Student Number: ______________________

Teacher Name: ______________________

Hills Grammar

Trial HSC Examinations 2025

Year 12

Mathematics Extension 1

Time Allowed: 2 hours + 10 minutes of reading

Classes: Mr Seo, Mrs Singh

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours
- Write using black or blue pen
- NESA approved calculators may be used
- A reference sheet has been provided
- All necessary working must be shown
- Write your student number at the top of every page
- All questions should be attempted

Total marks - 70

Section I
Multiple Choice Questions – 10 marks

- **Answer on Multiple Choice Answer Sheet provided**
- **Allow about 15 minutes for this section.**

Section II
Short Answer Questions – 60 marks

- **Answer each question in the writing booklets provided**
- **Allow about 1 hour and 45 minutes for this section**

Section I	**Your Mark:**	10
Section II	**Your Mark:**	60
Total	**Your Mark:**	70

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Section I

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

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

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1 Students from seven different schools are eligible for the district netball training squad.

What is the minimum number of students in the training squad if it is known that there must be at least 3 students from at least one of the schools?

A. 14
B. 15
C. 21
D. 22

2 Evaluate $\displaystyle\int_0^1 \frac{dx}{\sqrt{25-x^2}}$.

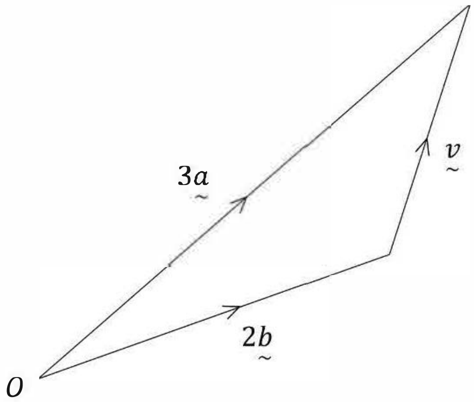
A. $\sin^{-1}\left(\frac{1}{5}\right)$

B. $\frac{1}{5}\sin^{-1}\left(\frac{1}{5}\right)$

C. $\tan^{-1}\left(\frac{1}{5}\right)$

D. $\frac{1}{5}\tan^{-1}\left(\frac{1}{5}\right)$

3 It is given that $\underset{\sim}{a} = \overrightarrow{OA} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$ and $\underset{\sim}{b} = \overrightarrow{OB} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$, and $\underset{\sim}{v}$ starts at the tip of $2\underset{\sim}{b}$ and finishes at the tip of $3\underset{\sim}{a}$ as shown.



Which vector is equal to $\underset{\sim}{v}$?

A. $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$

B. $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$

C. $\begin{pmatrix} 4 \\ 4 \end{pmatrix}$

D. $\begin{pmatrix} 10 \\ 9 \end{pmatrix}$

4 Which function, $f(x)$, and its inverse function, $f^{-1}(x)$, are equivalent, i.e. where $f(x) = f^{-1}(x)$?

A. $f(x) = \sin|x|$ for $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

B. $f(x) = x^2$ for $[0, \infty)$

C. $f(x) = |e^x|$ for $(-\infty, \infty)$

D. $f(x) = \frac{1}{x}$ for $(-\infty, 0) \cup (0, \infty)$

5 Let $P(x)$ be polynomial of degree 6. When $P(x)$ is divided by the polynomial $Q(x)$, the remainder is $x^2 + 2$.

Which statement is true about the about the degree of $Q(x)$?

A. The degree of $Q(x)$ must be at least 2
B. The degree of $Q(x)$ must be 2
C. The degree of $Q(x)$ must be at least 3
D. The degree of $Q(x)$ must be 3

6 The vectors $128\underset{\sim}{i} + m\underset{\sim}{j}$ and $\sqrt{m}\underset{\sim}{i} + \sqrt[3]{m}\,\underset{\sim}{j}$ are parallel, where *m* is a real number.

