STUDENT'S NAME: _____

TEACHER'S NAME: _____

2026 **Hurlstone Agricultural High School**
HSC TRIAL EXAMINATION

Mathematics Advanced

General Instructions

- Reading time – 10 minutes
- Working time – 3 hours
- Write using a black pen
- NESA approved calculators may be used
- A reference sheet has been provided in the Section I booklet
- For questions in Section II - VIII, **show all relevant mathematical reasoning and/or calculations**
- Write your name and your teachers name at the top of this page

Total marks: 100

Section I: 10 marks (pages 2 – 6)

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

Sections II – VIII: 90 marks (pages 13 – 52)

- Attempt Questions 11 – 38.
- 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 for Questions 1 – 10.

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1 The graph of $y = x^2 + 4x + 7$ is reflected about the *y*-axis, followed by a translation of 2 units to the right.

Which of the following is the equation of the new graph?

A. $y = (-x-2)^2 + 4(-x-2) + 7$

B. $y = (-x+2)^2 + 4(-x+2) + 7$

C. $-y = (x+2)^2 + 4(x+2) + 7$

D. $-y = (x-2)^2 + 4(x-2) + 7$

2 If x^2, $4x+3$, 25 are in a geometric sequence, what is the value of x?

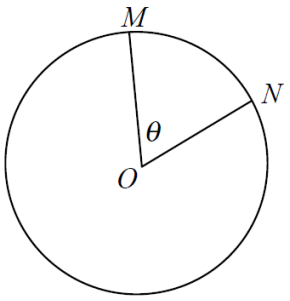
A. $-\frac{1}{3}$

B. -3

C. $\frac{1}{3}$ or -3

D. $-\frac{1}{3}$ or 3

3 The circle below has centre *O,* radius $\frac{3}{\pi}$ cm and arc length $MN = 1$ cm.



NOT TO SCALE

What is the exact area of the sector *MON?*

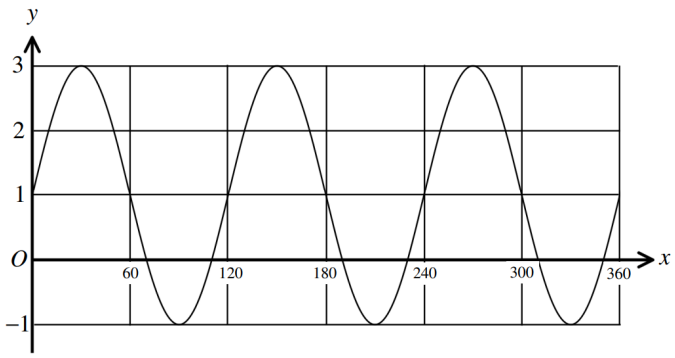
A. $\frac{3}{2\pi}$ cm^2

B. $\frac{\pi}{3}$ cm^2

C. $\frac{9}{2\pi^2}$ cm^2

D. $\frac{3}{\pi}$ cm^2

4



The figure above shows an accurate graph of $y = A + B\sin(Cx)$, where x is measured in degrees and A, B and C are constants.

Which of the following are the correct values of A, B and C?

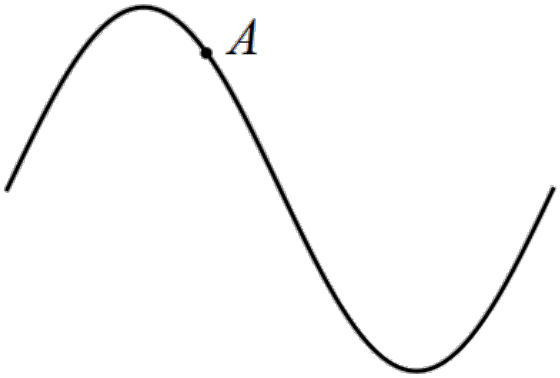
A. $A = 2$, $B = 1$ and $C = 3$

B. $A = 1$, $B = 2$ and $C = 3$

C. $A = 1$, $B = 3$ and $C = 2$

D. $A = 3$, $B = 2$ and $C = 1$

5 At point A, which of the following is true?



A. $f'(x) > 0$ and $f''(x) > 0$

B. $f'(x) < 0$ and $f''(x) > 0$

C. $f'(x) > 0$ and $f''(x) < 0$

D. $f'(x) < 0$ and $f''(x) < 0$

6 What is the derivative of $e^x \ln(\cos x)$?

A. $e^x(\ln(\cos x) - \tan x)$

B. $e^x(\ln(\cos x) + \tan x)$

C. $e^x(\ln(\cos x) - \cot x)$

D. $e^x(\ln(\cos x) + \cot x)$

7 The points below lie on the continuous curve $y = f(x)$.

x	4	7	10	13
$f(x)$	-6	4	7	2

Using the Trapezoidal Rule with 4 function values, which of the following is an estimate for $\int_4^{13} f(x)\,dx$?

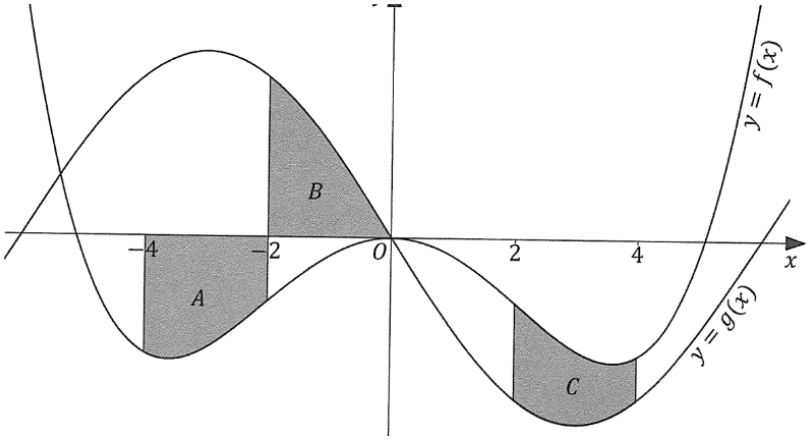
A. 11.8125

B. 15.75

C. 27

D. 36

8 The graph of an even function, $f(x)$, and an odd function, $g(x)$, are shown below.



Let A, B and C represent the shaded areas as shown.

Which of the following expressions equals $\int_0^4 g(x)\,dx$?

A. $A + B + C$

B. $-A - B - C$

C. $-A + B - C$

D. $A - B + C$

9 A set of data is normally distributed with a mean of 48 and a standard deviation of 3. Approximately what percentage of the scores lie between 39 and 45?

A. 15.85%

B. 31.7%

C. 47.5%

D. 49.85%

10 A probability function is given as below:

$$P(X = x) = \frac{x+2}{14} \text{ for } x = 0, 1, 2, 3$$

What is the variance of $P(x)$?

A. 1.12

B. 1.06

C. 1.86

D. 3.45

~ End of Section I ~

NSW Education Standards Authority

2021 HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Advanced
Mathematics Extension 1
Mathematics Extension 2

REFERENCE SHEET

Measurement

Length

$$l = \frac{\theta}{360} \times 2\pi r$$

Area

$$A = \frac{\theta}{360} \times \pi r^2$$

$$A = \frac{h}{2}(a + b)$$

Surface area

$$A = 2\pi r^2 + 2\pi rh$$

$$A = 4\pi r^2$$

Volume

$$V = \frac{1}{3}Ah$$

$$V = \frac{4}{3}\pi r^3$$

Functions

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

For $ax^3 + bx^2 + cx + d = 0$:

$$\alpha + \beta + \gamma = -\frac{b}{a}$$

$$\alpha\beta + \alpha\gamma + \beta\gamma = \frac{c}{a}$$

$$\text{and } \alpha\beta\gamma = -\frac{d}{a}$$

Relations

$$(x - h)^2 + (y - k)^2 = r^2$$

Financial Mathematics

$$A = P(1 + r)^n$$

Sequences and series

$$T_n = a + (n - 1)d$$

$$S_n = \frac{n}{2}[2a + (n - 1)d] = \frac{n}{2}(a + l)$$

$$T_n = ar^{n-1}$$

$$S_n = \frac{a(1 - r^n)}{1 - r} = \frac{a(r^n - 1)}{r - 1}, \; r \neq 1$$

$$S = \frac{a}{1 - r}, \; |r| < 1$$

Logarithmic and Exponential Functions

$$\log_a a^x = x = a^{\log_a x}$$

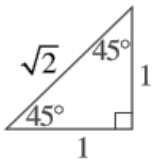
$$\log_a x = \frac{\log_b x}{\log_b a}$$

$$a^x = e^{x \ln a}$$

Trigonometric Functions

$$\sin A = \frac{\text{opp}}{\text{hyp}}, \quad \cos A = \frac{\text{adj}}{\text{hyp}}, \quad \tan A = \frac{\text{opp}}{\text{adj}}$$

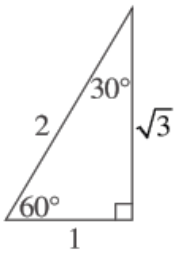
$$A = \frac{1}{2}ab\sin C$$



$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$c^2 = a^2 + b^2 - 2ab\cos C$$

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$



$$l = r\theta$$

$$A = \frac{1}{2}r^2\theta$$

Trigonometric identities

$$\sec A = \frac{1}{\cos A}, \ \cos A \neq 0$$

$$\operatorname{cosec} A = \frac{1}{\sin A}, \ \sin A \neq 0$$

$$\cot A = \frac{\cos A}{\sin A}, \ \sin A \neq 0$$

$$\cos^2 x + \sin^2 x = 1$$

Compound angles

$$\sin(A + B) = \sin A\cos B + \cos A\sin B$$

$$\cos(A + B) = \cos A\cos B - \sin A\sin B$$

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A\tan B}$$

If $t = \tan\frac{A}{2}$ then $\sin A = \frac{2t}{1+t^2}$

$$\cos A = \frac{1-t^2}{1+t^2}$$

$$\tan A = \frac{2t}{1-t^2}$$

$$\cos A\cos B = \frac{1}{2}\left[\cos(A - B) + \cos(A + B)\right]$$

$$\sin A\sin B = \frac{1}{2}\left[\cos(A - B) - \cos(A + B)\right]$$

$$\sin A\cos B = \frac{1}{2}\left[\sin(A + B) + \sin(A - B)\right]$$

$$\cos A\sin B = \frac{1}{2}\left[\sin(A + B) - \sin(A - B)\right]$$

$$\sin^2 nx = \frac{1}{2}(1 - \cos 2nx)$$

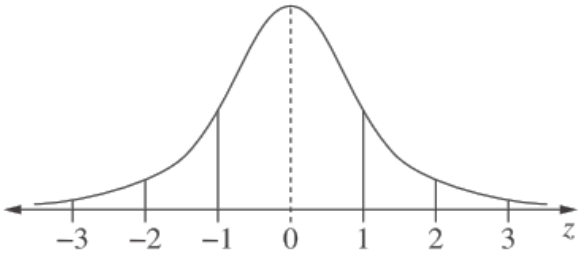
$$\cos^2 nx = \frac{1}{2}(1 + \cos 2nx)$$

