HURLSTONE
AGRICULTURAL HIGH
SCHOOL

STUDENT'S NAME: ______________________

TEACHER'S NAME: ______________________

2025

HSC ASSESSMENT TASK 4
TRIAL EXAMINATION

Mathematics Advanced

General Instructions

- Reading time – 10 minutes
- Working time – 3 hours
- Write using a black or blue pen
- NESA approved calculators may be used
- A reference sheet has been provided in the Section I booklet
- For questions in Section II-VII, **show all relevant mathematical reasoning and/or calculations**
- You may remove the Multiple-Choice Answer sheet from the back of Section I

Total marks: 100

Section I: 10 marks (pages 2 – 6)

- Attempt Questions 1 – 10.
  A multiple-choice answer sheet has been provided
- Allow about 15 minutes for this section

Sections II – VII: 90 marks (pages 13 – 48)

- Attempt Questions 11 – 37.
  Write your solutions in the spaces provided
- There are 6 **separate question/answer booklets**
- Allow about 2 hours and 45 minutes for these sections

SECTION I

10 marks
Attempt Questions 1 - 10
Allow about 15 minutes on this section.

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

---

1. What is the range of the function $f(x)=\dfrac{3}{\sqrt{x-2}}+1$?

   A. $(-\infty,\infty)$

   B. $(0,\infty)$

   C. $(1,\infty)$

   D. $(2,\infty)$

2. Given that $a=\log 5$ and $b=\log 2$, what is the expression of $\log 100$ in terms of a and b?

   A. $2(a+b)$

   B. $2a+b$

   C. $2ab$

   D. $(ab)^2$

3. If $\tan x=3$ and $\sin x<0$, what is the exact value of $\cos x$?

   A. $\sqrt{10}$

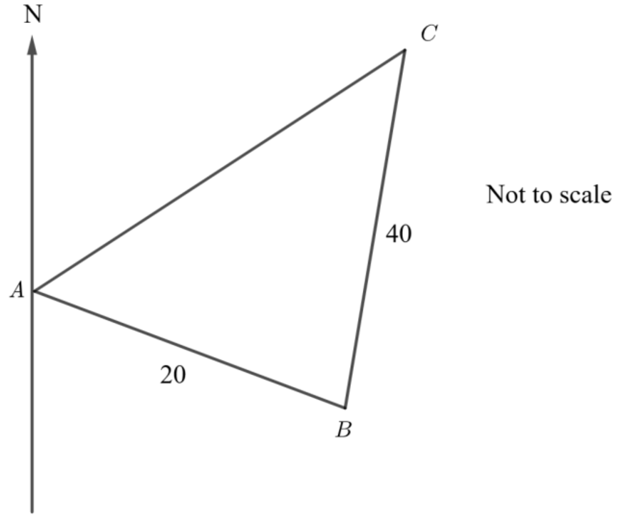
   B. 3

   C. $\dfrac{-1}{\sqrt{10}}$

   D. $-\sqrt{10}$

Section I continued on next page …

4. Two geologists on a large flat mining claim drive 20km from port A on a bearing of $150°$ T to a point B. They then drive 40 km on a bearing of $020°$ T to point C.



What is the bearing of B from C ?

A. $020°$ T

B. $050°$ T

C. $200°$ T

D. $220°$ T

5. Three runners compete in a race.

The probabilities that the three runners finish the race in under 10 seconds are $\frac{1}{4}$, $\frac{1}{6}$ and $\frac{2}{5}$ respectively.

What is the probability that at least one of the three runners will finish the race in under 10 seconds?

A. $\frac{1}{60}$

B. $\frac{37}{60}$

C. $\frac{3}{8}$

D. $\frac{5}{8}$

Section I continued on next page …

6. It is known that for a particular function, $y = f(x)$, that

$$f(2) = -5$$
$$f'(2) = 0$$
$$f''(2) = 3$$

Which statement below is true regarding the graph of $y = f(x)$?

A. It passes through the point $(2,0)$

B. There is a local minimum at $(2,-5)$

C. It's concave down at $(2,-5)$

D. There is a point of inflexion at $(2,4)$

7. The curve $y = 2x^3 - ax^2 + 6x$ has a point of inflection at $x = 4$.

What is the value of a?

A. -18

B. -24

C. 18

D. 24

8. What is the value of $\int_{-4}^{4} \sqrt{16-x^2}\ dx$?

A. 16

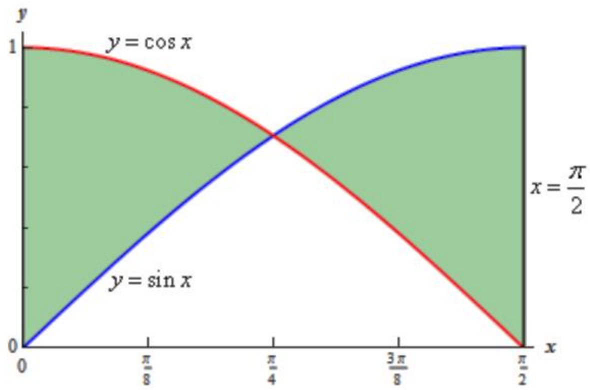
B. 4π

C. 8π

D. 32

Section I continued on next page …

9. Which of the following is the exact area bounded by $y = \sin x$, $y = \cos x$, $x = \dfrac{\pi}{2}$ and the y-axis?



A. $2 - 2\sqrt{2}$ u^2

B. $2 + 2\sqrt{2}$ u^2

C. $-2 + 2\sqrt{2}$ u^2

D. $-2 - 2\sqrt{2}$ u^2

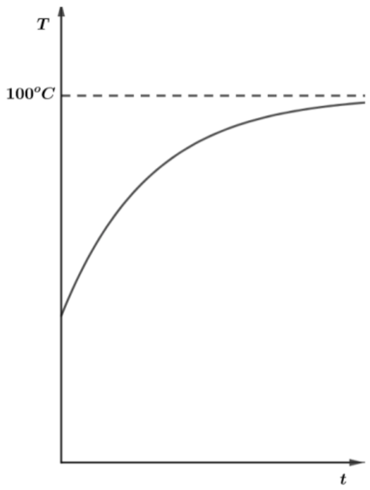
Section I continued on next page …

10. The graphs below show the temperature of an egg $T\ (°C)$ as a function of time, t, in minutes.

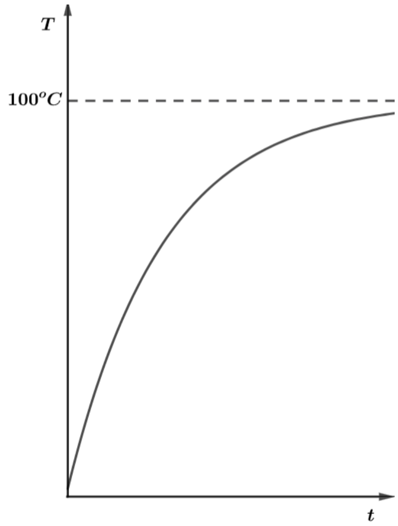
An egg is taken out of the refrigerator and immediately put into boiling water.

Which of the following graphs match the situation described above?

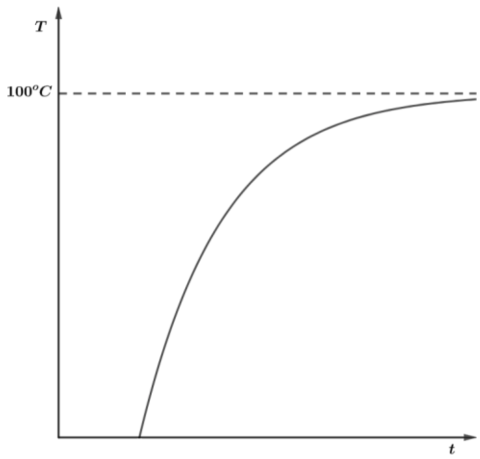
A.



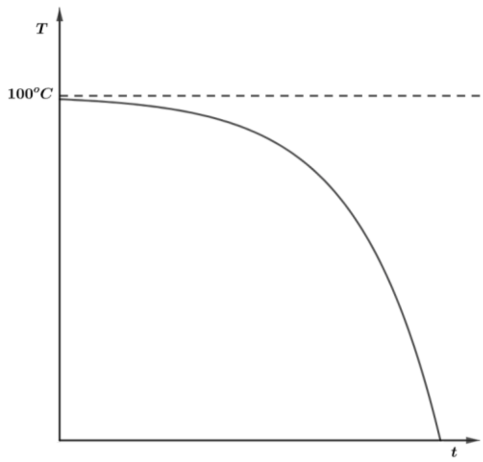
B.



C.



D.