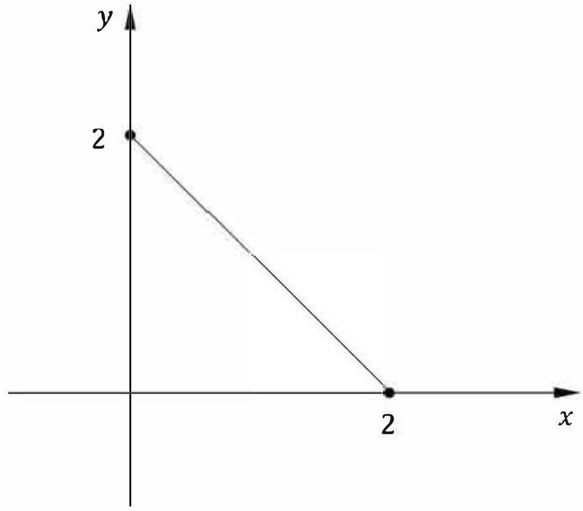
What is the value of *m*?

A. $m = 1$
B. $m = 8$
C. $m = 27$
D. $m = 64$

7 Which of the following functions has a range of $[0, \pi]$?

A. $y = \left|\sin^{-1} x\right|$
B. $y = \left|\cos^{-1}(x-1)\right|$
C. $y = \sin^{-1}|x+1|$
D. $y = \cos^{-1}|2x|$

8 The diagram shows the interval from $(0, 2)$ to $(2, 0)$.



Which pair of parametric equations does NOT represent the interval shown?

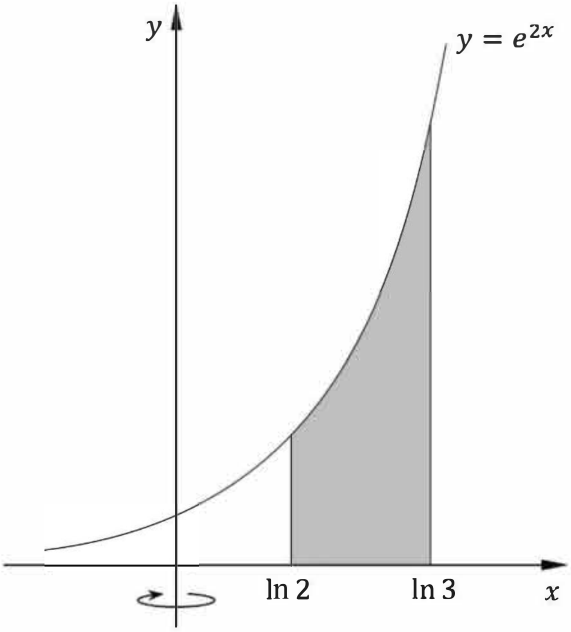
A. $x = e^t - 1, y = 3 - e^t$ for $0 \le t \le \ln 2$

B. $x = 2\left(1 - t^2\right), y = 2t^2$ for $0 \le t \le 1$

C. $x = 2\sin t, y = 2 - 2\sqrt{1 - \cos^2 t}$ for $0 \le t \le \dfrac{\pi}{2}$

D. $x = 2 - \dfrac{2}{\pi}\cos^{-1} t, y = \dfrac{2}{\pi}\cos^{-1} t$ for $-1 \le t \le 1$

9 A solid of revolution is found by rotating the region bounded by the curve $y = e^{2x}$, the x-axis, the line $x = \ln 2$ and the line $x = \ln 3$ about the y-axis.



NOT TO SCALE

Which expression could be used to evaluate the volume of the solid of revolution?

A. $V = 2\pi\left((\ln 3)^2 - (\ln 2)^2\right) + \pi\int_2^3 \left((\ln 3)^2 - \left(\frac{\ln y}{2}\right)^2\right) dy$

B. $V = 2\pi(\ln 3 - \ln 2)^2 + \pi\int_2^3 \left(\ln 3 - \frac{\ln y}{2}\right)^2 dy$

C. $V = 4\pi\left((\ln 3)^2 - (\ln 2)^2\right) + \pi\int_4^9 \left((\ln 3)^2 - \left(\frac{\ln y}{2}\right)^2\right) dy$

D. $V = 4\pi(\ln 3 - \ln 2)^2 + \pi\int_4^9 \left(\ln 3 - \frac{\ln y}{2}\right)^2 dy$

10 The sample proportion $\hat{p}$ from a sample size n is calculated, with the experiment repeated a large number of times.