Statistical Analysis

$$z = \frac{x - \mu}{\sigma}$$

An outlier is a score
less than $Q_1 - 1.5 \times IQR$
or
more than $Q_3 + 1.5 \times IQR$

Normal distribution



- approximately 68% of scores have z-scores between –1 and 1
- approximately 95% of scores have z-scores between –2 and 2
- approximately 99.7% of scores have z-scores between –3 and 3

$$E(X) = \mu$$

$$\text{Var}(X) = E\left[(X - \mu)^2\right] = E\left(X^2\right) - \mu^2$$

Probability

$$P(A \cap B) = P(A)P(B)$$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A|B) = \frac{P(A \cap B)}{P(B)}, \ P(B) \neq 0$$

Continuous random variables

$$P(X \leq r) = \int_a^r f(x)\,dx$$

$$P(a < X < b) = \int_a^b f(x)\,dx$$

Binomial distribution

$$P(X = r) = {}^nC_r p^r (1-p)^{n-r}$$

$$X \sim \text{Bin}(n, p)$$

$$\Rightarrow \ P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}, \ x = 0, 1, \ldots, n$$

$$E(X) = np$$

$$\text{Var}(X) = np(1-p)$$

Differential Calculus

Function	Derivative
$y = f(x)^n$	$\frac{dy}{dx} = nf'(x)[f(x)]^{n-1}$
$y = uv$	$\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$
$y = g(u)$ where $u = f(x)$	$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$
$y = \frac{u}{v}$	$\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$
$y = \sin f(x)$	$\frac{dy}{dx} = f'(x)\cos f(x)$
$y = \cos f(x)$	$\frac{dy}{dx} = -f'(x)\sin f(x)$
$y = \tan f(x)$	$\frac{dy}{dx} = f'(x)\sec^2 f(x)$
$y = e^{f(x)}$	$\frac{dy}{dx} = f'(x)e^{f(x)}$
$y = \ln f(x)$	$\frac{dy}{dx} = \frac{f'(x)}{f(x)}$
$y = a^{f(x)}$	$\frac{dy}{dx} = (\ln a)f'(x)a^{f(x)}$
$y = \log_a f(x)$	$\frac{dy}{dx} = \frac{f'(x)}{(\ln a)f(x)}$
$y = \sin^{-1} f(x)$	$\frac{dy}{dx} = \frac{f'(x)}{\sqrt{1-[f(x)]^2}}$
$y = \cos^{-1} f(x)$	$\frac{dy}{dx} = -\frac{f'(x)}{\sqrt{1-[f(x)]^2}}$
$y = \tan^{-1} f(x)$	$\frac{dy}{dx} = \frac{f'(x)}{1+[f(x)]^2}$

Integral Calculus

$$\int f'(x)[f(x)]^n dx = \frac{1}{n+1}[f(x)]^{n+1} + c \quad \text{where } n \neq -1$$

$$\int f'(x)\sin f(x)\,dx = -\cos f(x) + c$$

$$\int f'(x)\cos f(x)\,dx = \sin f(x) + c$$

$$\int f'(x)\sec^2 f(x)\,dx = \tan f(x) + c$$

$$\int f'(x)e^{f(x)}dx = e^{f(x)} + c$$

$$\int \frac{f'(x)}{f(x)}dx = \ln|f(x)| + c$$

$$\int f'(x)a^{f(x)}dx = \frac{a^{f(x)}}{\ln a} + c$$

$$\int \frac{f'(x)}{\sqrt{a^2-[f(x)]^2}}dx = \sin^{-1}\frac{f(x)}{a} + c$$

$$\int \frac{f'(x)}{a^2+[f(x)]^2}dx = \frac{1}{a}\tan^{-1}\frac{f(x)}{a} + c$$

$$\int u\frac{dv}{dx}dx = uv - \int v\frac{du}{dx}dx$$

$$\int_a^b f(x)\,dx$$

$$\approx \frac{b-a}{2n}\left\{f(a) + f(b) + 2\left[f(x_1) + \cdots + f(x_{n-1})\right]\right\}$$

where $a = x_0$ and $b = x_n$

Combinatorics

$${}^{n}P_{r} = \frac{n!}{(n-r)!}$$

$$\binom{n}{r} = {}^{n}C_{r} = \frac{n!}{r!(n-r)!}$$

$$(x+a)^{n} = x^{n} + \binom{n}{1}x^{n-1}a + \cdots + \binom{n}{r}x^{n-r}a^{r} + \cdots + a^{n}$$

Vectors

$$\left|\underset{\sim}{u}\right| = \left|x\underset{\sim}{i} + y\underset{\sim}{j}\right| = \sqrt{x^{2}+y^{2}}$$

$$\underset{\sim}{u}\cdot\underset{\sim}{v} = \left|\underset{\sim}{u}\right|\left|\underset{\sim}{v}\right|\cos\theta = x_{1}x_{2} + y_{1}y_{2},$$

where $\underset{\sim}{u} = x_{1}\underset{\sim}{i} + y_{1}\underset{\sim}{j}$

and $\underset{\sim}{v} = x_{2}\underset{\sim}{i} + y_{2}\underset{\sim}{j}$

$$\underset{\sim}{r} = \underset{\sim}{a} + \lambda\underset{\sim}{b}$$

Complex Numbers

$$z = a + ib = r(\cos\theta + i\sin\theta)$$
$$= re^{i\theta}$$

$$\left[r(\cos\theta + i\sin\theta)\right]^{n} = r^{n}(\cos n\theta + i\sin n\theta)$$
$$= r^{n}e^{in\theta}$$

Mechanics

$$\frac{d^{2}x}{dt^{2}} = \frac{dv}{dt} = v\frac{dv}{dx} = \frac{d}{dx}\left(\frac{1}{2}v^{2}\right)$$

$$x = a\cos(nt+\alpha) + c$$

$$x = a\sin(nt+\alpha) + c$$

$$\ddot{x} = -n^{2}(x-c)$$

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2026 **Hurlstone Agricultural High School**
HSC TRIAL EXAMINATION

Mathematics Advanced

Section I Multiple Choice Answer Sheet

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

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

A ○ B ● C ○ D ○

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

A ● B ⊗ C ○ D ○

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

A ⊗ B ⊗ (correct) C ○ D ○

1.	**A**	○	**B**	○	**C**	○	**D**	○
2.	**A**	○	**B**	○	**C**	○	**D**	○
3.	**A**	○	**B**	○	**C**	○	**D**	○
4.	**A**	○	**B**	○	**C**	○	**D**	○
5.	**A**	○	**B**	○	**C**	○	**D**	○
6.	**A**	○	**B**	○	**C**	○	**D**	○
7.	**A**	○	**B**	○	**C**	○	**D**	○
8.	**A**	○	**B**	○	**C**	○	**D**	○
9.	**A**	○	**B**	○	**C**	○	**D**	○
10.	**A**	○	**B**	○	**C**	○	**D**	○

STUDENT'S NAME: _____

TEACHER'S NAME: _____

2026 **Hurlstone Agricultural High School**
HSC TRIAL EXAMINATION

Mathematics Advanced

Section II Answer Booklet

Instructions

- Write your Name and your Teacher's Name at the top of this page
- Answer the questions in the spaces provided.
- Your responses should include relevant mathematical reasoning and/or calculations
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering
- Attempt Questions 11 - 13

/ 7

Question 11

Given that $\dfrac{4x^3 + x^{\frac{5}{2}}}{\sqrt{x}}$ can be written in the form $4x^a + x^b$, find the value of a and b. **2**

Question 12

Given that $\log_b x = 2.6$ and $\log_b y = 4.2$. Find the value of $\log_b\left(x^2\sqrt{y}\right)$. **2**

Question 13

Given $g(x) = 2x^2 + (k+4)x + k$, where k is a real constant.

a. Find the discriminant, in simplest form, of $g(x)$ in terms of k. **2**

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b. Hence, or otherwise state why $g(x)$ has two distinct real roots for all values of k. **1**

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~ End of Section II~

Extra Writing Space.

STUDENT'S NAME: _____

TEACHER'S NAME: _____

2026 **Hurlstone Agricultural High School**
HSC TRIAL EXAMINATION

Mathematics Advanced
Section III Answer Booklet

Instructions

- Write your Name and your Teacher's Name at the top of this page
- Answer the questions in the spaces provided.
- Your responses should include relevant mathematical reasoning and/or calculations
- Extra writing paper is available. If you use an extra page, clearly indicate which question you are answering
- Attempt Questions 14 - 16

10

Question 14

A company has a structured salary scheme for its employees.
Mahrukh's salary is reviewed every year. In year 1, Mahrukh earns $28,000.

In each of years 2, 3, …, 8, Mahrukh receives a raise of $1,500 per year.

After year 8, the annual raise increases to $2,500 per year. Mahrukh finishes on a salary of $58,500 at the end of the scheme.

a. What is Mahrukh's salary in year 8? **1**

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b. What is the total amount earned by Mahrukh over the entire scheme. **3**

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Question 15

Jayden is doing a sponsored cycle. He plans to cycle 1000 km over a number of days. **3**

He plans to cycle 10 km on day 1 and increase the distance by 10% a day.

How long will it take Jayden to complete the challenge?