~ End of Section I ~

HURLSTONE AGRICULTURAL HIGH SCHOOL

STUDENT'S NAME: ______________________

TEACHER'S NAME: ______________________

2025

HSC ASSESSMENT TASK 4

TRIAL EXAMINATION

Mathematics Advanced

Section II

Instructions

- Follow the instructions provided on the examination paper
- Write using black or blue pen
- Extra writing paper may be requested
- You may not remove any booklets, used or unused, from the examination room.

/ 17

SECTION II **Student Name:** ____________________

17 marks **Teacher Name:** ____________________

Attempt Questions 11 - 15

Allow about 27 minutes on this section.

For questions in this section, your responses should include relevant mathematical reasoning and/or calculations.

Answer each question in the spaces provided.

2025 Mathematics Advanced Trial Examination Section II **Marks**

Question 11

Solve the equation $|3x-2|=10$. **2**

Section II continued on next page …

Section II continued ….

Question 12

A YouTuber predicts that every person who views their latest video will share it with 5 other people after a day.

The YouTuber shares the video to 8 people in the first day.

After how many whole days should the YouTuber reach 1 million unique views? **3**

Section II continued on next page ….

Question 13

The population of stray cats can be modelled by the equation $P = P_0 e^{kt}$, where P_0 and k are constants.

Initially, a town had 30 stray cats. In 12 days, the population of cats increased to 120.

(a) Show that $P_0 = 30$. **1**

....

....

....

....

(b) Determine the exact value of k. **2**

....

....

....

....

....

....

....

....

(c) Determine the population of cats in 30 days. **1**

....

....

....

....

Section II continued on next page …

Section II continued ….

Question 14

Consider the function $f(x) = \dfrac{2x^2}{x^2 - 4}$

(a) Show that there is a horizontal asymptote at $y = 2$. **1**

....

....

....

....

(b) Determine the vertical asymptotes of the function. **1**

....

....

....

....

(c) Sketch the function, showing all asymptotes and intercepts. **2**

Section II continued on next page ….

Section II continued ….

Question 15

The quadratic equation $x^2+(m+6)x+8m=0$ has two distinct roots.

By considering the discriminant or otherwise, determine all the possible values of m . **4**

~ End of Section II~

HURLSTONE
AGRICULTURAL HIGH
SCHOOL

STUDENT'S NAME: ______________________

TEACHER'S NAME: ______________________

2025

HSC ASSESSMENT TASK 4

TRIAL EXAMINATION

Mathematics Advanced

Section III

Instructions

- Follow the instructions provided on the examination paper
- Write using black or blue pen
- Extra writing paper may be requested
- You may not remove any booklets, used or unused, from the examination room.

15

SECTION III **Student Name:** ____________________

15 marks **Teacher Name:** ____________________

Attempt Questions 16 - 20

Allow about 23 minutes on this section.

For questions in this section, your responses should include relevant mathematical reasoning and/or calculations.

Answer each question in the spaces provided.

2025 Mathematics Advanced Trial Examination Section III **Marks**

Question 16

In a workplace of 25 employees, each employee speaks either French or German, or both.

It is known that 36% of the employees speak German, and 20% speak both French and German.

Calculate the probability one person chosen could speak German if they could speak French.

Give your answer to the nearest percent. **2**

Section III continued on next page ….

Section III continued ….

Question 17

Two netball teams, Team A and Team B, each played 15 games in a tournament.

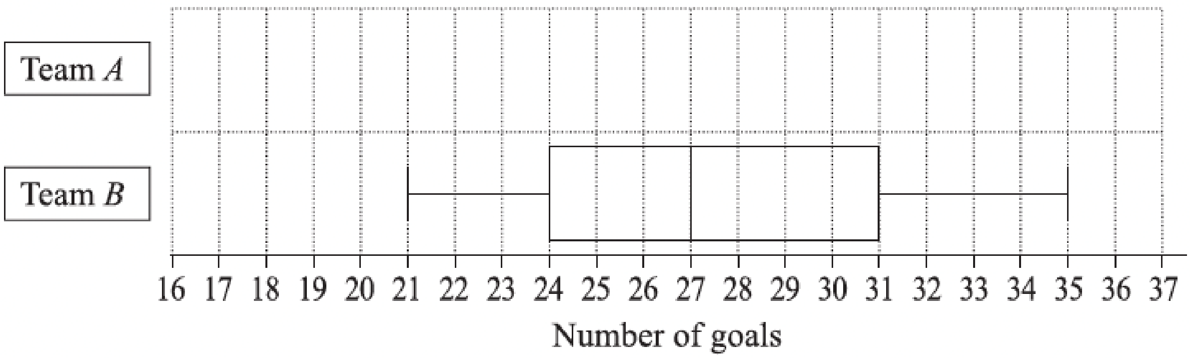
For each team, the number of goals scored in each game was recorded.

The frequency table to the right shows the data for Team A.

Team A

Number of goals	*Frequency*
19	1
20	0
21	1
22	1
23	1
24	3
25	0
26	4
27	3
28	1

(a) Construct a box-plot for the data for Team A in the diagram below, above that of Team B. **2**



……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

(b) Compare the distributions of the number of goals scored by the two teams.

Which team is more successful at scoring goals?

Justify your answer using summary statistics. **1**

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

Section III continued on next page ….

Section III continued ….

Question 18

The table below lists the average life span (in years) and average sleeping time (in hours/day) of 9 animal species.

species	**life span (years)**	**sleeping time (hours/day)**
baboon	27	10
cow	30	4
goat	20	4
guinea pig	8	8
horse	46	3
mouse	3	13
pig	27	8
rabbit	18	8
rat	5	13

(a) Using sleeping time as the independent variable, calculate the least squares regression line.

Give your answers correct to two decimal places. **2**

Question 18 continues on the next page ….

(b) A wallaby species sleeps for 4.5 hours on average, each day.

Use your equation from part (a) to predict its expected life span, to the nearest year. **1**

………

………

………

Question 19

The table shows the probability distribution of a discrete random variable.

x	0	1	2	3	4
$P(X = x)$	0	0.3	0.5	0.1	0.1

(a) Find the expected value, $E(X)$, of this distribution. **1**

………

………

………

(b) Calculate the standard deviation, correct to one decimal place, by using the appropriate formula on the reference sheet. **2**

………

………

………

………

………

………

………

Section III continued on next page ….

Question 20

A game involves rolling two six-sided dice, followed by rolling a third six-sided die.

To win the game, the number rolled on the third die must lie between the two numbers rolled previously.

For example, if the first two dice show 1 and 4, the game can only be won by rolling a 2 or 3 with the third die.

(a) What is the probability that a player has no chance of winning before rolling the third die? **2**

(b) What is the probability that a player wins the game? **2**

~ End of Section III ~

HURLSTONE
AGRICULTURAL HIGH
SCHOOL

STUDENT'S NAME: ______________________

TEACHER'S NAME: ______________________

2025 HSC ASSESSMENT TASK 4
TRIAL EXAMINATION

Mathematics Advanced

Section IV

Instructions

- Follow the instructions provided on the examination paper
- Write using black or blue pen
- Extra writing paper may be requested
- You may not remove any booklets, used or unused, from the examination room.

/ 15

SECTION IV **Student Name:** ____________________

15 marks **Teacher Name:** ____________________
Attempt Questions 21 - 25
Allow about 29 minutes on this section.

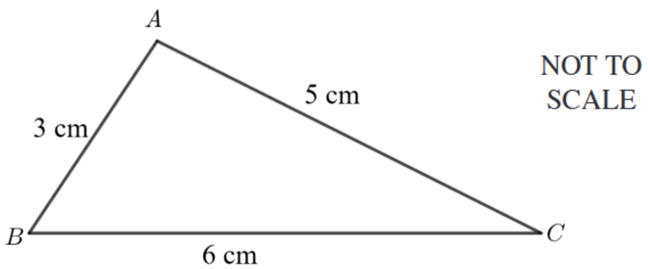
For questions in this section, your responses should include relevant mathematical reasoning and/or calculations.

Answer each question in the spaces provided.

2025 Mathematics Advanced Trial Examination Section IV **Marks**

Question 21

ABC is a triangle in which $AB = 3$ cm, $BC = 6$ cm and $CA = 5$ cm as shown in the diagram below.



(a) Use the Cosine rule to calculate $\angle BAC$ to the nearest degree **2**

....

....

....

....

....

....

....

....

Question 21 continued on next page …

Section IV continued ….

Question 21 continued…

(b) Calculate the area of triangle ABC. Give your answer correct to two significant figures. **1**

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

Question 22

Prove that $\tan\theta\sin\theta+\cos\theta=\sec\theta$ **2**

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

Section IV continued on next page ….

Section IV continued ….

Question 23

(a) Sketch the graph of $y = 4\sin x - 1$ in the domain $-2\pi \le x \le 2\pi$. **2**

Show all important features.

(b) What is the range of the function $y = 4\sin x - 1$? **1**

Question 23 continued on next page ….

