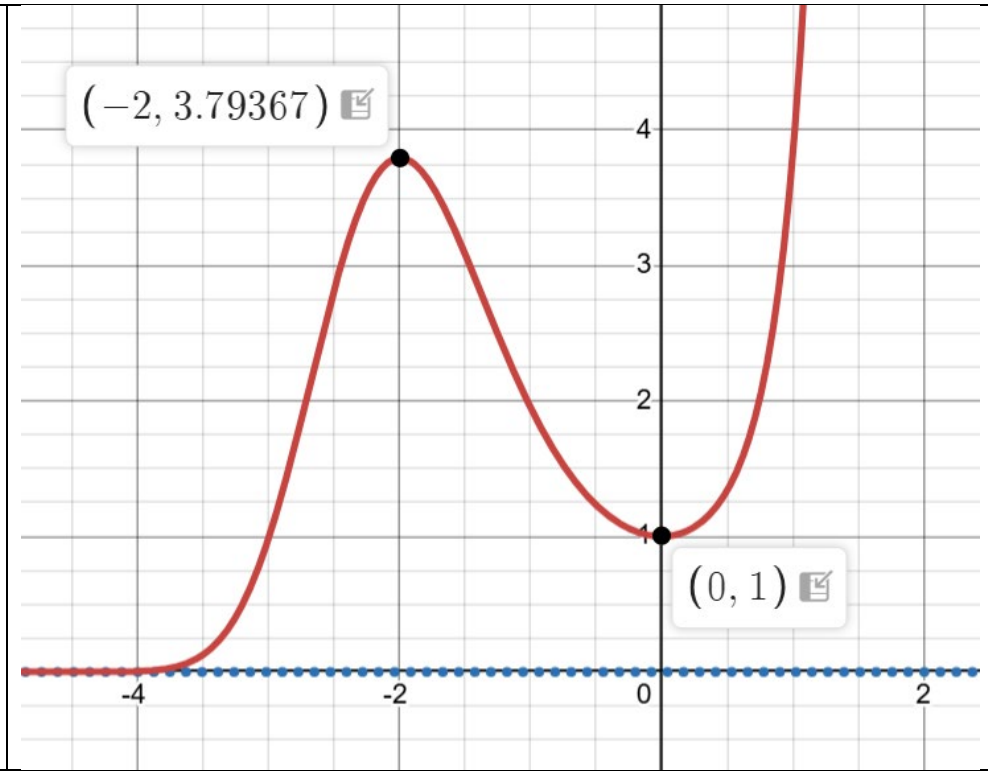
		1 mark for finding PC or equivalent but makes not further progress.
25c	$\frac{\sin \angle QCP}{4} = \frac{\sin 65°}{5.632}$ $\angle QCP = 40.06°$ Therefore bearing is $360 - (40.06 + 25)$ $= 295°$ (neares degeee)	2 marks for correct working and solution. 1 mark for finding angle QCP or equivalent merit.
26	$\frac{a}{1-r} = 500$ $a = 500(1-r)$ ① and $\frac{a(1-r^3)}{1-r} = 244$ ② sub ① into ② $\frac{500(1-r)(1-r^3)}{1-r} = 244$ $500(1-r^3) = 244$ $1-r^3 = \frac{64}{125}$ $r = 0.8$ $\therefore \quad a = 100$ $S_{10} = \frac{100(1-0.8^{10})}{1-0.8}$ $S_{10} = 446.31$	3 marks for correct working and solution. 2 marks for correct working and simultaneous equations and states the 'r' and 'a' values but does not find the sum or makes no further progress. 1 mark for forming simultaneous equations of equivalent merit.
27	$\int_0^{300} \frac{1}{60} e^{-\frac{x}{60}} dx$ $= \left[-e^{-\frac{x}{60}}\right]_0^{300}$ $= -e^{-5} + 1$ $= 0.99262053...$ $\therefore P(X > 300) = 1 - 0.99262053$ $= 0.006737947$ $= 0.67\%$	2 marks for correct working and solution. 1 mark for correct integral or equivalent merit. NOTE: a lot of students did not change the time to seconds.

28a	$(1-0.12)^3 = 0.6815$	1 mark correct answer
28b	$1-0.88^n = 0.75$ $0.25 = 0.88^n$ $\log_{0.88} 0.25 = 10.844$ $\therefore$ 11 scans	3 marks for correct working and correct solution 2 marks for correct working and showing log form, but states the incorrect value of n 1 mark for writing correct equation or just stating correct value of n without working.
29	$2\sin\left(3x+\frac{\pi}{2}\right)=1$ $2\cos(3x)=1$ since $\sin\left(3x+\frac{\pi}{2}\right)=\cos(3x)$ $\cos(3x)=\frac{1}{2}$ $3x=\frac{\pi}{3},\frac{5\pi}{3},\frac{7\pi}{3}$ for $0\le 3x\le 3\pi$ $x=\frac{\pi}{9},\frac{5\pi}{9},\frac{7\pi}{9}$ for $0\le x\le \pi$	3 marks for correct working and solution. 2 marks for correct working and stating some correct solutions, but not all. 1 mark for stating 1 solution or equivalent merit. NOTE: some students did not adjust the domain and accepted an answer that was not in the correct domain and were therefore penalised a mark.
30a	$v=15\sin(3t)+2t$ $\frac{dv}{dt}=45\cos(3t)+2$ $\therefore \quad \frac{dv}{dt}=0$ when $45\cos(3t)=-2$ $\cos(3t)=-\frac{2}{45}$ $3t=1.62$ $t=0.54$ seconds	2 marks for correct working and solution 1 mark for correct derivative or equivalent merit. NOTE: a lot of students had their calculator in degree mode which gave the incorrect answer and were penalised.