Question 16

In an arithmetic series, the 1^{st} term is -12, the 17^{th} term is 12 and the last term is 45.
Find the sum of all the terms in the series. **3**

~ End of Section III ~

STUDENT'S NAME: _____

TEACHER'S NAME: _____

2026 **Hurlstone Agricultural High School**
HSC TRIAL EXAMINATION

Mathematics Advanced
Section IV Answer Booklet

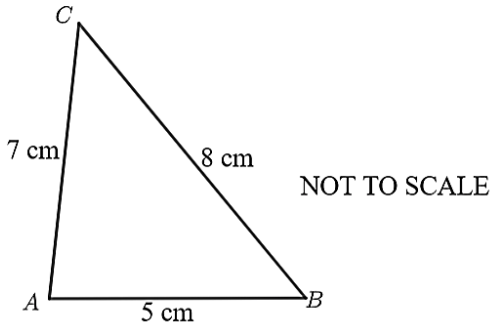
Instructions

- Write your Name and your Teacher's Name at the top of this page
- Answer the questions in the spaces provided.
- Your responses should include relevant mathematical reasoning and/or calculations
- Extra writing paper is available. If you use an extra page, clearly indicate which question you are answering
- Attempt Questions 17 – 20

/ **13**

Question 17

The diagram shows ΔABC with sides $AB = 5$ cm, $BC = 8$ cm and $AC = 7$ cm



a. Show that $\cos A = \frac{1}{7}$. **1**

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b. By finding the exact value of $\sin A$, determine the exact value of the area of ΔABC. **2**

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Question 18

Solve $2\cos^2 x + 3\cos x + 1 = 0$ for $0 \le x \le 2\pi$. **3**

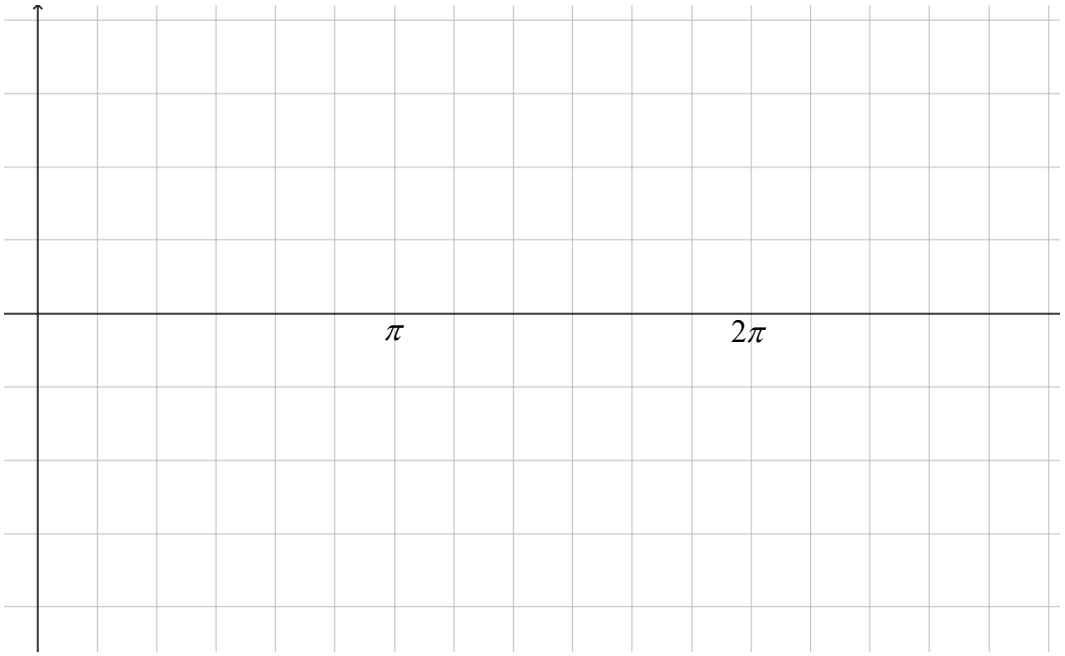
Question 19

Show that $\dfrac{\cos^2\theta - \sin^2\theta}{\cos^2\theta + \sin\theta\cos\theta} = 1 - \tan\theta$. **3**

Question 20

The depth d metres of a diver relative to the water surface is modelled by the function $d(t) = \cos(2t + \frac{\pi}{3}) - 1$ where t is measured in seconds.

a. Sketch the graph of $d(t)$ for $0 \le t \le 2\pi$ on the grid provided. Label the coordinates of all intercepts. **3**



Note: A spare grid is also provided in the Extra writing space on page 26.

b. Find the greatest and least values of d. **1**

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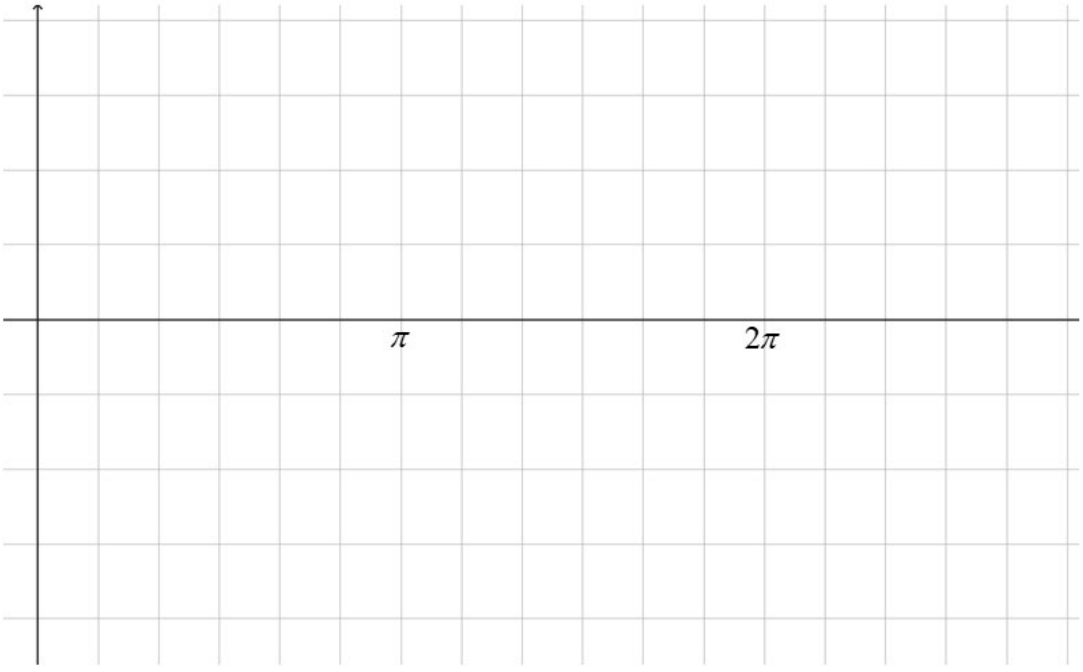
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~ End of Section IV ~

Extra Writing Space.

Extra Graph for Question 20 a)



STUDENT'S NAME: _____

TEACHER'S NAME: _____

2026 **Hurlstone Agricultural High School**
HSC TRIAL EXAMINATION

Mathematics Advanced

Section V Answer Booklet

Instructions

- Write your Name and your Teacher's Name at the top of this page
- Answer the questions in the spaces provided.
- Your responses should include relevant mathematical reasoning and/or calculations
- Extra writing paper is available. If you use an extra page, clearly indicate which question you are answering
- Attempt Questions 21 - 24

16

Question 21

Differentiate $f(x) = x^2 + 3x$ using first principles. **3**

Question 22

A function is given by $y = -x^3 + 9x^2 - 24x + 16$.

a. Find any stationary points, determine their nature and find any point/s of inflection. **4**

Question 22 continued …

b. Hence, or otherwise sketch the curve labelling all points from (a) and the y-intercept. **2**

Question 23

A curve has the equation $y = \log_e(x^3 - 5)$.

Find the equation of the normal to the curve at the point $x = 2$. **3**

Question 24

A function $g(x) = ax^2 + \frac{b}{x}$ has a minimum value at $x = 4$. It is also known that $g(4) = 96$.

Calculate the values of a and b. **4**

~ End of Section V ~

STUDENT'S NAME: _____

TEACHER'S NAME: _____

2026 Hurlstone Agricultural High School
HSC TRIAL EXAMINATION

Mathematics Advanced

Section VI Answer Booklet

Instructions

- Write your Name and your Teacher's Name at the top of this page
- Answer the questions in the spaces provided.
- Your responses should include relevant mathematical reasoning and/or calculations
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering
- Attempt Questions 25 - 30

/ 17

Question 25

Find $\int \frac{e^{3x}}{e^{3x}+1}\,dx$. **2**

Question 26

a. Prove that $\sec^2 x = 1 + \tan^2 x$. **1**

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b. Hence, find $\int_0^{\frac{\pi}{6}} \tan^2 2x \ dx$ **2**

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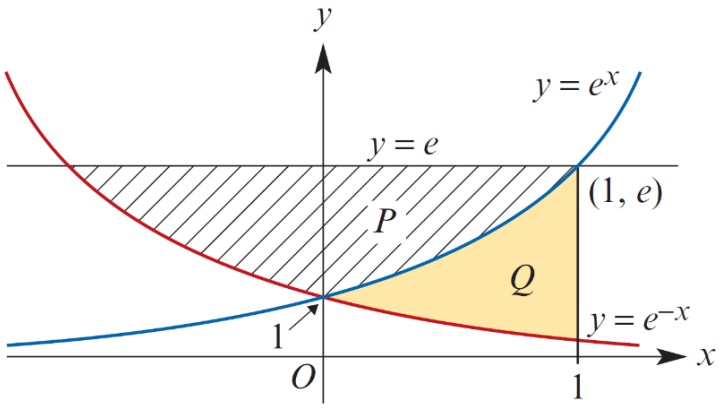
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Question 27

The curves $y = e^x$ and $y = e^{-x}$ are shown below, with the horizontal line $y = e$ and vertical line $x = 1$. P is the lined region, and Q is the solid shaded region, as shown in the diagram below.



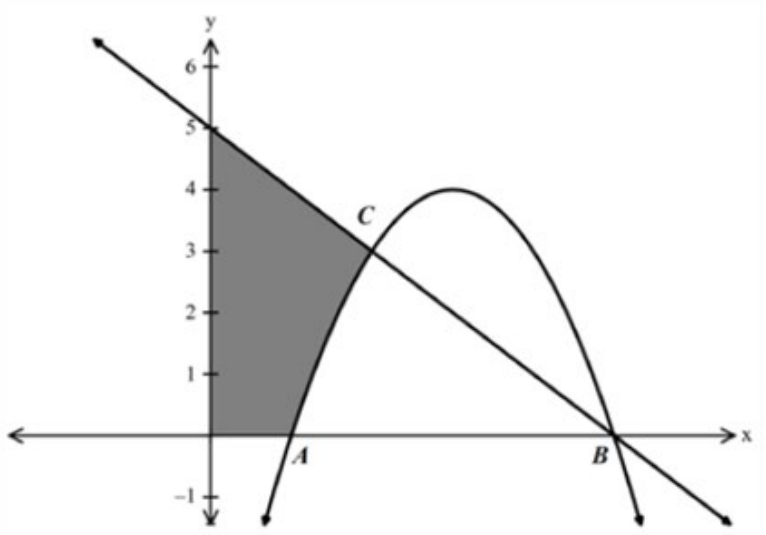
a. Find the area of the entire lined region P. **2**

b. Write an integral which could be used to find the area of the shaded region Q. **1**
Do not solve this integral.

Question 28

The parabola $y = -x^2 + 6x - 5$ meets the x-axis at the points $A(1,0)$ and $B(5,0)$.