Section IV continued ….

Question 23 continued…

(c) Explain how the graph of $y = 4\sin\left(x + \frac{\pi}{2}\right) - 1$ transforms from the graph of $y = 4\sin x - 1$. **1**

………

………

………

………

Question 24

Solve $2\sin^2 x - 3\sin x - 2 = 0$ for $0 \le x \le 2\pi$. **3**

………

………

………

………

………

………

………

………

………

………

………

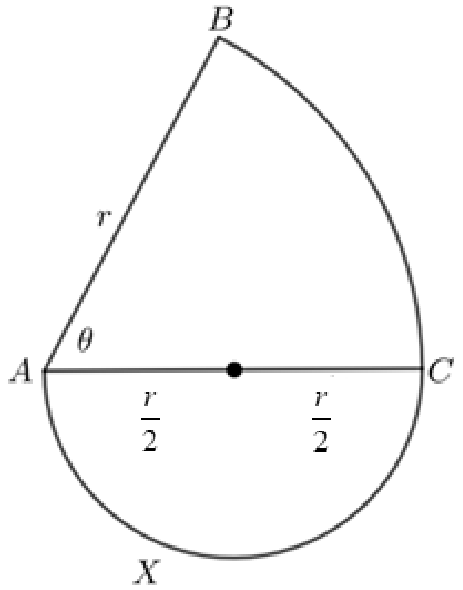
………

Section IV continued on next page ….

Section IV continued ….

Question 25

A cam (a piece of mechanical linkage) is formed with cross-section as shown in the figure below.



NOT TO SCALE

The cross-section consists of a semi-circle *AXC* centre *O* and radius $\frac{r}{2}$ and a sector *ABC* of radius *r*, centre *A* and angle θ, where θ is in radians.

(a) What is the perimeter *ABCX* of the cam in terms of *r* and θ ? **1**

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

Question 25 continued on next page ….

Section IV continued ….

Question 25 continued…

(b) If the area of the cross section of the cam is 1 square unit, show that the value of θ is given by: **2**

$$\theta = \frac{8 - \pi r^2}{4r^2}$$

~ End of Section IV ~

HURLSTONE AGRICULTURAL HIGH SCHOOL

STUDENT'S NAME: ______________________

TEACHER'S NAME: ______________________

2025 HSC ASSESSMENT TASK 4

TRIAL EXAMINATION

Mathematics Advanced

Section V

Instructions

- Follow the instructions provided on the examination paper
- Write using black or blue pen
- Extra writing paper may be requested
- You may not remove any booklets, used or unused, from the examination room.

16

SECTION V **Student Name:** ____________________

16 marks **Teacher Name:** ____________________
Attempt Questions 26 - 29
Allow about 30 minutes on this section.

For questions in this section, your responses should include relevant mathematical reasoning and/or calculations.

Answer each question in the spaces provided.

2025 Mathematics Advanced Trial Examination Section V **Marks**

Question 26

Differentiate the following with respect to x:

(a) $y = 3\ln x$ **1**

....

....

....

....

(b) $y = \dfrac{\sin x}{x+1}$ **2**

....

....

....

....

....

....

....

....

Section V continued on next page ….

Section V continued ….

Question 27

Given $f(x) = x^2 - x$,

(a) Expand and simplify $f(x+h)$. **1**

(b) Hence or otherwise, differentiate $f(x) = x^2 - x$ from first principles. **2**

Section V continued on next page ….

Section V continued ….

Question 28

The line $y = mx + b$ is a tangent to the curve $y = x^3 - 3x + 2$ at the point $(-2, 0)$.

Find the value of m and b. **3**

………

………

………

………

………

………

………

………

Question 29

Given the function $y = (3-x)(x-1)^3$,

(a) State the x and y intercepts. **2**

………

………

………

………

Question 29 continued on next page…

Section V continued ….

Question 29 continued

(b) Given that $\dfrac{d}{dx}\left[(3-x)(x-1)^3\right]=2(x-1)^2(5-2x)$, find the stationary points and determine their nature **3**

Question 29 continued on next page…

Section V continued ….

Question 29 continued

(c) Sketch the curve $y=(3-x)(x-1)^3$, clearly showing intercepts and stationary points. **2**

~ End of Section V ~

HURLSTONE
AGRICULTURAL HIGH
SCHOOL

STUDENT'S NAME: ______________________

TEACHER'S NAME: ______________________

2025

HSC ASSESSMENT TASK 4

TRIAL EXAMINATION

Mathematics Advanced

Section VI

Instructions

- Follow the instructions provided on the examination paper
- Write using black or blue pen
- Extra writing paper may be requested
- You may not remove any booklets, used or unused, from the examination room.

/ 17

SECTION VI **Student Name:** ______________________________

17 marks **Teacher Name:** ______________________________

Attempt Questions 30- 35

Allow about 33 minutes on this section.

For questions in this section, your responses should include relevant mathematical reasoning and/or calculations.

Answer each question in the spaces provided.

2025 Mathematics Advanced Trial Examination Section VI **Marks**

Question 30

Find $\int \sec^2 2x \ \ dx$ **1**

....

....

....

....

Question 31

Find the exact value of $\int_{-a}^{a} \frac{e^x - e^{-x}}{e^x + e^{-x}} \ dx$ **2**

....

....

....

....

....

....

....

....

....

....

Section VI continued on next page ….

Section VI continued …

Question 32

Arnold, a Year 12 student, runs his own business selling eco-friendly toothpaste. He supplies his product to a national supermarket chain.

The **price–demand function** $(p(x))$ models the relationship between the price per tube and the number of tubes demanded per week (x). In general, price decreases as demand increases.

The **marginal price–demand function** $(p'(x))$, represents the rate of change of price with respect to quantity demanded, measured in tubes per week.

These functions are used in business to analyse the **price–elasticity of demand** and assist in determining profitable pricing strategies.

Arnold knows that when the demand is 50 tubes per week, the price is \$2.35 per tube.

He is also given the following marginal price–demand function $p'(x) = -0.015e^{-0.01x}$ **.**

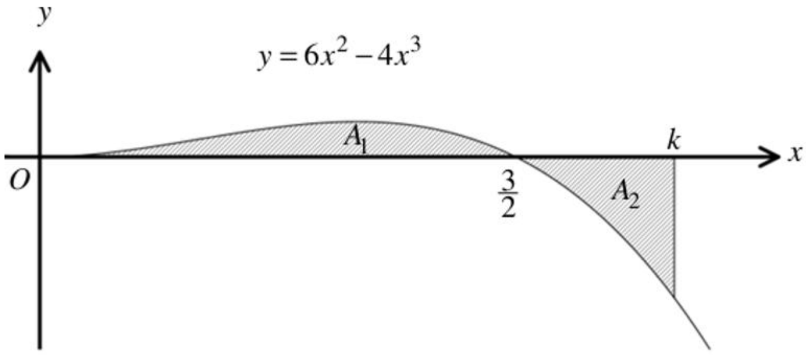
Find the **price–demand equation**, given the marginal price–demand function and the information above. **3**

Section VI continued on next page ….

Section VI continued …

Question 33

The figure shows the graph of the curve with equation $y = 6x^2 - 4x^3$.



NOT TO SCALE

The curve meets the x-axis at the origin and at the point $\left(\frac{3}{2}, 0\right)$.

The point $(k, 0)$, $k > \frac{3}{2}$ is such that the area A_1 is equal to the area A_2.

(a) Show that the area $A_1 = \frac{27}{16}$ u^2 . **2**

....

....

....

....

....

....

....

....

Question 33 continued on next page ….

Section VI continued …

Question 33 continued…

(b) Hence, or otherwise determine the value of k. **3**

Section VI continued on next page ….

Section VI continued …

Question 34

It is given that $\frac{d}{dx}\left(x^2 \ln x\right) = 2x \ln x + x$.

Find $\int x \ln x \, dx$ **2**

....

....

....

....

....

....

....

....

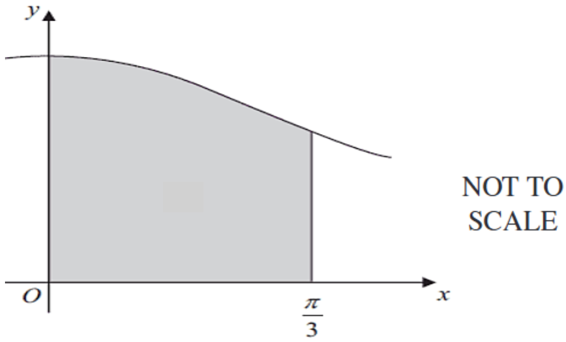
Section VI continued on next page ….

Section VI continued ….

Question 35

The diagram shows a curve with equation $y=\sqrt{0.75+\cos^2 x}$.