It is known that p is very close to 0.4.

It is found that on exactly nineteen times out of every twenty experiments that $0.38 \leq \hat{p} \leq 0.42$.

What is the best estimate for the value of n?

A. 12
B. 24
C. 600
D. 2400

Section II

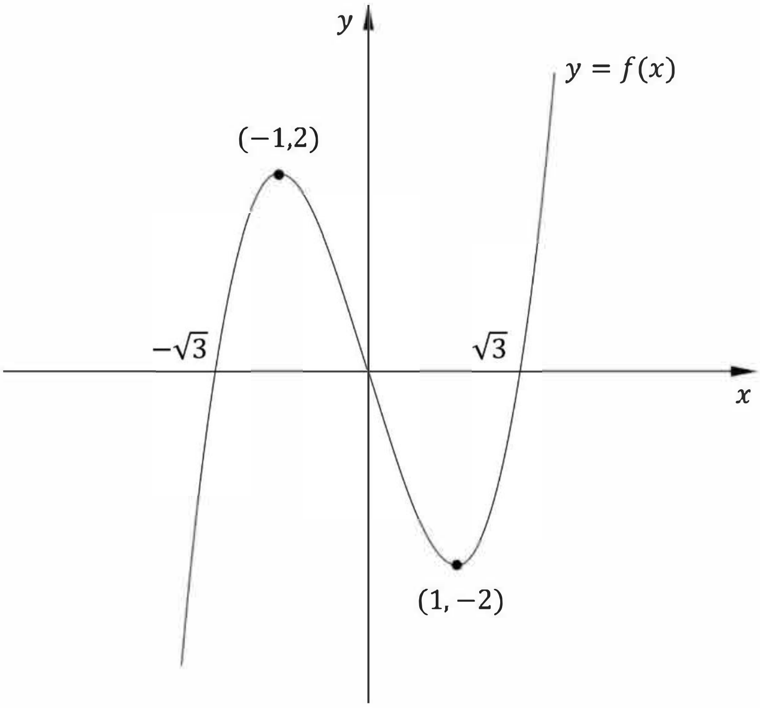
60 marks
Attempt Questions 11-14
Allow about 1 hour and 45 minutes for this section

Answer each question in the appropriate writing booklet. Extra writing booklets are available.

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

Question 11 (15 marks) Use the Question 11 Writing Booklet

(a) The diagram shows the graph of $y = f(x)$ where $f(x) = x^3 - 3x$. **3**



The diagram is reproduced on page 24.

Sketch $y = \dfrac{1}{f(x)}$ on the diagram on that page, showing all turning points and asymptotes.

Question 11 continues on page 10

Question 11 (continued)

(b) Using the substitution $u = 3x^3 + 2$, or otherwise, find **2**

$$\int x^2\left(3x^3+2\right)^5 dx$$

(c) Evaluate **3**

$$\int_0^{\pi/3} \cos^2 2x \, dx$$

(d) (i) In how many ways can the letters of the word SUCCESS be arranged in a line if there are no restrictions? **1**

(ii) In how many ways can the letters of the word SUCCESS be arranged in a line if the two Cs are NOT adjacent? **2**

(e) Find the angle between the vectors $\begin{pmatrix} -12 \\ 5 \end{pmatrix}$ and $\begin{pmatrix} 8 \\ 6 \end{pmatrix}$ correct to the nearest degree. **2**

(f) The cubic polynomial $P(x) = x^3 + x^2 - 8x - 12$ has roots α, β and γ. **2**

Find $\alpha^2 + \beta^2 + \gamma^2$.

End of Question 11

Question 12 (16 marks) Use the Question 12 Writing Booklet

(a) It is given that $3\cos x + b\sin x = 5\cos\left(x+\theta\right)$, where $b > 0, -90^\circ < \theta < 90^\circ$. **3**

Find the values of b and θ, giving your answer for θ correct to the nearest minute.

(b) The volume, V, of a weather balloon in cubic metres after t minutes is modelled by the function $V = 1.26 + Ae^{0.1t}$. **2**

The balloon initially has a volume of 2.5 cubic metres.