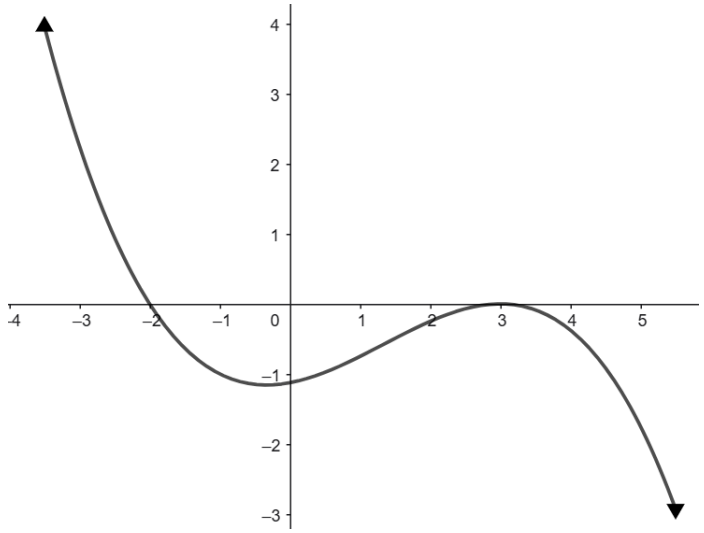
The line $y = -x + 5$ meets the parabola at points $C(2, 3)$ and B.



Find the area of the shaded region. **3**

Question 29

The diagram shows the graph of $y = f'(x)$, that is, the derivative of $y = f(x)$.

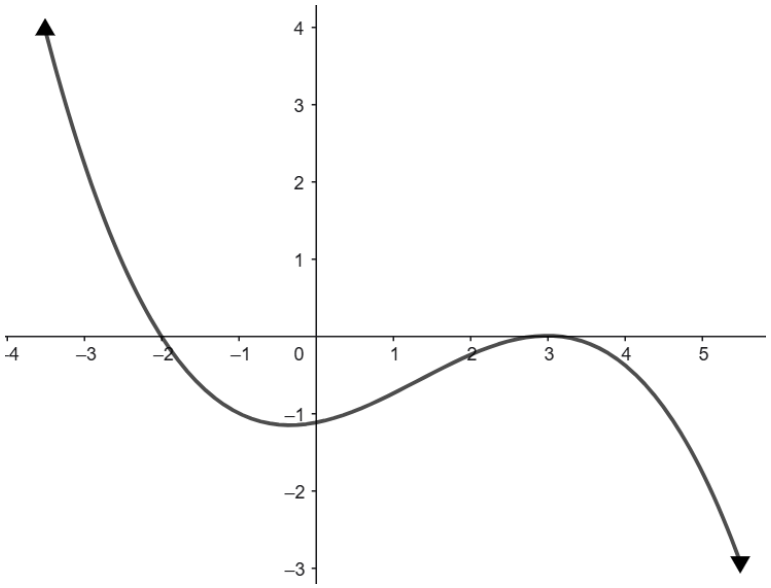


a. For what values of x is the curve $y = f(x)$ increasing? **1**

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b. Hence, sketch a possible graph of $y = f(x)$. **2**



Question 30

a. Find $\frac{d}{dx}\left(\sqrt{x}+1\right)^3$ **2**

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b. Hence, find $\int \frac{\left(\sqrt{x}+1\right)^2}{2\sqrt{x}}\,dx$ **1**

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~ End of Section VI ~

Extra Writing Space.

STUDENT'S NAME: _____

TEACHER'S NAME: _____

2026 **Hurlstone Agricultural High School**
HSC TRIAL EXAMINATION

Mathematics Advanced

Section VII Answer Booklet

Instructions

- Write your Name and your Teacher's Name at the top of this page
- Answer the questions in the spaces provided.
- Your responses should include relevant mathematical reasoning and/or calculations
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering
- Attempt Questions 31 - 36

16

Question 31

A factory assembles torches. Each torch requires one battery and one bulb. It is known that 6% of all batteries and 4% of all bulbs are defective.

Find the probability that if a torch selected at random, both the battery and the bulb are not defective. Give your answer correct to 2 decimal places. **2**

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Question 32

A pizza shop estimates that the time X hours to deliver a pizza from when it is ordered is a continuous random variable with probability density function given by

$$f(x) = \begin{cases} \frac{4}{3} - \frac{2}{3}x & 0 < x < 1 \\ 0 & \text{otherwise} \end{cases}$$

What is the probability of the pizza being delivered within half an hour of being ordered? **2**

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Question 33

The monthly sales, X (in units of \$100, 000), of a business are modelled by the two probability density functions:

$$f(x) = \begin{cases} k\,x^3\left(1-x^2\right) & 0 \le x \le 1 \\ 0 & \text{otherwise} \end{cases} \qquad \text{Model 1}$$

$$g(x) = \begin{cases} 2x & 0 \le x \le 1 \\ 0 & \text{otherwise} \end{cases} \qquad \text{Model 2}$$

a. Determine the value of k in the first model. **2**

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b. Show that the two models have the same median value. **3**

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Question 34

The weights of bags of red gravel may be modelled by a normal distribution with mean 25.8 kg and a standard deviation of 0.5 kg.

	first decimal place									
z	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0.	0.5000	0.5398	0.5793	0.6179	0.6554	0.6915	0.7257	0.7580	0.7881	0.8159
1.	0.8413	0.8643	0.8849	0.9032	0.9192	0.9332	0.9452	0.9554	0.9641	0.9713
2.	0.9772	0.9821	0.9861	0.9893	0.9918	0.9938	0.9953	0.9965	0.9974	0.9981
3.	0.9987	0.9990	0.9993	0.9995	0.9997	0.9998	0.9998	0.9999	0.9999	1.0000

What is the probability that a randomly selected bag will have a weight between 25.5 kg and 26.5 kg ? **3**

Question 35

A bus is uniformly late between 2 and 10 minutes.

If the bus is late by greater than 7 minutes, you will be late for school.

What is the probability of you being late for school? **2**

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Question 36

Consider the following bivariate data relating number of firefighters putting out a fire and on average how many square metres of damage was done.

No. of firefighters	4	10	16	30	100
Average of damage done (m^2)	98.5	271.1	550.6	1018.9	4414.8

a. Calculate the correlation coefficient *r,* to 3 decimal places, between the two variables. **1**

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b. Determine the equation of the least squares regression line, with coefficients correct to 2 decimal places. **1**

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~ End of Section VII ~

Extra Writing Space.

STUDENT'S NAME: _____

TEACHER'S NAME: _____

2026 **Hurlstone Agricultural High School**
HSC TRIAL EXAMINATION

Mathematics Advanced

Section VIII Answer Booklet

Instructions

- Write your Name and your Teacher's Name at the top of this page
- Answer the questions in the spaces provided.
- Your responses should include relevant mathematical reasoning and/or calculations
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering
- Attempt Questions 37 - 38

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Question 37

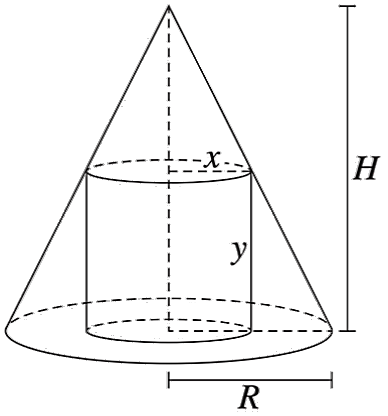
Find the global maximum and minimum values of $y = x^3 - 3x^2 - 9x + 5$ for $-2 \leq x \leq 5$. **4**

Question 38

The diagram shows a cylinder of radius x and height y inscribed in a cone of radius R and height H, where R and H are constants.

The volume of a cone of radius r and height h is $\frac{1}{3}\pi r^2 h$.

The volume of a cylinder of radius r and height h is $\pi r^2 h$.



a. Show that the volume, V, of the cylinder can be written as $V = \frac{H}{R}\pi x^2 (R - x)$. **3**

Question 38 continued …

b. By considering the inscribed cylinder of maximum volume, show that the volume of any inscribed cylinder does not exceed $\frac{4}{9}$ of the volume of the cone. **4**

~ End of Section VIII ~

Extra Writing Space.

Extra Writing Space.

Outcomes Addressed in this Question

	Solutions	
Q1	Given: $$f(x) = x^2 + 4x + 7$$ **Step 1: Reflect about the y-axis** A reflection in the y-axis replaces x with $-x$: $$f(-x) = (-x)^2 + 4(-x) + 7$$ **Step 2: Translate 2 units to the right** A translation 2 units right replaces x with $x - 2$: $$f(-(x-2)) = f(-x+2)$$ Therefore, $$y = (-x+2)^2 + 4(-x+2) + 7$$ **Answer: B**	
Q2	The three terms are: $$x^2, \quad 4x + 3, \quad 25$$ For a geometric sequence, $$\frac{4x+3}{x^2} = \frac{25}{4x+3}$$ Cross-multiply: $$(4x+3)^2 = 25x^2$$ Taking square roots: $$4x + 3 = \pm 5x$$ **Case 1:** $$4x + 3 = 5x$$ $$x = 3$$ **Case 2:** $$4x + 3 = -5x$$ $$9x = -3$$ $$x = -\frac{1}{3}$$ Therefore, $$\boxed{x = -\frac{1}{3} \text{ or } 3}$$ **Answer: D**	

Q3

Given:

$MN = 1$ and $r = \dfrac{3}{\pi}$

$1 = \dfrac{3}{\pi}\theta$

$\theta = \dfrac{\pi}{3}$

Area of the sector:

$A = \dfrac{1}{2}\left(\dfrac{3}{\pi}\right)^2 \dfrac{\pi}{3}$

$A = \dfrac{3}{2\pi}$ cm^2

Answer: *A*

Q4

In $y = A + B\sin(Cx)$,

A represents vertical translation, B represents the amplitude and period of the graph is calculated by $\dfrac{360^0}{C}$.

Inspecting the given graph, we can see that there is a vertical translation up by 1 unit.

$\therefore A = 1$

The graph exists for $-1 \le y \le 3$. Hence amplitude is equal to 2 units.