The area is bounded by the curve, the y-axis, the x-axis and the lines with equation $x=0$ and $x=\frac{\pi}{3}$.



(a) Complete the table with the remaining values of x (evenly spaced) and y for 5 function values. **2**

x	0		$\frac{\pi}{6}$		$\frac{\pi}{3}$
y	1.32		1.22		1

(b) Estimate the area of the shaded region by using the trapezoidal rule, with 5 function values, correct to 2 decimal places. **2**

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

~ End of Section VI ~

HURLSTONE AGRICULTURAL HIGH SCHOOL

STUDENT'S NAME: ____________________

TEACHER'S NAME: ____________________

2025

HSC ASSESSMENT TASK 4

TRIAL EXAMINATION

Mathematics Advanced

Section VII

Instructions

- Follow the instructions provided on the examination paper
- Write using black or blue pen
- Extra writing paper may be requested
- You may not remove any booklets, used or unused, from the examination room.

10

SECTION VII **Student Name:** ____________________

10 marks **Teacher Name:** ____________________
Attempt Questions 36 - 37
Allow about 23 minutes on this section.

For questions in this section, your responses should include relevant mathematical reasoning and/or calculations.

Answer each question in the spaces provided.

2025 Mathematics Advanced Trial Examination Section VII **Marks**

Question 36

Consider the expression $L = \frac{7}{\sin\theta} + \frac{5}{\cos\theta}$.

(a) Determine an expression for $\frac{dL}{d\theta}$ **2**

....

....

....

....

....

....

(b) For what values of θ is $\frac{dL}{d\theta} = 0$? Round you answer to three decimal places. **2**

....

....

....

....

....

....

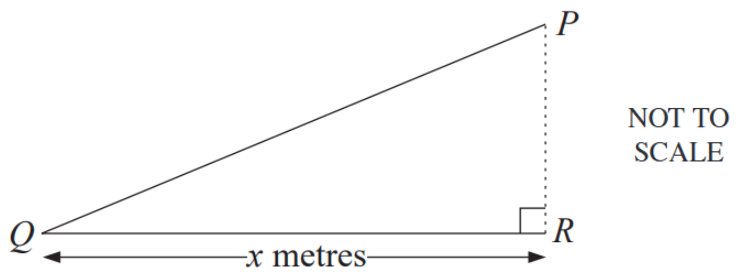
....

Section VII continued on next page ….

Section VII continued …

Question 37

A wire of length 5 metres is to be bent to form the hypotenuse and base of a right-angled triangle PQR, as shown in the diagram.



Let the length of the base QR be x metres.

(a) Show that the area of the triangle PQR is $\frac{1}{2}x\sqrt{25-10x}$ square metres. **2**

....

....

....

....

....

....

....

....

Question 37 continued on next page …

Section VII continued …

Question 37 continued…

(b) What is the maximum possible area of the triangle? **4**

~End of Section VII~

Multiple Choice

1)

Let $u = \sqrt{x-2}$

As $u \to \infty^{-}, \frac{3}{u} + 1 \to 1$

As $u \to 0,\ \frac{3}{u} + 1 \to\ \infty$

The function approaches 1 but never reaches it, range is $(1, \infty)$

∴**C**

2)

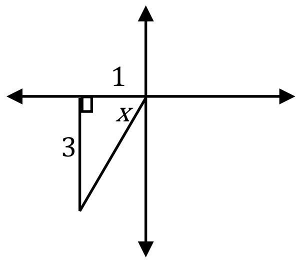
$\log 100 = \log 10^2 = 2\log 10$

$\log 10 = \log 2 + \log 5 = \log(a+b)$

∴**A**

3)

If $\tan x = 3$ and sin is negative the relationship is true in the third quadrant.



By Pythagoras' theorem hypotenuse length is $\sqrt{10}$.

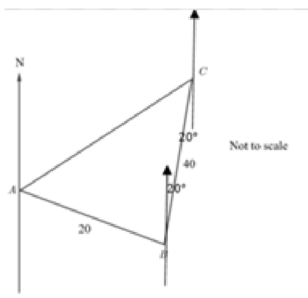
cos x is negative in third quadrant hence,

$$\cos x = \frac{-1}{\sqrt{10}}$$

∴ ***C***

4)

By adding relevant information from the question to the given diagram and using alternate angles in parallel lines,



∴ ***C***

5)

Probability that the runners do not finish in under 10 seconds:

P(A) = $1 - \frac{1}{4} = \frac{3}{4}$

P(B) = $1 - \frac{1}{6} = \frac{5}{6}$

P(C) = $1 - \frac{2}{5} = \frac{3}{5}$

$$P(none) = P(A) \times P(B) \times P(C) = \frac{3}{8}$$

$$P(at\ least\ one) = 1 - \frac{3}{8} = \frac{5}{8}$$

∴ ***D***

6)

There is a stationary point at $x = 2$.

Checking the second derivative, f''(x)>0 which is concave up.

Hence at $x = 2$, there is a local minimum.

∴ ***B***

7) $y = 2x^3 - ax^2 + 6x$ $y' = 6x^2 - 2ax + 6$ $y'' = 12x - 2a$ $0 = 12(4) - 2a$ $2a = 48$ $a = 24$ $\therefore$ ***D***	8) **Area =** $\int_0^{\frac{\pi}{4}} \cos x - \sin x \; dx + \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \sin x - \cos x \; dx$ $= \left[\sin x + \cos x\right]_0^{\frac{\pi}{4}} + \left[-\cos x - \sin x\right]_{\frac{\pi}{4}}^{\frac{\pi}{2}}$ $= 2\sqrt{2} - 2$ $\therefore$**C**
9) This is the top semi-circle with radius 4. $\int_{-4}^{4} \sqrt{16 - x^2} \; dx = \frac{1}{2} \times \pi \times 4^2 = 8\pi$ $\therefore$**C**	10) Initially the temperature of the egg is very low (approximately 2 or 3 degree Celsius) as it has been taken out of the refrigerator. The egg is then put into boiling water immediately, so the temperature of egg rises and becomes equal to 100 degrees Celsius. $\therefore$ ***B***

<table>
<tr><td>Year 12</td><td>Mathematics Advanced</td><td>Task 4 2025</td></tr>
<tr><td>Section II</td><td>Solutions and Marking Guidelines</td><td>Part B</td></tr>
</table>

Outcomes Addressed in this Question

MA12-1: uses detailed algebraic and graphical techniques to critically construct, model and evaluate arguments in a range of familiar and unfamiliar contexts
MA12-4: applies the concepts and techniques of arithmetic and geometric sequences and series in the solution of problems

<table>
<tr><th>Outcome</th><th>Solutions</th><th>Marking Guidelines</th></tr>
<tr><td>MA12-1</td><td>Question 11

$|3x-2|=10$
$3x-2=10$ or $3x-2=-10$
$3x=12$ or $3x=-8$
$x=4$ or $x=-\frac{8}{3}$

Marker’s notes: Very well done by the cohort. Some students thought the second solution was found by changing the – into a + for the $3x-2$ term which is incorrect – the whole expression is to be multiplied by -1 (or the 10 is to be multiplied by -1).</td><td>2 marks
Solves the absolute value equation to obtain both solutions

1 mark
Solves the absolute value equation to obtain one solution</td></tr>
<tr><td>MA12-4</td><td>Question 12

This is a geometric progression where $a=8$ and $r=5$.
1 million unique views require finding the sum of the geometric progression.

$S_n=\frac{a(r^n-1)}{r-1}$
$1000000=\frac{8(5^n-1)}{4}$
$1000000=2(5^n-1)$
$5^n-1=500000$
$5^n=5000001$
$n\ln 5=\ln 5000001$
$n=\frac{\ln 5000001}{\ln 5}$
$=8.1533...$

Therefore, it takes 9 full days to reach 1 million unique views.