Find the volume of the weather balloon after ten minutes, correct to two decimal places.

(c) Use mathematical induction to prove for all integers $n \geq 1$ that **3**

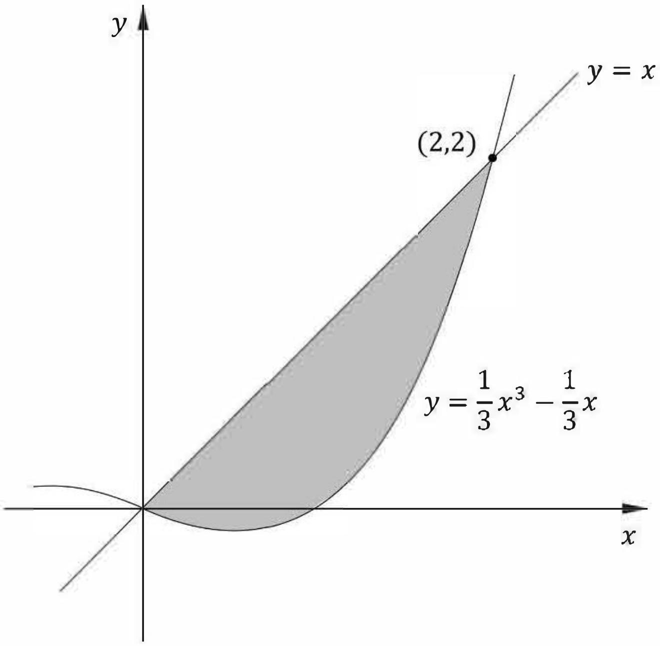
$$1\times 2 + 2\times 3 + 3\times 4 + \ldots + n\left(n+1\right) = \frac{1}{3}n\left(n+1\right)\left(n+2\right).$$

(d) Find the curve which satisfies the differential equation $\dfrac{dy}{dx} = \dfrac{y}{2}$ and passes through the point $\left(0,-1\right)$. **3**

Question 12 continues on page 12

Question 12 (continued)

(e) Find the area between the functions $y = \frac{1}{3}x^3 - \frac{1}{3}x$ and $y = x$ in the region between $x = 0$ and $x = 2$. **3**



(f) When a fair coin is tossed, the chance that it will come up heads is exactly 50%. **2**

The coin is tossed 100 times.

What is the probability that it will NOT come up heads exactly 50 times to the nearest percentage?

End of Question 12

Question 13 (15 marks) Use the Question 13 Writing Booklet

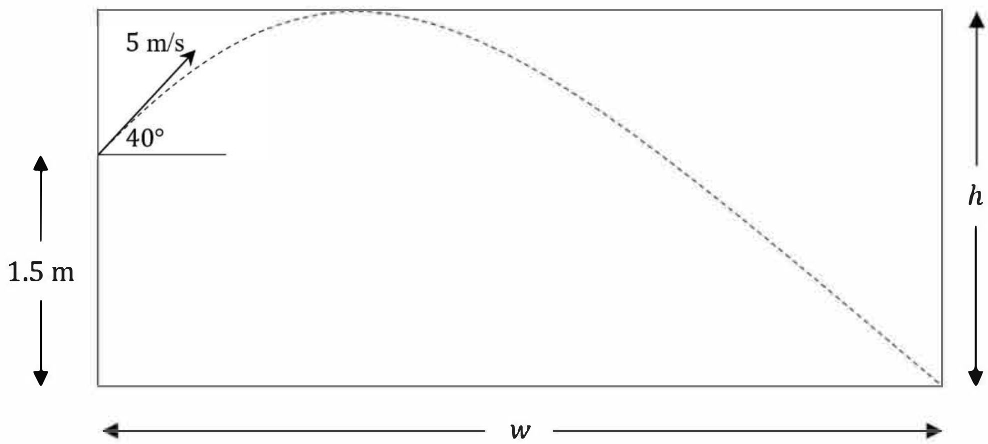
(a) Using $t = \tan\dfrac{x}{2}$, or otherwise, prove that **2**

$$\frac{2}{1+\cos x} = \sec^2\left(\frac{x}{2}\right).$$

(b) When an object is projected from the origin with initial speed 5 m/s at an angle of projection 40° to the horizontal, from a height of 1.5 metres, its horizontal and vertical displacement t seconds after projection are **4**

$$x = 5t\cos 40^\circ,\quad y = 5t\sin 40^\circ - 5t^2 + 1.5 \qquad \text{(Do NOT prove these)}$$

A student is standing in the doorway to a classroom, which has a height of h metres and a width of w metres. They throw a ball from a height of 1.5 metres, at a speed of 5 m/s with an angle of projection of 40°. The ball just touches the ceiling before landing at the junction of the floor and the wall, as shown.