$\therefore B = 2$

the period of the given graph is 120 degrees

$\dfrac{360^0}{C} = 120^0$

$C = \dfrac{360^0}{120^0}$

$\therefore C = 3$

Answer: *B*

Q5

At point A:

- The graph is **decreasing**, so

$$f'(x) < 0$$

- The graph is bending **downwards** as it approaches the point of inflection from the left, so

$$f''(x) < 0$$

Therefore,

$$\boxed{f'(x) < 0 \text{ and } f''(x) < 0}$$

Answer: D

Q6

Differentiate:

$$y = e^x \ln(\cos x)$$

Using the **product rule:**

$$y' = e^x \ln(\cos x) + e^x \frac{d}{dx}[\ln(\cos x)]$$

Now,

$$\frac{d}{dx}[\ln(\cos x)] = \frac{-\sin x}{\cos x} = -\tan x$$

Therefore,

$$y' = e^x \ln(\cos x) - e^x \tan x$$

Factor out e^x:

$$\boxed{y' = e^x(\ln(\cos x) - \tan x)}$$

Answer: A

Q7

Using the formula on the Reference Sheets

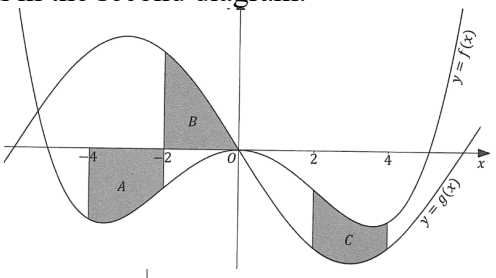
$$\int_4^{13} f(x)\,dx \approx \frac{13-4}{2\times 3}\Big(f(4)+f(13)+2\big(f(7)+f(10)\big)\Big)$$

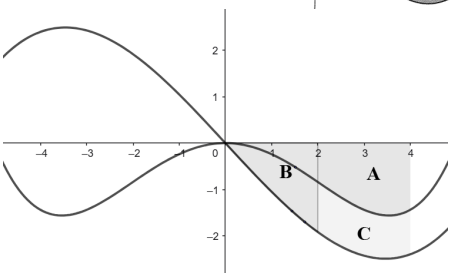
$$= \frac{9}{6}\big(-6+2+2(4+7)\big) = 27$$

$\therefore C$

Q8

As $y = g(x)$ is odd and $y = f(x)$ is even, by symmetry, the between the curve $y = g(x)$ between $x = 0$ and $x = 4$ is as shown in the second diagram.





Note: $\int_0^4 g(x)\,dx$ is represented by an area entirely below the *x*-axis and so is negative.

$\therefore \int_0^4 g(x)\,dx = -(A+B+C)$

$\therefore B$

Q9

Mean:

$$\mu = 48$$

Standard deviation:

$$\sigma = 3$$

We want:

$$P(39 < X < 45)$$

Convert both values to z-scores.

For 39:

$$z = \frac{39 - 48}{3} = -3$$

For 45:

$$z = \frac{45 - 48}{3} = -1$$

Therefore:

$$P(39 < X < 45) = P(-3 < Z < -1)$$

Using the standard normal distribution:

$$P(Z < -1) \approx 0.1587$$

$$P(Z < -3) \approx 0.00135$$

Hence:

$$0.1587 - 0.00135 = 0.15735$$

$$\approx 15.7\%$$

The closest option is **15.85%**.

Answer: A

Q10

We are given:

$$P(X = x) = \frac{x+2}{14}, \qquad x = 0, 1, 2, 3$$

So the probability table is:

x	0	1	2	3
$P(X = x)$	$\frac{2}{14}$	$\frac{3}{14}$	$\frac{4}{14}$	$\frac{5}{14}$

First calculate $E(X)$:

$$E(X) = \sum xp(x)$$

$$E(X) = 0\left(\frac{2}{14}\right) + 1\left(\frac{3}{14}\right) + 2\left(\frac{4}{14}\right) + 3\left(\frac{5}{14}\right)$$

$$= \frac{3+8+15}{14} = \frac{26}{14} = \frac{13}{7}$$

Now calculate $E(X^2)$:

$$E(X^2) = \sum x^2 p(x)$$

$$E(X^2) = 0 + \frac{3}{14} + \frac{16}{14} + \frac{45}{14}$$

$$= \frac{64}{14} = \frac{32}{7}$$

Variance is:

$$\mathrm{Var}(X) = E(X^2) - [E(X)]^2$$

$$= \frac{32}{7} - \left(\frac{13}{7}\right)^2$$

$$= \frac{224}{49} - \frac{169}{49}$$

$$= \frac{55}{49}$$

$$\approx 1.122$$

Therefore,

$$\boxed{\mathrm{Var}(X) \approx 1.12}$$

Answer: A

Year 12 Mathematics Advanced — Task 4 2026

Section II — Solutions and Marking Guidelines

Outcomes Addressed in this Question

MA11-6
manipulates and solves expressions using the logarithmic and index laws, and uses logarithms and exponential functions to solve practical problems

MA12-1
uses detailed algebraic and graphical techniques to critically construct, model and evaluate arguments in a range of familiar and unfamiliar contexts.

	Solutions	Marking Guidelines
Q11	$\dfrac{4x^3 + x^{\frac{5}{2}}}{\sqrt{x}} = \dfrac{4x^3}{x^{\frac{1}{2}}} + \dfrac{x^{\frac{5}{2}}}{x^{\frac{1}{2}}}$ $= 4x^{3-\frac{1}{2}} + x^{\frac{5}{2}-\frac{1}{2}}$ $= 4x^{\frac{5}{2}} + x^2 = 4x^a + x^b$ $\therefore\ a = \dfrac{5}{2},\quad b = 2$	2 mark: correct working out with correct values for a and b. 1 mark: one error in the solution but then carried forward the error to get an answer.
Q12	$\log_b\left(x^2\sqrt{y}\right) = \log_b x^2 + \log_b \sqrt{y}$ $= \log_b x^2 + \log_b y^{\frac{1}{2}}$ $= 2\log_b x + \dfrac{1}{2}\log_b y$ $= 2(2.6) + \dfrac{1}{2}(4.2)$ $= 7.3$	2 marks : correct use of log laws and substitution to find the final value 1 mark: an error in the almost correct solution.

Q13 (a)	$g(x) = 2x^2 + (k+4)x + k$ $a = 2, \quad b = (k+4), \quad c = k$ $\Delta = b^2 - 4ac$ $= (k+4)^2 - 4(2)(k)$ $= k^2 + 8k + 16 - 8k$ $= k^2 + 16$	2 marks: correct formula for discriminant used, substituted in correctly the values for a, b and c to get the correct expression for discriminant. 1 mark: correct formula for discriminant used but made an error in the substitution or simplification.
(b)	For there to be 2 distinct real roots the discriminant must be greater than 0, $\Delta > 0$. k^2 is greater than 0 for all values of k. Thus $k^2 + 16 > 0$ for all values of k. Therefore as $\Delta > 0$, $g(x)$ will have 2 distinct real roots.	1 mark: correct explanation of why $g(x)$ will have 2 distinct real roots

Year 12 Mathematics Advanced		Task 4 2026
Section III	Solutions and Marking Guidelines	
Outcomes Addressed in this Question		
MA12-4 applies the concepts and techniques of arithmetic and geometric sequences and series in the solution of problems		
	Solutions	**Marking Guidelines**
Q14 (a)	$a = 28000, \quad d = 1500$ $T_8 = 28000 + (n-1) \times 1500$ $= 38500$	1 mark: correct calculation of salary for 8th year
(b)	Total earned for the first 8 years: $S_8 = \frac{8}{2}(28\,000 + 38\,500)$ $= 266\,000$	
	Number of years after the first 8 years: $58\,500 = 41\,000 + (n-1) \times 2500$ $2\,500n - 2\,500 = 17\,500$ $n = \frac{17\,500 + 2\,500}{2\,500}$ $n = 8$	1 mark : correct total earned for first 8 years 1 mark: Correct calculation of number of years after the first 8 years
	Total for the remaining 8 years: $S_8 = \frac{8}{2}(41\,000 + 58\,500)$ $= 398\,000$	1 mark: correct total for the remaining 8 years and the total for whole scheme
	Total earned over the whole scheme: $= \$266\,000 + \$398\,000$ $= \$664\,000$	
	Markers Comment: A lot of students added the \$38500 twice in their calculations. Once when calculating the sum of the first 8 years and again when calculating the sum of the next 8 years.	

Q15	This is a geometric series …. $10 + 10 \times 1.1 + 10 \times 1.1^2 + \ldots$ $a = 10, \qquad r = \dfrac{10 \times 1.1}{10} = 1.1$ $\dfrac{a\left(r^n - 1\right)}{r - 1} > 1\,000$ $\dfrac{10\left(1.1^n - 1\right)}{1.1 - 1} > 1\,000$ $100\left(1.1^n - 1\right) > 1000$ $1.1^n > \dfrac{1000}{100} + 1$ $1.1^n > 11$ $n \log 1.1 > \log 11$ $n > \dfrac{\log 11}{\log 1.1}$ $n > 25.158....$ Therefore it will take Jayden 26 days. **Markers Comment:** Some did not recognise that this was a geometric series and did the sum of an arithmetic series. Some used the wrong formula, although it is given in the reference sheet.	1 mark : recognising a geometric series and substituting correctly into the sum formula. 1 mark : solving correctly the equation to get $n > 25.158\ldots$. 1 mark: to conclude that it will be the 26th day

Q16	$a = -12$ $T_{17} = 12$ $a + (n-1)d = 12$ $-12 + (17-1)d = 12$ $16d = 24$ $d = \frac{3}{2} = 1.5$ Find the number of terms in the series: $T_n = -12 + (n-1) \times 1.5$ $45 = -12 + 15n - 1.5$ $58.5 = 1.5n$ $n = 39$ Therefore 45 is the 39^{th} term Sum of the series: $S_{39} = \frac{39}{2}(-12+45)$ $= 643.5$	1 mark: find the value of d 1 mark: to find the number of terms in the series 1 mark: finding the sum of the series

Year 12	Mathematics Advanced	Assessment Task 4 2026
Section IV	Solutions and Marking Guidelines	

Outcomes Addressed in this Question:

MA11-4: uses the concepts and techniques of periodic functions in the solutions of trigonometric equations or proof of trigonometric identities
MA11-3: uses the concepts and techniques of trigonometry in the solution of equations and problems involving geometric shapes
MA12-5: applies the concepts and techniques of periodic functions in the solution of problems involving trigonometric graphs

Solutions	Marking Guidelines
Q17 a) Use Cosine Rule: $\cos A = \frac{5^2 + 7^2 - 8^2}{2 \times 5 \times 7} = \frac{1}{7}$ **Marker's Notes:** • Working must be shown, as simply stating $\cos A = \frac{1}{7}$ is insufficient for a "show that" question. • Common errors included using the wrong side as the side opposite angle A, incorrectly substituting the side lengths, or omitting the negative sign in the cosine rule.	**1 mark:** Correctly applies the cosine rule and shows that $\cos A = \frac{1}{7}$
Q17 b) $\sin^2 A + \cos^2 A = 1$ $\sin^2 A = 1 - \cos^2 A$ $\sin^2 A = 1 - \left(\frac{1}{7}\right)^2 = \frac{48}{49}$ $\sin A = \sqrt{\frac{48}{49}} = \frac{4\sqrt{3}}{7}$ $\text{Area} = \frac{1}{2} \times 5 \times 7 \times \frac{4\sqrt{3}}{7} = 10\sqrt{3} \text{ cm}^2$ **Markers' notes** • A common error was failing to determine $\sin A$ in exact form. • Giving an answer in terms of $\sin\left(\cos^{-1}\left(\frac{1}{7}\right)\right)$ or as a decimal approximation for Area does not satisfy the requirement for an exact simplified value.	**2 marks:** Correctly finds the exact value of $\sin A$ and uses it to determine the exact area of $\triangle ABC$. **1 mark:** Correctly finds the exact value of $\sin A$ but makes an error when determining the exact area. OR Correctly applies the area formula using their incorrect exact value of $\sin A$.