Marker’s notes: Many students used T_n rather than S_n. 2 marks were awarded if T_n was used. Coincidently using T_n produces the same answer.</td><td>3 marks
Correctly determines the number of days after solving the geometric progression equation using logarithm laws

2 marks
Correctly solves the required equation using logarithm laws or equivalent effort

1 mark
Identifies that a sum of a geometric progression is required and obtains the equation
$1000000=\frac{8(5^n-1)}{4}$
or equivalent</td></tr>
<tr><td>MA12-1</td><td>Question 13

(a)
When $t=0$, $P=30$</td><td>

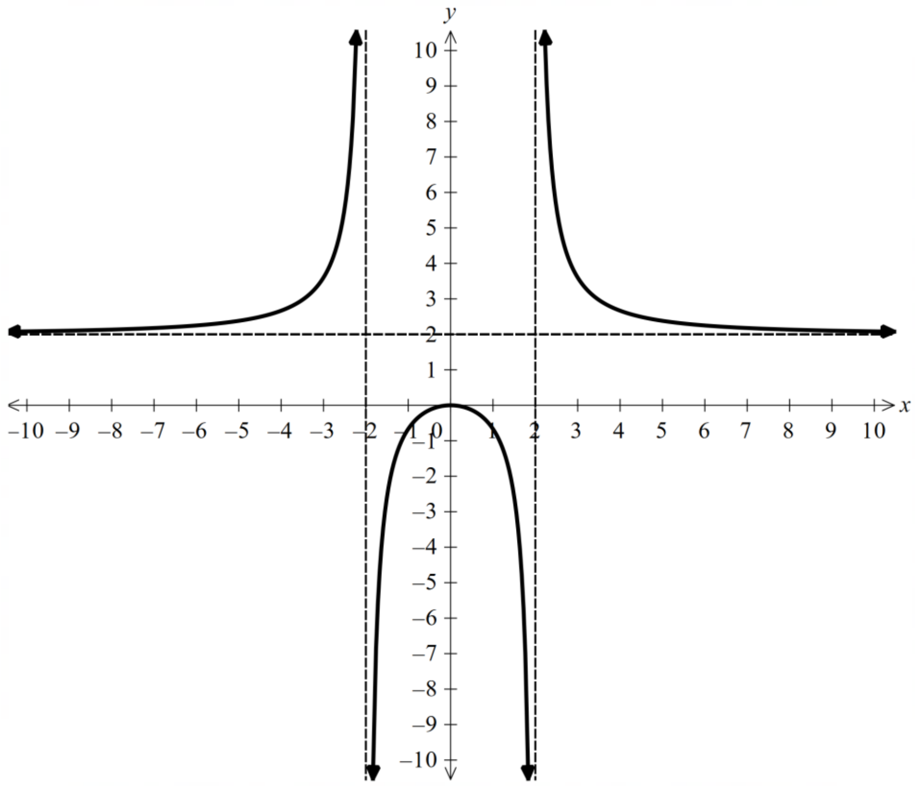
1 mark
Substitutes $t=0$ and $P=30$ into the</td></tr>
</table>

	$30 = P_0 e^{k\times 0}$ $30 = P_0 \times 1$ $P_0 = 30$ Marker's notes: Very well done. (b) When $t = 12,\ \ P = 120$ $120 = 30e^{12k}$ $4 = e^{12k}$ $\ln 4 = \ln e^{12k}$ $12k = \ln 4$ $k = \dfrac{\ln 4}{12}$ Optional: $k = \dfrac{\ln 4}{12} = \dfrac{2\ln 2}{12} = \dfrac{\ln 2}{6}$ Marker's notes: Very well done, bizarrely many students when dividing 120 by 30 wrote 40 rather than 4. (c) $P = 30e^{\frac{\ln 4}{12}\times 30}$ $\quad = 960$ Marker's notes: Very well done.	equation and solves to obtain $P_0 = 30$ **2 marks** Correctly obtains the exact value of k by substituting values then solving for k **1 mark** Correctly substitutes values for t and P into the equation **1 mark** Obtains 960 by substituting in correct values for t and k
MA12-1	**Question 14** (a) Horizontal asymptote is at $y = \lim\limits_{x\to\infty} f(x)$. $y = \lim\limits_{x\to\infty} f(x)$ $\quad = \lim\limits_{x\to\infty} \dfrac{2x^2}{x^2-4}$ $\quad = \lim\limits_{x\to\infty} \dfrac{\frac{2x^2}{x^2}}{\frac{x^2}{x^2} - \frac{4}{x^2}}$ $\quad = \lim\limits_{x\to\infty} \dfrac{2}{1-\frac{4}{x^2}}$ $\quad = \dfrac{2}{1-0}$ $\quad = 2$	**1 mark** Correctly uses limits to show that the horizontal asymptote is at $y = 2$

<table>
<tr>
<td></td>
<td>Marker's notes: All students were given a mark for this question due to its difficulty and vagueness of the syllabus.

(b)
Vertical asymptotes occur when the denominator of $f(x)$ is equal to zero.
$x^2 - 4 = 0$
$x^2 = 4$
$x = \pm 2$

Marker's notes: Very well done by the cohort. A few forgot about the plus-minus sign.

(c)


Marker's notes: Students need to take care of sketching their graphs, a lot of graphs have poor attention to detail, such as the curve "bouncing" up once it reaches the asymptote, or symmetry (as the function is even).</td>
<td>1 mark
Correctly identifies both vertical asymptotes

2 marks
Graph is the correct shape and in the correct position, with all asymptotes drawn

1 mark
One portion of the graph is correct, with all asymptotes and intercept labelled

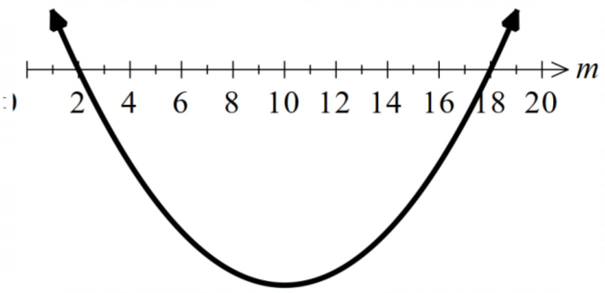
OR

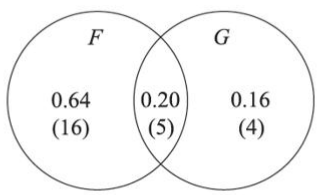
Correct graph is produced with all asymptotes and intercepts labelled, but the curve does not correctly approach the asymptote</td>
</tr>
<tr>
<td>MA12-1</td>
<td>Question 15

$\Delta = b^2 - 4ac$
$= (m+6)^2 - 4(1)(8m)$
$= m^2 + 12m + 36 - 32m$
$= m^2 - 20m + 36$

For two distinct roots, $\Delta > 0$
$m^2 - 20m + 36 > 0$
$(m-2)(m-18) > 0$</td>
<td>4 marks
Determines all possible values of m by correctly solving $(m-2)(m-18) > 0$

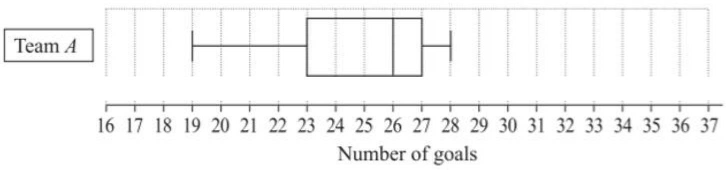
3 marks
Obtains $(m-2)(m-18) > 0$ or equivalent effort</td>
</tr>
</table>

	Sketching a diagram of $m^2 - 20m + 36$, and observing which parts of the graph is above the x-axis:  $\therefore m < 2$ or $m > 18$ Marker's notes: Many students failed to consider the inequality. Two marks maximum for stating $m = 2$ and $m = 18$ without identifying that $\Delta > 0$.	**2 marks** Obtains $m^2 - 20m + 36 > 0$ or equivalent effort **1 mark** Substitutes correct values into the discriminant formula

Year 12 Mathematics Advanced Trial 2025		
Section III	Solutions and Marking Guidelines	
Outcomes Addressed in this Question		
MA11-7 uses concepts and techniques from probability to present and interpret data and solve problems in a variety of contexts, including the use of probability distributions **MA12-8** solves problems using appropriate statistical processes		
Outcome	**Solutions**	**Marking Guidelines**
	Question 16  $P(G \mid F) = \dfrac{P(G \cap F)}{P(F)}$ $= \dfrac{0.20}{0.84}$ $= 0.238\ldots$ $= 24\%$	2 marks: correct solution 1 mark: uses correct formula with a correct probability or equivalent

Question 17

(a)



2 marks: correct solution

1 mark: correct shape plus 3 correct values

(b) Team B is more successful at scoring goals as each value in its 5-point summary is higher than Team A's equivalent value.

Note:

- Students needed to select only reasoning that supported Team B being more successful and state that, not additional information even if correct e.g. Team B being slightly positively skewed or symmetrical.
- Question stated use summary statistics.
- correct terminology was required, for example median, not med and correct percentages needed to be quoted.
- the justification required correct context – scores given were match scores. If referring to the percentage of scores, it needed to be in this context e.g. Team B scored greater than 27 goals in 50% of matches.
- Stating Team B has a higher interquartile range or larger range does not justify higher scores. Consider a team with $Q_1 = 10$ and $Q_3 = 20$ or lowest and highest scores 8 and 23.
- Reasoning had to be supported by the data. Team B having a higher median is proved by the data. Team B having a higher mean is not. The summary statistics you use should be supported by the data.
- Students who gave more than one reason required both to be correct to get the mark (e.g. in multiple choice can not give the correct plus an incorrect answer and get the mark.