NOT TO SCALE

Find the width and height of the room, correct to the nearest centimetre.

Question 13 continues on page 14

Question 13 (continued)

(c) A rocket is fired horizontally from a platform which is two metres above the origin. **3**

The gradient of its trajectory is given by $\frac{dy}{dx} = \frac{x^2}{y}$ for $x \geq 0$.

Find the equation of its trajectory in the form $y = f(x)$.

(d) *You may use the information on page 18 to answer this question.* **3**

A bus driver passes through the same set of traffic lights forty times every day.

Each time the driver approaches the traffic lights there is a 20% chance that the lights are green.

Use the standard normal distribution to approximate the probability that, on a particular day, the lights are green at least twelve times. Answer as percentage correct to one decimal place.

(e) Show that the equation of the tangent to the curve $y = x^2 \sin^{-1} x$ at the point with coordinates $\left(\frac{1}{2}, \frac{\pi}{24}\right)$ is **3**

$$y = \frac{\sqrt{3}+\pi}{6}x - \frac{2\sqrt{3}+\pi}{24}.$$

End of Question 13

Question 14 (14 marks) Use the Question 14 Writing Booklet

(a) The digits 1, 2, 3, 4, 5 and 6 are spaced evenly around a circle. **2**

Each digit has another digit which is directly opposite it on the circle.

If the digits are placed around the circle at random, what is the probability that exactly one pair of opposite digits add to 7?

(b) It is given that **3**

$$\tan 3\theta = \frac{3\tan\theta - \tan^3\theta}{1 - 3\tan^2\theta}.$$

By letting $x = \tan\theta$, where $0 < \theta < \pi$, solve

$$x^3 - 3x^2 - 3x + 1 = 0.$$

(c) Let $f(x) = e^{-x} - 2x$.

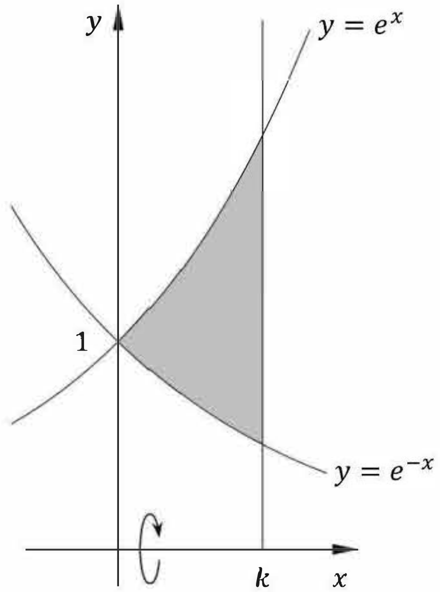
(i) Explain why the inverse of $f(x)$ is a function. **1**

(ii) Let $g(x) = f^{-1}(x)$. Find the gradient of $g(x)$ where its graph cuts the x-axis. **2**

Question 14 continues of page 16

Question 14 (continued)

(d) The region R is bounded by the y-axis, the graph of $y = e^x$, the graph of $y = e^{-x}$ and the line $x = k$ where $k > 0$, as shown in the diagram. **3**



The volume of the solid of revolution formed when the region R is rotated about the x-axis is

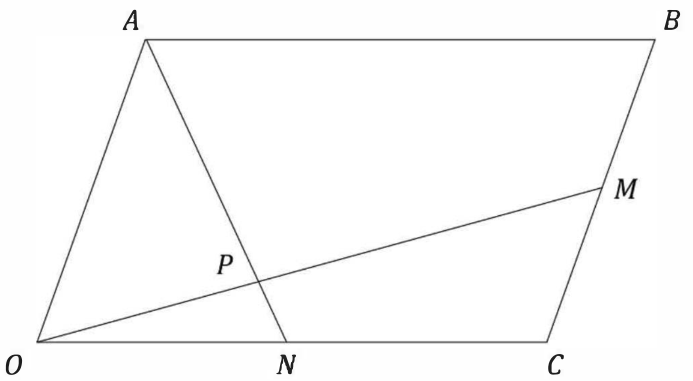
$$V = \frac{9\pi}{8} \text{ units}^3$$

Find the exact value of k.