Q18)

$2\cos^2 x + 3\cos x + 1 = 0$

Let $u = \cos x$

$2u^2 + 3u + 1 = 0$

$(2u+1)(u+1) = 0$

$u = -\frac{1}{2},\ \ u = -1$

$\cos x = -\frac{1}{2}$ or $\cos x = -1$

$x = \pi - \frac{\pi}{3},\ \pi + \frac{\pi}{3}$ or $x = \pi$

$x = \frac{2\pi}{3},\ \frac{4\pi}{3}$

$\therefore x = \frac{2\pi}{3},\ \pi,\ \frac{4\pi}{3}$

Markers' notes:

- This question was generally well answered.
- Common careless errors included giving answers in degrees instead of radians, selecting incorrect quadrants, and confusing exact trigonometric values.

3 marks: Correctly factorises the equation and obtains all solutions in the given domain, expressed in radians.

2 marks: Correctly factorises the equation and obtains correct values of x, but makes an error or omission when determining all solutions in the given domain.

1 mark: Makes a correct relevant step, such as correctly factorising the quadratic or finding one correct value of x from their previous incorrect working.

Q19)

$$\text{LHS} = \frac{\cos^2\theta - \sin^2\theta}{\cos^2\theta + \sin\theta\cos\theta}$$
$$= \frac{(\cos\theta - \sin\theta)(\cos\theta + \sin\theta)}{\cos\theta(\cos\theta + \sin\theta)}$$
$$= \frac{\cos\theta - \sin\theta}{\cos\theta}$$
$$= \frac{\cos\theta}{\cos\theta} - \frac{\sin\theta}{\cos\theta}$$
$$= 1 - \tan\theta = \text{RHS}$$

Markers' notes

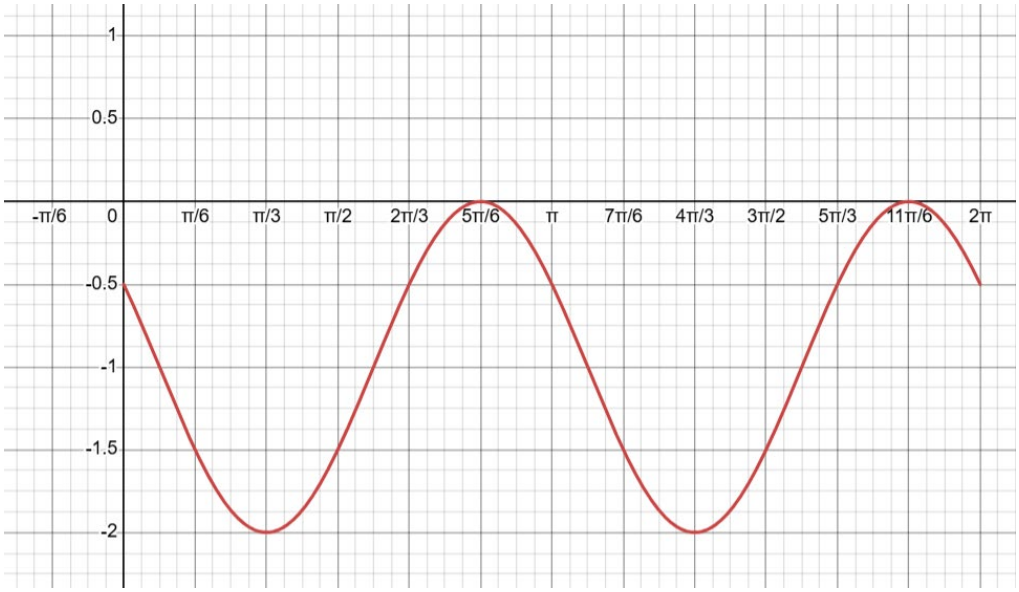
- A common error was failing to recognise $\cos^2\theta - \sin^2\theta$ as a **difference of squares**, preventing further simplification.
- Some students were unable to progress further after applying the Pythagorean trigonometric identity or other identities and did not consider alternative techniques, such as working from the RHS
- Students should ensure that each algebraic or trigonometric manipulation is applied to the entire expression and that the proof clearly reaches the required RHS.

3 marks: Correctly manipulates the expression using appropriate factorisation and trigonometric identities

2 marks: Correctly factorises the numerator as a difference of squares and the denominator by taking out a common factor, but makes a minor error or does not complete the proof.

1 mark: Correctly applies a relevant trigonometric identity

Q20 a)



Markers' notes

- For full marks, the graph should show the correct turning points and endpoints and label all intercepts.
- Common errors included using a period of 2π, shifting the graph in the wrong direction, and incorrectly positioning the turning points or endpoints, using the wrong amplitude.

3 marks: Correctly sketches the graph, including:

- correct amplitude and vertical translation
- correct phase shift
- correct number of cycles over $0 \leq t \leq 2\pi$, with turning points, endpoints and all intercepts correctly positioned and labelled.

2 marks: Correctly shows any two of the three key features above, with a substantially correct graph.

1 mark: Correctly shows one of the following:

- amplitude and vertical translation
- phase shift
- correct number of cycles in the given domain.

Q20 b)

Greatest value of $d = 0$ and least value of $d = -2$

Markers' notes

- The mark was awarded only when both the **greatest value** and **least value** of d were explicitly identified.
- The question asks for the greatest and least **values of** d, not the greatest and least depth. However, answers stated in terms of **greatest depth** and **least depth** were accepted where the meaning was explicitly and correctly communicated.
- Simply stating the range $-2 \leq d \leq 0$ without identifying which value is greatest and which is least was not sufficient.

1 mark: Explicitly states both the greatest and least values of d

Year 12	Mathematics Advanced	Task 4 2026
Section V	Solutions and Marking Guidelines	
Outcomes Addressed in this Question		
MA12-6: applies appropriate differentiation methods to solve problems		

Outcome	Solutions	Marking Guidelines
MA12-6	**Question 21** $f(x)=x^2+3x$ $f(x+h)=(x+h)^2+3(x+h)$ $=x^2+2xh+h^2+3x+3h$ $\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}=\lim_{h\to 0}\frac{x^2+2xh+h^2+3x+3h-(x^2+3x)}{h}$ $=\lim_{h\to 0}\frac{2xh+h^2+3h}{h}$ $=\lim_{h\to 0}\frac{h(2x+h+3)}{h}$ $=\lim_{h\to 0}2x+h+3$ $=2x+3$ Marker's feedback: • Many students not getting the formula correct. Common mistakes include using $f(x-h)$ instead of $f(x+h)$, and $f(x)$, $f(h)$ or x instead of h in the denominator. • If $\lim_{h\to 0}$ was not present in working out, full marks cannot be obtained. Many students used $\lim_{h\to\infty}$ instead, which is incorrect and marks were deducted. Many students who correctly had $\lim_{h\to 0}$ in the formula had it in the incorrect location, though marks were not deducted for this. • To obtain full marks, you must show the h in the denominator being cancelled out, as you substitute zero in the denominator.	**3 marks** Correctly shows that $\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ is $2x+3$ **2 marks** Determines the correct expression for $\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$, or equivalent merit **1 mark** Determines the correct expansion of $f(x+h)$, or equivalent merit
MA12-6	**Question 22a** $y'=-3x^2+18x-24$ Stationary points occur at $y'=0$ $-3x^2+18x-24=0$ $-3(x^2-6x+8)=0$ $x^2-6x+8=0$ $(x-2)(x-4)=0$ $\therefore x=2$ or $x=4$ When $x=2$, $y=-(2)^3+9(2)^2-24(2)+16$ $=-4$	**4 marks** Determines the co-ordinates and the nature of all stationary points, and identifies the co-ordinates of inflection and show that it is a point of inflection with all relevant working **3 marks** Determines the x and y co-ordinates and the nature of all

When $x = 4$,
$y = -(4)^3 + 9(4)^2 - 24(4) + 16$
$= 0$

$\therefore$ The stationary points are at $(2, -4)$ and $(4, 0)$

$y'' = -6x + 18$

When $x = 2$,
$y'' = -6(2) + 18$
$= 6 > 0$
$\therefore$ Concave up
$\therefore (2, -4)$ is a local minimum

Alternatively:

x	1	2	3
y'	–9	0	3

When $x = 4$,
$y'' = -6(4) + 18$
$= -6 < 0$
$\therefore$ Concave down
$\therefore (2, -4)$ is a local maximum

Alternatively:

x	3	4	5
y'	3	0	–9

Points of inflection occur at $y'' = 0$ **and** if there is a concavity change
$-6x + 18 = 0$
$-6x = -18$
$x = 3$

When $x = 3$,
$y = -(3)^3 + 9(3)^2 - 24(3) + 16$
$= -2$

x	2	3	4
y''	6	0	–6

$\therefore$ As there is a change in concavity, $(3, -2)$ is a point of inflection.

Marker's feedback:

- The most common error was not showing that there is a change in concavity after finding the potential point of inflection.
- Answers can be improved especially when determining the nature of stationary points for those who used the second

stationary points with all relevant working

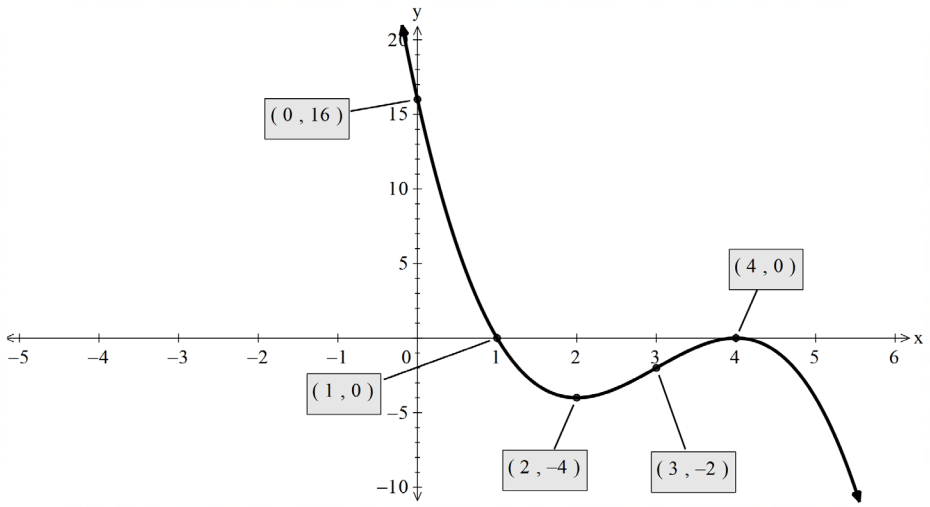
2 marks
Determines the x co-ordinates of stationary points with all relevant working, or equivalent merit

1 mark
Attempts to solve $y' = 0$, or equivalent merit

derivative. Many students concluded without explaining why. Similar problems in the HSC contain sample solutions where after determining the value of y'', an inequality with zero is stated, then a conclusion made about concavity, followed by a conclusion about the nature of the stationary point.