1 mark: justification which includes correct terminology and reference to at least one of the quartiles or median without additional information not supporting the correct solution

Question 18

(a) By calculator:

Life span = $42.89 - 2.85 \times$ sleeping time

2 marks: correct solution

1 mark: correct A or B or both or correct equation found for sleeping time as dependant variable.

	(b) Predicted life span of wallaby $= 42.89 - 2.85 \times 4.5$ $= 30.06\ldots$ $= 30$ years Note: • Question said to use sleeping time as the independent variable so this needs to be x when entering the data in the calculator • Students were required to determine whether to substitute x = 4.5 or y = 4.5. If (a) done with x and y around the same way, for (b), students needed to be consistent with their choice of variable for sleeping time in (a)	1 mark: correct answer
	Question 19 a. $E(X) = 0 + 1 \times 0.3 + 2 \times 0.5 + 3 \times 0.1 + 4 \times 0.1$ $= 0.3 + 1 + 0.3 + 0.4$ $= 2$	1 mark: correct answer
	b. $\mathrm{Var}(X) = E(X^2) - [E(X)]^2$ $= (0 + 1^2 \times 0.3 + 2^2 \times 0.5 + 3^2 \times 0.1 + 4^2 \times 0.1) - 2^2$ $= (0.3 + 2 + 0.9 + 1.6) - 4$ $= 0.8$ $\therefore \sigma = \sqrt{0.8}$ $= 0.8944\ldots$ $= 0.9$ (to 1 d.p.)	2 marks: correct solution 1 mark: correct answer not supported by using formula on reference sheet or correctly calculates variance or finds standard deviation from variance

	Question 20	
	(a)	2 marks: correct solution 1 mark: correctly calculates probability for same number or adjoining numbers or equivalent

Construct a sample space of the number of possible winning rolls:

	1	**2**	**3**	**4**	**5**	**6**
1	–	–	1	2	3	4
2	–	–	–	1	2	3
3	1	–	–	–	1	2
4	2	1	–	–	–	1
5	3	2	1	–	–	–
6	4	3	2	1	–	–

$$\begin{aligned} P(\text{no chance}) &= \frac{\text{number of pairs with no gap}}{\text{total possibilities}} \\ &= \frac{16}{36} \\ &= \frac{4}{9} \end{aligned}$$

(b)

The sample space in the table shows:

$\rightarrow$ 8 combinations leave a gap for a single winning number,

$\rightarrow$ 6 combinations leave a gap for two winning numbers,

$\vdots$

$$\begin{aligned} \therefore P(\text{winning}) &= \frac{1}{36}\left[8 \times \frac{1}{6} + 6 \times \frac{2}{6} + 4 \times \frac{3}{6} + 2 \times \frac{4}{6}\right] \\ &= \frac{1}{36}\left(\frac{8}{6} + \frac{12}{6} + \frac{12}{6} + \frac{8}{6}\right) \\ &= \frac{1}{36}\left(\frac{40}{6}\right) \\ &= \frac{5}{27} \end{aligned}$$

2 marks: correct solution

1 mark: correct solution with a minor error or correct answer with insufficient explanation to justify validity of method

Note: it is important to be able to provide reasoning for your calculations, so that marks can be awarded.

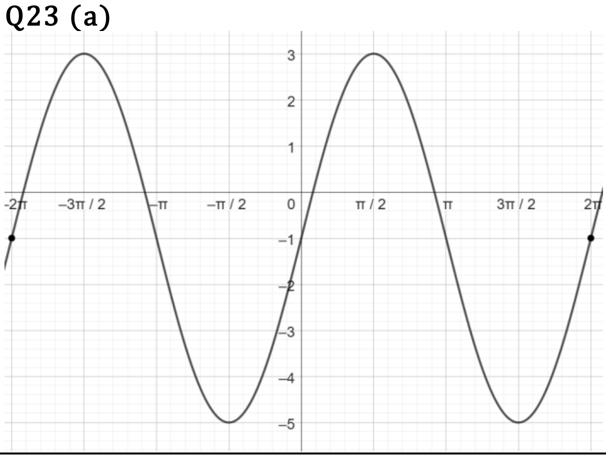
Year 12 Mathematics Advanced Assessment Task 4 2025
Section IV Solutions and Marking Guidelines

Outcomes Addressed:

MA11-3 uses the concepts and techniques of trigonometry in the solution of equations and problems involving geometric shapes

MA11-4 uses the concepts and techniques of periodic functions in the solutions of trigonometric equations or proof of trigonometric identities

MA12-5 applies the concepts and techniques of periodic functions in the solution of problems involving trigonometric graphs

Outcome	Solution	Marking Guidelines
MA11-3	**Q21 (a)** $\cos A = \dfrac{3^2+5^2-6^2}{2(3)(5)}$ $= \dfrac{-1}{15}$ $\angle A = \cos^{-1}\left(\dfrac{-1}{15}\right)$ $= 93.8°$ $= 94°$ (nearest degree)	**2 marks** ▪ Correctly applies the Cosine rule ▪ Correct final rounded answer **1 mark** ▪ Shows partial correct working towards finding an unknown angle
MA11-3	**Q21 (b)** $\text{Area} = \dfrac{1}{2}ab\sin C$ $= \dfrac{1}{2}(3)(5)\sin 94°$ $= 7.48$ $= 7.5 \text{ units}^2$	**1 mark** ▪ Correctly applies the area of a triangle formula ▪ Correct final answer
MA11-4	**Q22** $LHS = \tan\theta\sin\theta + \cos\theta$ $= \dfrac{\sin\theta}{\cos\theta}\sin\theta + \cos\theta$ $= \dfrac{\sin^2\theta}{\cos\theta} + \dfrac{\cos^2\theta}{\cos\theta}$ $= \dfrac{1}{\cos\theta}$ $= \sec\theta = RHS$	**2 marks** ▪ Correctly applies trigonometric identities to prove LHS=RHS **1 mark** ▪ Shows partial correct working towards proving LHS=RHS
MA12-5	**Q23 (a)** 	**2 marks** ▪ Correctly draws the graph of $y = 4\sin x - 1$ and in the correct domain $-2\pi \le x \le 2\pi$ **1 mark** ▪ Correct range only or ▪ Some progress towards the correct graph with an error in one key feature
MA12-5	**Q23 (b)** Range: $-5 \le y \le 3$ or $[-5,3]$ **Q23 (c)** Shift $y = 4\sin x - 1$ to the left $\dfrac{\pi}{2}$ units	**1 mark** ▪ Correct range stated (for the graph given in Q23(a)) **1 mark** ▪ Correct statement

MA11-3	**Q24** Solve: $2\sin^2 x - 3\sin x - 2 = 0$ $Let\ u = \sin x$ $2u^2 - 3u - 2 = 0$ $2u^2 - 4u + u - 2 = 0$ $2u(u-2) + 1(u-2) = 0$ $(2u+1)(u-2) = 0$ $u = \frac{-1}{2}\ ,\ u = 2$ $\therefore \sin x = \frac{-1}{2}$, $\sin x = 2$ (not a solution, $-1 \le \sin x \le 1$) ($\sin x$ is negative in 3rd and 4th quadrant related angle is $x = \frac{\pi}{6}$) $x = \pi + \frac{\pi}{6},\ 2\pi - \frac{\pi}{6}$ $\therefore x = \frac{7\pi}{6},\ \frac{11\pi}{6}$	**3 marks** Correctly shows all the following ▪ Factorising a quadratic ▪ Determining two solutions for $\sin x$ and eliminating one ▪ Solving appropriately and determining the two correct values of x **2 marks** Contains partially correct working but omits at least one of the above points **1 mark** Contains partially accurate working but omits at least two of the points listed above
MA11-3	**Q25** a) Perimeter $= r + r\theta + \frac{\pi r}{2}$ b) Area = Area of sector + Area of semi-circle $1 = \frac{1}{2}r^2\theta + \frac{1}{2}\pi\left(\frac{r}{2}\right)^2$ $1 = \frac{1}{2}r^2\theta + \frac{1}{2}\pi\frac{r^2}{4}$ $1 = \frac{1}{2}r^2\theta + \frac{1}{8}\pi r^2$ $\frac{1}{2}r^2\theta = 1 - \frac{1}{8}\pi r^2$ $r^2\theta = 2 - \frac{1}{4}\pi r^2$ $\theta = \frac{2}{r^2} - \frac{\pi r^2}{4r^2}$ $\theta = \frac{8}{4r^2} - \frac{\pi r^2}{4r^2}$ $\therefore \theta = \frac{8 - \pi r^2}{4r^2}$	**1 mark** Correct expression for the perimeter **2 marks** Contains complete and correct working **1 mark** Contains partially accurate working showing the correct formula for one of the areas.