Question 14 continues of page 17

Question 14 (continued)

(e) In the parallelogram $OABC$, M is the midpoint of BC and N is the midpoint of OC. **3**



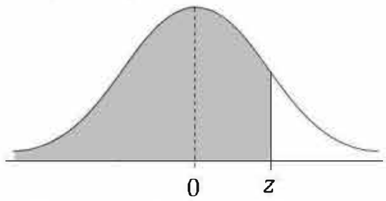
Let $\overrightarrow{OA} = \underset{\sim}{a}$ and $\overrightarrow{OC} = \underset{\sim}{c}$.

Prove that $\overrightarrow{OP} = \dfrac{1}{5}\underset{\sim}{a} + \dfrac{2}{5}\underset{\sim}{c}$.

End of paper

You may use the information below to answer Question 13 (d).

Table of values $P(Z < z)$ for the normal distribution $N(0, 1)$



Z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.10	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.20	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.30	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.40	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.50	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.60	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.70	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.80	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.90	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.00	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.10	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.20	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.30	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.40	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.50	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.60	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.70	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.80	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.90	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.00	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.10	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.20	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.30	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.40	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.50	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.60	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.70	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.80	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.90	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.00	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

NSW GOVERNMENT

2025

NSW Education Standards Authority

2023 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 $ax^3 + bx^2 + cx + d = 0$:

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

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

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

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

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

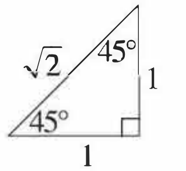
$$a^x = e^{x \ln a}$$

Trigonometric Functions

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

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

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

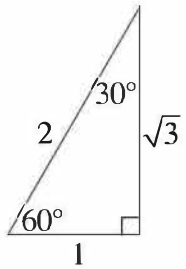


$c^2 = a^2 + b^2 - 2ab\cos C$

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

$l = r\theta$

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



Trigonometric identities

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

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

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

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

Compound angles

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

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

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

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

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

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

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

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

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

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

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

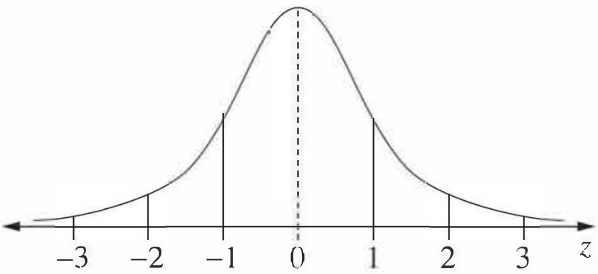
$\cos^2 nx = \dfrac{1}{2}(1 + \cos 2nx)$

Statistical Analysis

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

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

$E(X) = \mu$

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

Probability

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

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

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

Continuous random variables

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

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

Binomial distribution

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

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

$\Rightarrow \ P(X = x)$

$= \dbinom{n}{x} p^x (1 - p)^{n-x}, \ x = 0, 1, \ldots, n$

$E(X) = np$

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

Differential Calculus

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

Integral Calculus

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

where $n \neq -1$

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\underset{\sim}{u}\cdot\underset{\sim}{v} = \left|\underset{\sim}{u}\right|\left|\underset{\sim}{v}\right|\cos\theta = x_1x_2 + y_1y_2,$$

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

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

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

Mechanics

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

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

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

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

2025 Trial Higher School Certificate Examination
Mathematics Extension 1

Student number ______________________________ Teacher ____________________________

Section I – Multiple Choice Answer Sheet

Allow about 15 minutes for this section

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 ○

Question 11 (a)