- Whilst many students showed that there was a change in concavity, some did not explain that there was a change in concavity and that is why there is a point of inflection.
- A couple of students did not show full working for finding the x values of the stationary points, or the y values of the stationary points.
- To summarise the above, it is vital that students write fully complete solutions. Your aim is to show the marker that you can successfully solve the question, by showing full working and communicate your working clearly and effectively so that there is no doubt in their minds that you understand what is needed to be done and shown.

Question 22b



Marker's feedback:

- Many students had a change in concavity at the beginning part of the graph, particularly as the graph approached the y-axis. Marks were deducted for this, because if there was another change in concavity, we'd observe another stationary point or point of inflection, but there isn't one.
- As the question did not specify to also label the x-intercept, this was overlooked when marking, but it is a good idea to do anyway.
- A few students drew a point of inflection as a horizontal point of inflection. A horizontal point of inflection is a stationary point. A point of inflection is not a stationary point.
- Once again, students need to carefully revise the curvature of polynomials.
- Some students forgot to add arrowheads at the ends of the graph.

2 marks
Correct graph including the y-intercept

1 mark
One error in the graph such as curvature (concavity), or forgetting to label the y-intercept

MA12-6	**Question 23** $y = \log_e(x^3 - 5) = \ln(x^3 - 5)$ $y' = \dfrac{3x^2}{x^3 - 5}$ When $x = 2$, $y = \log_e(2^3 - 5)$ $= \log_e(3) = \ln 3$ $y' = \dfrac{3(2)^2}{(2)^3 - 5}$ $= 4$ $\therefore m_{\text{tangent}} = 4$ $\therefore m_{\text{normal}} = -\dfrac{1}{4}$ $y - \ln 3 = -\dfrac{1}{4}(x - 2)$ $y = -\dfrac{1}{4}(x - 2) + \ln 3$ $= -\dfrac{1}{4}x + \dfrac{1}{2} + \ln 3$ Alternatively in general form, $y - \ln 3 = -\dfrac{1}{4}(x - 2)$ $4y - 4\ln 3 = -(x - 2)$ $4y - 4\ln 3 = -x + 2$ $x + 4y - 4\ln(3) - 2 = 0$ Marker's notes: • Most common error was differentiating – errors in the power as well as the coefficient. The formula for differentiating $\ln f(x)$ is in the formula sheet. • Many students also did not realise they had the gradient of the tangent and needed to find the gradient of the normal or calculated the gradient of the normal incorrectly. • Interestingly, some students substituted y' in terms of x directly into the point gradient formula, then multiplying this with x in the point gradient formula. This is not correct – we want the exact gradient at $x = 2$, not the formula for the gradient of the tangent. • Very few students did not use exact form. While the question did not state this, it is always ideal to use exact form.	**3 marks** Correctly determines the equation of the normal with all relevant working out **2 marks** Determines the value for the gradient of the normal, or equivalent merit **1 mark** Determines the correct expression for y', or equivalent merit

MA12-6	**Question 24** Given that $g(4)=96$, $g(x)=ax^2+\frac{b}{x}$ $a(4)^2+\frac{b}{4}=96$ $16a+\frac{b}{4}=96$ $64a+b=384$ $b=384-64a \qquad (1)$ Given that $g(x)$ is a minimum stationary point, $g'(4)=0$ $g'(x)=2ax-\frac{b}{x^2}$ $2a(4)-\frac{b}{4^2}=0$ $8a-\frac{b}{16}=0$ $128a-b=0 \qquad (2)$ Substitute (1) into (2) $128a-b=0$ $128a-(384-64a)=0$ $192a-384=0$ $192a=384$ $a=2$ Substitute $a=2$ into (2) $128(2)-b=0$ $256-b=0$ $b=256$ $\therefore a=2,\ b=256$ Many similar methods for this question that yield the same result. Marker's notes: • Generally, very well done, perhaps the best completed question in this section. • Most common error was differentiating $g(x)$ or calculation errors when solving simultaneously or expressing equations in equivalent form without fractions.	**4 marks** Determines the correct values of a and b by solving the equations simultaneously, showing all relevant working **3 marks** Determines either a or b by solving the equations simultaneously, or equivalent merit **2 marks** Determines one correct equation in terms of a and b, or equivalent merit **1 mark** Determines the correct expression for $g'(x)$, or equivalent merit

Year 12 Mathematics Advanced Trial 2026

Section VI — Solutions and Marking Guidelines

Outcomes Addressed in this Question

MA12-7 applies the concepts and techniques of indefinite and definite integrals in the solution of problems

Solutions	**Marking Guidelines**
Question 25 $\int \frac{e^{3x}}{e^{3x}+1}dx = \frac{1}{3}\int \frac{3e^{3x}}{e^{3x}+1}dx$ (putting in form $\int \frac{f'(x)}{f(x)}dx$ $= \frac{1}{3}\log_e\left\|e^{3x}+1\right\| + c$ Note: • As $e^{3x}+1>0$, could also write $\frac{1}{3}\log_e\left(e^{3x}+1\right)+c$ • Answer needed to include the constant • Question was very well done!	2 marks: correct solution 1 mark: manipulates expression correctly to enable integration or uses correct form with incorrect manipulation or correct integral without the constant added
Question 26 a. From the reference sheet, $\cos^2 x + \sin^2 x = 1$ Dividing by $\cos^2 x$, $\frac{\cos^2 x}{\cos^2 x} + \frac{\sin^2 x}{\cos^2 x} = \frac{1}{\cos^2 x}$ $\therefore 1 + \tan^2 x = \sec^2 x$ $\therefore \sec^2 x = 1 + \tan^2 x.$ Note: • Must work with one side at a time, cannot treat like an equation • Well done by most students!	1 mark: correct solution
b. $\int_0^{\frac{\pi}{6}} \tan^2 2x\,dx = \int_0^{\frac{\pi}{6}} (\sec^2 2x - 1)\,dx$ $= \frac{1}{2}\int_0^{\frac{\pi}{6}} 2\sec^2 2x\,dx - \int_0^{\frac{\pi}{6}} 1\,dx$ $= \left[\frac{1}{2}\tan 2x - x\right]_0^{\frac{\pi}{6}}$ $= \frac{1}{2}\left(\sqrt{3}-0\right) - \left(\frac{\pi}{6}-0\right)$ $= \frac{\sqrt{3}}{2} - \frac{\pi}{6}$ $= \frac{3\sqrt{3}-\pi}{6}$ Note: • Mostly well done! • Hence means use result from above – this is a clue! • Extra care needed when manipulating with the half, to get line 2.	2 marks: correct solution 1 mark: correct integral or evaluates integral of equivalent merit correctly
Question 27 a. Area $P = 2 \times$(area rectangle $-$ area under the curve $y = e^x$ between $x = 0$ and 1 and above the x axis) $= 2 \times (e - \int_0^1 e^x dx)$	2 marks: correct solution 1 mark: correct integral or equivalent

$= 2 \times (e - \left[e^x \right]_0^1)$

$= 2 \times (e - \left(e^1 - e^0 \right))$

$= 2(e - e + 1)$

$= 2 \text{ u}^2$

evaluation of incorrect integral of equivalent merit

Note:

- Quickest done using symmetry
- Could also be done as $= 2 \times (\int_0^1 e\,dx - \int_0^1 e^x dx)$
- Well done by most students!

b. $\int_0^1 e^x dx - \int_0^1 e^{-x} dx$ or $\int_0^1 e^x - e^{-x} dx$

1 mark: correct answer

Note:

- Reminder that integrals should always have the dx at the end
- Very well done!

Question 28

Shaded area $= \int_0^2 -x + 5\,dx - \int_1^2 -x^2 + 6x - 5\,dx$

$= \left[-\frac{x^2}{2} + 5x \right]_0^2 - \left[-\frac{x^3}{3} + 3x^2 - 5x \right]_1^2$

$= -2 + 10 - (0 + 0) - \left(-\frac{8}{3} + 12 - 10 - \left(-\frac{1}{3} + 3 - 5 \right) \right)$

$= 8 - \frac{5}{3}$

$= \frac{19}{3} \text{ u}^2$

3 marks: correct solution
2 mark: substantially correct solution with one minor error or correct evaluation of incorrect integrals of equivalent difficulty
1 mark: correct expression for shaded area or correct evaluation of incorrect integral or equivalent

Note:

- Can use formulae for triangles and trapeziums instead of evaluating integrals
- While most students integration and evaluation were good, many need further practice in identifying the integral expressions required to find such areas.

Question 29

a. Increasing when $f'(x) > 0$.

This occurs when $x < -2$

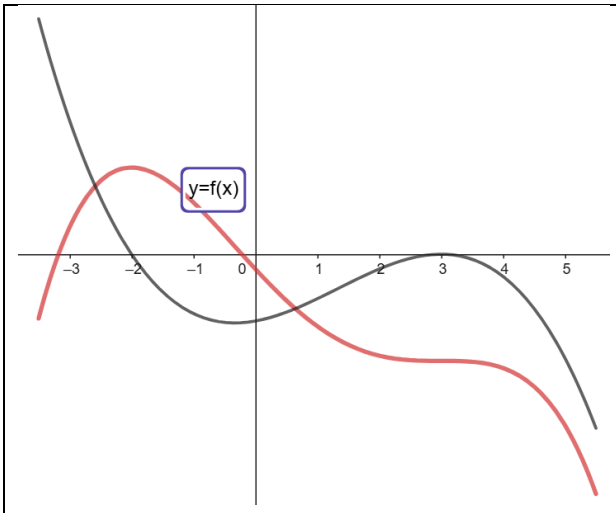
b. Increasing when $x < -2$, decreasing when $-2 < x < 3$ and when $x > 3$.