Solutions and Marking Guidelines – Year 12 Mathematics Advanced Trials

Outcomes assessed in this question

MA12-3 applies calculus techniques to model and solve problems

MA12-6 applies appropriate differentiation methods to solve problems

Question	Solutions	Marking Guidelines
26 (a)	$y=3\ln x$ $\dfrac{dy}{dx}=\dfrac{3}{x}$	**1 mark** Correct solution
(b)	$y=\dfrac{\sin x}{x+1}$ $\dfrac{dy}{dx}=\dfrac{(x+1)\cos x-\sin x(1)}{(x+1)^2}$ $\dfrac{dy}{dx}=\dfrac{\cos x(x+1)-\sin x}{(x+1)^2}$ $\dfrac{dy}{dx}=\dfrac{x\cos x+\cos x-\sin x}{(x+1)^2}$	**2 marks** Correctly uses the quotient rule (or otherwise) to obtain the correct solution **1 mark** Correctly applies the quotient rule (or otherwise) OR contains ONE error in the final solution.
27 (a)	$f(x+h)=x^2+2xh+h^2-x-h$	**1 mark** Correct solution
(b)	$f'(x)=\lim\limits_{h\to 0}\dfrac{x^2+2xh+h^2-x-h-(x^2-x)}{h}$ $f'(x)=\lim\limits_{h\to 0}\dfrac{2xh+h^2-h}{h}$ $f'(x)=\lim\limits_{h\to 0}\dfrac{h(2x+h-1)}{h}$ $f'(x)=\lim\limits_{h\to 0}2x+h-1$ $f'(x)=2x+0-1$ $f'(x)=2x-1$	**2 marks** Applies the first principles rule to communicate the solution to the gradient function in a cohesive and clear manner. Must use first principles. Obtaining the correct derivative by the power rule will yield zero marks.

28	$y' = 3x^2 - 3$ At $x = -2, y' = 3(-2)^2 - 3$ $y' = 9$ $y - 0 = 9(x+2)$ $y = 9x + 18$ $\therefore m = 9, b = 18$	**1 mark** Applies the result from part (a) and substituting it into the first principles formula OR makes some progress towards the correct solution. **3 marks** Correctly finds the equation of the tangent and obtains the values of m and b **2 marks** Correctly differentiates the function and obtains either ONE of m OR b OR makes significant progress towards the correct solution. **1 mark** Correctly differentiates the function OR makes some progress towards the correct solution.
29 (a)	$x - \text{int} : (3,0), (1,0)$ $y - \text{int} : (0,-3)$ Does not have to be in coordinate form.	**2 marks** Correct x and y intercepts **1 mark** Either correct x OR y intercept

(b)

Stationary points occur at $y' = 0$

$$2(x-1)^2(5-2x) = 0$$

$$x = 1 \text{ or } \frac{5}{2}$$

When $x = 1.\, y = 0$

When $x = \frac{5}{2},\ y = \frac{27}{16}$

Stationary points occur at $(1,0)$ and $\left(\frac{5}{2}, \frac{27}{16}\right)$

Testing $x = 1$

x	0.9	1	1.1
y'	$+$	0	$+$

Testing $x = \frac{5}{2}$

x	2.4	$\frac{5}{2}$	2.6
y'	$+$	0	$-$

$\therefore$ At $(1, 0)$ there is a horizontal point of inflection and at $\left(\frac{5}{2}, \frac{27}{16}\right)$, there is a local maximum.

3 marks

Correctly determines the roots AND determines the nature of the stationary points.

Must be coordinate form and nature of both stationary points must be correct

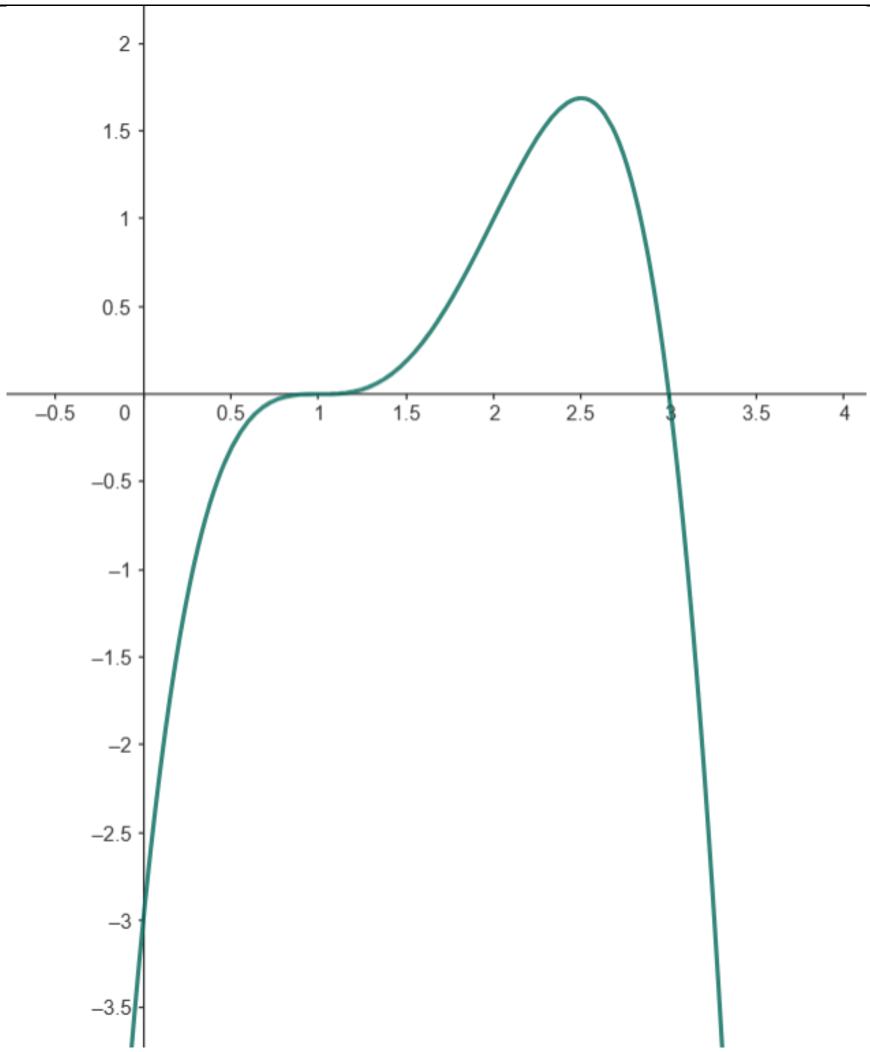
For the point $(1,0)$, solution must refer to horizontal point of inflection or point of inflection.

2 marks

Determines the correct roots and correctly determines the nature of ONE stationary point OR makes significant progress towards the correct solution.

1 mark

Determines the correct roots OR makes some progress towards the correct solution.

(c)		**2 marks** Correct graph, clearly showing the maximum turning point, horizontal point of inflection AND intercepts. **1 mark** Graph shows correct turning point OR point of inflection OR student demonstrates an appropriate attempt of sketching their information obtained from part (b) Graphs must <u>clearly</u> show key points to be awarded full marks.

Question	Solutions	Marking Guidelines
	$\int \sec^2 2x\ dx = \frac{1}{2}\tan 2x + c$	**1 mark** Correct integral + c
	$\int_{-a}^{a} \frac{e^x - e^{-x}}{e^x + e^{-x}}\ dx = \ln\left(e^x + e^{-x}\right)\Big\|_{-a}^{a}$ $= \ln\left(e^a + e^{-a}\right) - \ln\left(e^{-a} + e^a\right)$ $= 0$ Note: Many did not recognise that $\ln\left(e^a + e^{-a}\right) - \ln\left(e^{-a} + e^a\right) = 0$	**2 marks** Correct integral and substitution to get final answer **1 mark** Correct integral but no final answer or equivalent.
	$p(x) = \int -0.015e^{-0.01x}\ dx$ $= -0.015\int e^{-0.01x}\ dx$ $= \frac{-0.015}{-0.01}e^{-0.01x} + c$ $p(x) = 1.5e^{-0.01x} + c$ We know that \$2.35 is the price per tube for 50 tubes per week. $p(50) = 1.5e^{-0.01(50)} + c$ $2.35 = 1.5e^{-0.01(50)} + c$ $c = 2.35 - 0.91 = 1.44$ $\therefore\ p(x) = 1.5e^{-0.01x} + 1.44$ Note: A lot of students incorrectly divided 2.35 by $\frac{3}{2}$ or 1.5 after substitution. Some incorrectly substituted the values for x and $p(x)$.	**3 marks** Correct integral + c Substitution of 50 and \$2.35 was correct Correct value of c

<table>
<tr>
<td></td>
<td>

$$A_1 = \int_0^{\frac{3}{2}} 6x^2 - 4x^3 \ dx$$

$$= \left[2x^3 - x^4 \right]_0^{\frac{3}{2}}$$

$$= \left[2\left(\frac{3}{2}\right)^3 - \left(\frac{3}{2}\right)^4 \right] - [0]$$

$$= \frac{27}{4} - \frac{81}{16}$$

$$= \frac{27}{16} \text{ u}^2$$

</td>
<td>

2 marks:
Correct integral with boundaries

Correct showing of all steps to get required answer.