30b	$x = -5\cos(3t) + t^2 + C$ $t = 0\ x = 10$ $10 = -5\cos(3 \times 0) + 0^2 + C$ $C = 15$ $x = -5\cos(3t) + t^2 + 15$ when $t = 4$ $x = -5\cos(12) + 4^2 + 15$ $x = 26.78m$	3 marks for correct working and solution 2 marks for correct displacement formula and finds the correct C value 1 mark for correct displacement formula NOTE: once again a lot of students had their calculator in degree mode, however the answer was almost identical by coincidence and hence those students were not penalised.
31a	$\frac{1}{2x-3} = x - 1$ $1 = (x-1)(2x-3)$ $0 = 2x^2 - 5x + 2$ $x = \frac{5 \pm \sqrt{25-16}}{4}$ $x = \frac{1}{2}, 2$	1 mark each for each correct x-coordinates supported by correct working out.
31b	From Graph, $\frac{3}{2} < x \leq 2,$ $x \leq \frac{1}{2}$ or, $x \in \left(-\infty, \frac{1}{2}\right] \cup \left(\frac{3}{2}, 2\right]$	1 mark each for each correct interval
31c	Area of Triangle = $\frac{1}{2} \times 1 \times 1 = \frac{1}{2}$ Area of the remaining shaded area = $\int_2^3 \frac{1}{2x-3}\,dx$ $= \frac{1}{2}[\ln(2x-3)]_2^3$ $\frac{1}{2}\ln(3)$ Total area = $\frac{1}{2}(1 + \ln(3))$ or, 1.049 $(3d.p)$	1 mark for calculating the area of triangle correctly 1 mark for correct integral for the remaining region 1 mark for correct total area with correct working out
32a	$x\cos x + \sin x$	1 mark for correct answer

32b	From $32(a)$, $d(x\sin x) = (x\cos x + \sin x)dx$ $\therefore \int x\cos x\,dx = \int \left(\frac{d(x\sin x)}{dx} - \sin x\right)dx$ $= \int \frac{d(x\sin x)}{dx}dx - \int \sin x dx$ $= x\sin x + \cos x + c$	1 mark for using the result from 32a correctly. 1 mark for correct answer with correct integration.
33	$y = 3x^2 - ax + 2b$ $y' = 6x - a$ At (1,5), $f'(x = 1) = 6 - a$ Gradient of Normal from the given equation, $m = -\frac{1}{2}$ $\therefore$ gradient of tangent = 2 so, $6 - a = 2$ $\therefore a = 4$ Substituting in the given function, $y = 3x^2 - 4x + 2b$ It passes through (1,5), $5 = 3 - 4 + 2b$ $6 = 2b$ $\therefore b = 3$	1 mark for correct differentiation of the function 1 mark for equating the gradients of normal/tangent correctly 1 mark each for each correct value of a and b supported by correct working out.
34	$d > 40$ $80\sin(2\theta) > 40$ $\sin(2\theta) > \frac{1}{2}$ $\therefore \quad 30° < 2\theta < 150°$ i.e., $15° < \theta < 75°$  z score for $\theta = 15$, $= \frac{15 - 30}{15}$ $= -1$ z score for $\theta = 75$, $= \frac{75 - 30}{15}$ $= 3$	1 mark for solving the trig inequality 1 mark for correctly determining that theta lies between 15 and 75 degrees 2 marks for correct answer including correct working out for z scores NOTE: A lot of the students who solved only for P(z>-1) got ¾ marks provided that the working out was correct.

	$P(-1<z<3) = \frac{68\%}{2} + \frac{99.7\%}{2}$ $= 83.85\%$  	
35	$y = e^{x^2 + \frac{x^3}{3}}$ $y' = e^{x^2 + \frac{x^3}{3}}\left(2x + \frac{3x^2}{3}\right)$ $y' = x(2+x)e^{x^2 + \frac{x^3}{3}}$ for stationary points, $y' = 0$ $\therefore x(2+x)e^{x^2 + \frac{x^3}{3}} = 0$ since $e^{x^2 + \frac{x^3}{3}} \neq 0$, $x(2+x) = 0$ $x = 0, -2$ Therefore, the stationary points are $f(0) = e^0 = 1$, i.e, $(0,1)$ $f(-2) = e^{(-2)^2 + \frac{(-2)^3}{3}}$ $f(-2) = e^{\frac{4}{3}}$ $= 3.79(2d.p.)$, i.e, $(-2, 3.79)$	1 mark for correct differentiation of the function. 1 mark each for finding and plotting each stationary point (rounded to 2d.p.). 1 mark for working out the nature of the curve by testing points in the first derivative function. (alternative methods used to figure out the nature of the graph was accepted as correct too, so long as the working out was correct) 1 mark for correct sketch of the graph.


(−2, 3.79367)
(0, 1)
4
3
2
1
-4
-2
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2