Stationary when $x = -2$: local maximum as $f'(x)$ is positive when $x < 2$, zero when $x = 2$ and negative when $x > -2$

Stationary when $x = 3$: horizontal point of inflection as $f'(x)$ is negative on both sides of the stationary point

Graph may be moved up/down the y axis

2 marks: correct solution
1 mark: solution correctly positioning/shape of one of the stationary points



Note:

- Extra care is required when drawing horizontal points of inflection. Ensure the curve changes from concave up to concave down (in this case) and that the gradient of the tangent at this point is zero
- Mostly well done

Question 30

a. using $\frac{d}{dx}\left(f(x)\right)^n = n\left(f(x)\right)^{n-1} f'(x)$

$$= 3\left(\sqrt{x}+1\right)^2 \times \frac{d}{dx}\left(x^{\frac{1}{2}}\right)$$

$$= \frac{3\left(\sqrt{x}+1\right)^2}{2\sqrt{x}}$$

Very well done!

\
2 marks: correct solution
1 mark: uses correct rule but incorrect differentiation inside brackets or vice-versa

b. Since $\frac{d}{dx}\left(\sqrt{x}+1\right)^3 = \frac{3\left(\sqrt{x}+1\right)^2}{2\sqrt{x}}$,

$$\therefore \int \frac{3\left(\sqrt{x}+1\right)^2}{2\sqrt{x}}\,dx = \left(\sqrt{x}+1\right)^3 + c$$

$$\therefore 3\int \frac{\left(\sqrt{x}+1\right)^2}{2\sqrt{x}}\,dx = \left(\sqrt{x}+1\right)^3 + c$$

$$\therefore \int \frac{\left(\sqrt{x}+1\right)^2}{2\sqrt{x}}\,dx = \frac{1}{3}\left(\sqrt{x}+1\right)^3 + c$$

Well done!

1 mark: correct answer or equivalent merit

Year 12	Mathematics Advanced	Assessment Task 4 2026
Section VII		Solutions and Marking Guidelines

Outcomes Addressed in this Question

MA12-8 solves problems using appropriate statistical processes

Question	Solutions	Marking Guidelines
31	$P(\text{Battery not defective}) = 1 - 0.06 = 0.94$ $P(\text{Bulb not defective}) = 1 - 0.04 = 0.96$ $P(\text{both not defective}) = 0.94 \times 0.96$ $= 0.902$ $= 0.90$	**2 marks** Establishes the product of both non-defective probabilities and correct solution rounded to two decimal places. **1 mark** Establishes the probability of non-defective probabilities with incorrect solution OR makes some progress towards the correct solution.
32	$P(X \le 0.5) = \int_0^{0.5} \frac{4}{3} - \frac{2}{3}x \; dx$ $= \left[\frac{4}{3}x - \frac{1}{3}x^2 \right]_0^{0.5}$ $= \frac{4}{3}(0.5) - \frac{1}{3}(0.5)^2$ $P(X \le 0.5) = \frac{7}{12} \approx 0.5833$	**2 marks** Establishes correct integral AND provides correct solution. **1 mark** Correctly determines the integral with incorrect solution OR makes some progress towards the correct solution.
33 **(a)**	$k\int_0^1 x^3 - x^5 \; dx = 1$ $k\left[\frac{x^4}{4} - \frac{x^6}{6} \right]_0^1 = 1$ $k\left(\frac{1}{4} - \frac{1}{6} \right) = 1$ $k = 12$	**2 marks** Correct solution of k AND correctly integrates relevant function. **1 mark** Correctly integrates relevant function, however, incorrect solution OR makes some progress towards the correct solution.

33 (b)

$$\int_0^m 2x\,dx = \frac{1}{2}$$

$$\left[x^2\right]_0^m = \frac{1}{2}$$

$$m^2 = \frac{1}{2}$$

$$m = \frac{1}{\sqrt{2}}$$

$$\int_0^m 12x^3(1-x^2)\,dx = \frac{1}{2}$$

$$12\int_0^m x^3 - x^5\,dx = \frac{1}{2}$$

$$12\left[\frac{x^4}{4} - \frac{x^6}{6}\right]_0^m = \frac{1}{2}$$

$$12\left[\frac{m^4}{4} - \frac{m^6}{6}\right] = \frac{1}{2}$$

$$3m^4 - 2m^6 = \frac{1}{2}$$

When $m = \frac{1}{\sqrt{2}}$

$$3\left(\frac{1}{\sqrt{2}}\right)^4 - 2\left(\frac{1}{\sqrt{2}}\right)^6 = \frac{1}{2}$$

$\therefore m = \frac{1}{\sqrt{2}}$ is true

Both models have the same median

3 marks
Correctly shows both median values are the same through integrating both functions.

2 marks
Successfully integrates both functions, however, only finding one correct median OR makes significant progress towards the correct solution.

1 mark
Finding only one median value OR makes some progress towards the correct solution.

34

$$z_1 = \frac{25.5 - 25.8}{0.5} = -0.6$$

$$z_2 = \frac{26.5 - 25.8}{0.5} = 1.4$$

$$P(25.5 < X < 26.5) = P(-0.6 < Z < 1.4)$$

$$P(Z < 1.4) = 0.9192$$

$$P(Z < -0.6) = 1 - P(Z < 0.6) = 1 - 0.7257$$

$$= 0.2743$$

$$\therefore P(-0.6 < Z < 1.4) = 0.9192 - 0.2743$$

$$= 0.6449$$

3 marks
Correctly determines both z-scores, establishes correct probability from the table AND obtains correct solution.

2 marks
Two correct criterions above OR makes significant progress towards the correct solution.

1 mark
One correct criteria above OR makes some progress towards the correct solution.

35	Uniform distribution means probabilities are all equal There are a total of 8 minutes between 2 and 10 $P(1\,\text{min}) = \frac{1}{8}$ $P(X > 7) = \frac{3}{8} = 0.375$	**2 marks** Correct solution AND establishes the length of the distribution is 8. **1 mark** Some progress towards the correct solution.
36 **(a)**	$r = 0.998$	**1 mark** Correct solution
(b)	$y = 45.62x - 188.97$	**1 mark** Correct solution

Year 12	Mathematics Advanced	Ass Task 4 2026 HSC
Section VIII	Solutions and Marking Guidelines	TRIAL HSC

Outcomes Addressed in this Question

MA12-3 applies calculus techniques to model and solve problems

Question	Solutions	Marking Guidelines

37

Need to test stationary points ***and*** end points…

Check end points in domain:

at $x=-2$ $\quad y=(-2)^3-3(-2)^2-9(-2)+5$

$=3$

at $x=5$ $\quad y=(5)^3-3(5)^2-9(5)+5$

$=10$

Check stationary points:

$$y=x^3-3x^2-9x+5$$

$$\frac{dy}{dx}=3x^2-6x-9=0 \quad \text{for stationary points}$$

$$x^2-2x-3=0$$

$$(x-3)(x+1)=0$$

$$x=-1,\ 3$$

at $x=-1$ $\quad y=(-1)^3-3(-1)^2-9(-1)+5$

$=10$

at $x=3$ $\quad y=(3)^3-3(3)^2-9(3)+5$

$=-22$

global minimum is $y=-22$ (at $x=3$)

global maximum is $y=10$ (at $x=-1,\ 5$)

4 marks: Correct solution. Note… final answer stated as global max/min **values**, *not points*

3 marks: Substantially correct eg. All four points and *y*-values correct, but final answer given as a coordinate rather than a value, or the comparison isn't made explicit.

2 marks: Partially correct. ie Stationary points correct but endpoints not checked (or vice versa) or equivalent merit

1 mark: Correct dy/dx and genuine attempt at stationary points, but with an error.

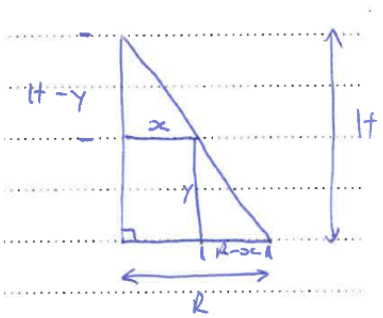
General note: This question basically boiled down to 2 marks awarded for "going through the motions" and 2 marks awarded for demonstrating understanding

38(a)

Using similar triangles…

$$\frac{y}{R-x}=\frac{H}{R}$$

$$y=\frac{H}{R}(R-x)$$



$$V_{cylinder}=\pi r^2 h$$

$$=\pi x^2 y$$

$$=\pi x^2\times\frac{H}{R}(R-x)$$

$$=\frac{H}{R}\pi x^2(R-x)$$

3 marks: Correct solution.

2 marks: $V=\pi x^2 y$ stated and similar triangles correct, but substitution/algebra to the given result has an error.

1 mark: $V=\pi x^2 y$ stated ***or*** similar triangles correct, or equivalent merit

38(b)

$$V_{cone} = \frac{1}{3}\pi r^2 h$$
$$= \frac{1}{3}\pi R^2 H$$

$$V_{cylinder} = \frac{H}{R}\pi x^2 (R - x)$$
$$= H\pi x^2 - \frac{H}{R}\pi x^3$$
$$V'_{cylinder} = 2H\pi x - 3\frac{H}{R}\pi x^2$$
$$V''_{cylinder} = 2H\pi - 6\frac{H}{R}\pi x$$

$V' = 0$ for stationary point

ie $H\pi x\left(2 - \frac{3}{R}x\right) = 0$

$$x = 0 \text{ or } \frac{2R}{3}$$

Test for max at $x = \frac{2R}{3}$ (note, $x = 0$ has no physical relevance here)

$$V''_{cylinder} = 2H\pi - 6\frac{H}{R}\pi\left(\frac{2R}{3}\right)$$
$$= 2H\pi - 4H\pi$$
$$= -2H\pi < 0 \quad \therefore \text{ maximum at } x = \frac{2R}{3}$$

$\therefore$ max vol of cylinder is:

$$V_{cylinder} = \frac{H}{R}\pi x^2 (R - x)$$
$$= \frac{H}{R}\pi\left(\frac{2R}{3}\right)^2\left(R - \frac{2R}{3}\right)$$
$$= \frac{4R^2 H\pi}{9R}\left(\frac{R}{3}\right)$$
$$= \frac{4}{9}\left(\frac{\pi R^2 H}{3}\right)$$
$$= \frac{4}{9} \times V_{cone}$$

Note: this was a 'show' question, so unambiguous clarity of each step was important.

4 marks: Correct solution, including statement or evidence addressing "does not exceed."

3 marks: Substantially correct solution (but not fully showing comparison to V_{cone} giving the ratio 4/9, and with a concluding statement addressing "does not exceed")

2 marks: Significant progress towards correct solution, including correct V'(x) and solving for stationary point x = 2R/3 (rejecting x = 0), and valid test confirming maximum (second derivative or sign test)… or equivalent merit

1 mark: partial progress. Eg finding V'(x) and solving for stationary point x = 2R/3.
Or equivalent merit