</td>
</tr>
<tr>
<td></td>
<td>

$$\int_{\frac{3}{2}}^{k} 6x^2 - 4x^3 \ dx = -\frac{27}{16}$$

$$\left[2x^3 - x^4 \right]_{\frac{3}{2}}^{k} = -\frac{27}{16}$$

$$\left[2k^3 - k^4 \right] - \left[2\left(\frac{3}{2}\right)^3 - \left(\frac{3}{2}\right)^4 \right] = -\frac{27}{16}$$

$$2k^3 - k^4 - \frac{27}{4} + \frac{81}{16} = -\frac{27}{16}$$

$$2k^3 - k^4 = 0$$

$$k^3(2-k) = 0$$

$$k = 0 \quad \text{or} \quad k = 2$$

$$\therefore \ k = 2 \qquad (k > \frac{3}{2})$$

Notes;
Overall very poorly done.
Many students did not recognise that the integral should equal to a negative value as the area is below the x-axis.
Many did absolute the integral, however then were not able to solve correctly to get final answer.

Method 2:

Was to set up and solve

$$\int_0^{k} 6x^2 - 4x^3 \ dx = 0$$

Recognising that the integral above and below show add to give 0.

</td>
<td>

3 Marks
Setting up correct integral equation with boundaries

Substituting in boundaries and simplifying correctly to get two values for k.

Recognising/ writing that $k > \frac{3}{2}$ and so only correct answer should be $k = 2$

</td>
</tr>
</table>

<table>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td>

x	0	$\frac{\pi}{12}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$
y	1.32	1.29	1.22	1.12	1

</td><td>1 mark correct values of x

1 mark for correct values of y</td></tr>
<tr><td></td><td>

$$\text{Area} = \frac{1}{2}\left(\frac{\pi}{12}\right)\left[1.32 + 2\left(1.29 + 1.22 + 1.12\right) + 1\right]$$
$$= 1.26 \text{ u}^2$$

</td><td>1 mark for correct expression of Trapezoidal rule

1 mark for correct final answer to 2dp.</td></tr>
<tr><td></td><td>

$$\int 2x\ln x + x \, dx = x^2 \ln x + C$$
$$\int 2x\ln x \, dx + \int x \, dx = x^2 \ln x + C$$
$$2\int x\ln x \, dx + \frac{x^2}{2} = x^2 \ln x + C$$
$$2\int x\ln x \, dx = x^2 \ln x - \frac{x^2}{2} + C$$
$$\int x\ln x \, dx = \frac{1}{2}x^2 \ln x - \frac{1}{4}x^2 + C$$

</td><td>1 mark for setting up of line 3 or equivalent

1 mark for correct final integral + c</td></tr>
</table>

Year 12 Mathematics Advanced	Assessment Task 4 2025
Section VII Solutions and Marking Guidelines	

Outcomes Addressed in this Question: MA12-3 applies calculus techniques to model and solve problems

Part	Solutions	Marking Guidelines
Q36 (a)	$L=\dfrac{7}{\sin\theta}+\dfrac{5}{\cos\theta}$ $\dfrac{dL}{d\theta}=\dfrac{0-7\cos\theta}{\sin^2\theta}+\dfrac{0-5(-\sin\theta)}{\cos^2\theta}$ $\dfrac{dL}{d\theta}=\dfrac{-7\cos\theta}{\sin^2\theta}+\dfrac{5\sin\theta}{\cos^2\theta}$	**2 marks awarded for** • Correctly differentiating both terms using the derivatives of the reciprocal trigonometric functions, or using quotient rule and writing the final answer in simplified form. **1 mark awarded for** • Correctly differentiating only one term while making a major error in the other.
Q36(b)	$\dfrac{dL}{d\theta}=0$ $\dfrac{-7\cos\theta}{\sin^2\theta}+\dfrac{5\sin\theta}{\cos^2\theta}=0$ $\dfrac{5\sin\theta}{\cos^2\theta}=\dfrac{7\cos\theta}{\sin^2\theta}$ $5\sin^3\theta=7\cos^3\theta$ $\dfrac{\sin^3\theta}{\cos^3\theta}=\dfrac{7}{5}$ $\tan^3\theta=\dfrac{7}{5}$ $\tan\theta=\sqrt[3]{\dfrac{7}{5}}$ $\theta=\tan^{-1}\left(\sqrt[3]{\dfrac{7}{5}}\right)$ or $\pi+\tan^{-1}\left(\sqrt[3]{\dfrac{7}{5}}\right)$ $\theta=0.841$ or 3.983 (to 3 dp)	**2 marks awarded for** • Correctly setting $\dfrac{dL}{d\theta}$ equal to zero and solving for θ using appropriate trigonometric identities or algebraic manipulation to find the numerical value(s) of θ, rounded to three decimal places. **1 mark awarded for** • Correctly working out the equation $\tan^3\theta=\dfrac{7}{5}$ but making a minor error in solving for θ. Or • making an error in setting up the equation but solving their incorrect equation correctly for θ.

Q37(a)	Applying Pythagoras Theorem in right -angled traingle ΔPQR $(PQ)^2=(QR)^2+(PR)^2$ $(5-x)^2=(x)^2+(h)^2$ $h^2=(5-x)^2-x^2$ $h^2=25-10x+x^2-x^2$ $h^2=25-10x$ $h=\sqrt{25-10x}$ Area of triangle ΔPQR $A=\frac{1}{2}\times x\times\sqrt{25-10x}$ $A=\frac{1}{2}x\sqrt{25-10x}$	**2 marks awarded for** • Correctly determining the length of PR (height h) in terms of x by applying the Pythagoras theorem, and showing the steps required for full simplification of this expression. • Correctly substituting the base and height into the formula for the area of a triangle and simplifying to obtain the required expression in the form given in the question. **1 mark awarded for** • Correctly identifying and setting up the relationship for the height PR but not showing the steps required for the full simplification **Or** • Making a minor error in determining the height but substituting their expression into the area formula.
Q37(b)	$A=\frac{1}{2}x\sqrt{25-10x}$ $\frac{dA}{dx}=\frac{1}{2}\sqrt{25-10x}+\frac{1}{2}x\times\frac{1}{2}(25-10x)^{1-\frac{1}{2}}(-10)$ $\frac{dA}{dx}=\frac{1}{2}\sqrt{25-10x}-\frac{5}{2}x\times(25-10x)^{-\frac{1}{2}}$ $\frac{dA}{dx}=\frac{\sqrt{25-10x}}{2}-\frac{5x}{2\sqrt{25-10x}}$ $\frac{dA}{dx}=\frac{25-10x-5x}{2\sqrt{25-10x}}$ $\frac{dA}{dx}=\frac{25-15x}{2\sqrt{25-10x}}$	**4 marks awarded for** • Differentiating the area expression correctly with respect to x • Setting the derivative equal to zero and accurately solving for the value of x corresponding to the stationary point. • Justifying that this value of x gives a maximum, using either the first derivative test or the second derivative test appropriately. • Substituting this value of x into the original area expression to obtain the correct maximum possible area. **3 marks awarded for** • A complete and mostly correct solution but missing one of the required steps, such as: ○ Not fully justifying the maximum (e.g. not giving values for the first derivative test and only giving signs)

	$\frac{dA}{dx}=0$ for stationary points $\frac{25-15x}{2\sqrt{25-10x}}=0$ $25-15x=0 \quad$ for $0\le x\le 2.5$ $x=\frac{25}{15}=\frac{5}{3}$ x: 1, $\frac{5}{3}$, 2 $\frac{dA}{dx}$: 1.290994..., 0, −1.118033.... $\therefore x=\frac{5}{3}$ is a maximum turning point and gives maximum Area. Maximum Area $A=\frac{1}{2}x\sqrt{25-10x}$ $A=\frac{1}{2}\times\frac{5}{3}\times\sqrt{25-10\times\frac{5}{3}}$ $A=\frac{5}{6}\sqrt{\frac{75-50}{3}}$ $A=\frac{5}{6}\sqrt{\frac{25}{3}}$ $A=\frac{25}{6\sqrt{3}}u^2$	○ Making a minor error in differentiation ○ Making an error in solving for x ○ Making an error in substitution into the area expression **2 marks awarded for** • a mostly correct solution where only two of the above-mentioned steps for a fully correct solution have been completed correctly **1 mark awarded for** • a partially correct solution where only one of the above-mentioned steps for a fully correct solution has been completed correctly

x	1	$\frac{5}{3}$	2
$\frac{dA}{dx}$	1.290994...	0	$-1.118033....$