2024 HSC Mathematics Extension 1
Marking Guidelines

Section I

Multiple-choice Answer Key

Question	Answer
1	B
2	D
3	B
4	A
5	C
6	D
7	C
8	B
9	A
10	D

Section II

Question 11 (a) (i)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$\underset{\sim}{a} = 3\underset{\sim}{i} + 2\underset{\sim}{j}, \qquad \underset{\sim}{b} = -\underset{\sim}{i} + 4\underset{\sim}{j}$

$$\begin{aligned} 2\underset{\sim}{a} - \underset{\sim}{b} &= 2\left(3\underset{\sim}{i} + 2\underset{\sim}{j}\right) - \left(-\underset{\sim}{i} + 4\underset{\sim}{j}\right) \\ &= 6\underset{\sim}{i} + 4\underset{\sim}{j} + \underset{\sim}{i} - 4\underset{\sim}{j} \\ &= 7\underset{\sim}{i} \end{aligned}$$

Question 11 (a) (ii)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$\begin{aligned} \underset{\sim}{a} \cdot \underset{\sim}{b} &= 3 \times -1 + 2 \times 4 \\ &= -3 + 8 \\ &= 5 \end{aligned}$$

Question 11 (b)

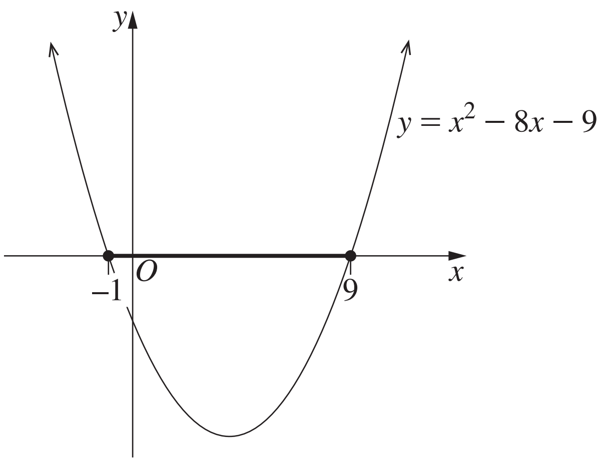
Criteria	Marks
• Provides correct solution	2
• Attempts to factor the LHS, or equivalent merit	1

Sample answer:

$x^2 - 8x - 9 \leq 0$

$y = x^2 - 8x - 9$

$\quad = (x-9)(x+1)$



$-1 \leq x \leq 9$

Question 11 (c)

Criteria	Marks
• Provides correct solution	3
• Obtains correct integral in terms of u, or equivalent merit	2
• Correctly substitutes for one element of the integrand, or equivalent merit	1

Sample answer:

$u = x - 1$

$\frac{du}{dx} = 1$

$du = dx$

$$\int x\sqrt{x-1} \cdot dx = \int (u+1)u^{\frac{1}{2}} \cdot du$$

$$= \int \left(u^{\frac{3}{2}} + u^{\frac{1}{2}}\right) du$$

$$= \frac{2u^{\frac{5}{2}}}{5} + \frac{2u^{\frac{3}{2}}}{3} + C$$

$$= \frac{2\left(\sqrt{x-1}\right)^5}{5} + \frac{2\left(\sqrt{x-1}\right)^3}{3} + C$$

Question 11 (d)

Criteria	Marks
• Provides correct solution	2
• Separates the variables, or equivalent merit	1

Sample answer:

$$\frac{dy}{dx} = xy$$

$$\int \frac{dy}{y} = \int x\,dx$$

$$\log_e y = \frac{x^2}{2} + C \qquad \text{as } y > 0$$

$$y = e^{\frac{x^2}{2} + C}$$

Answers could include:

$$Ae^{\frac{x^2}{2}}$$

Question 11 (e)

Criteria	Marks
• Provides correct derivative	1

Sample answer:

$$y = \arcsin\left(x^5\right)$$

Let $f(x) = x^5$

$\therefore$ $f'(x) = 5x^4$

$$\frac{dy}{dx} = \frac{f'(x)}{\sqrt{1 - [f(x)]^2}}$$

$$= \frac{5x^4}{\sqrt{1 - x^{10}}}$$

Question 11 (f)

Criteria	Marks
• Provides correct solution	2
• Correctly applies the chain rule to find an expression for $\frac{dr}{dt}$, or equivalent merit	1

Sample answer:

$$V = \frac{4}{3}\pi r^3, \qquad \frac{dV}{dt} = 10 \text{ cm}^3\,\text{s}^{-1}$$

$$\frac{dV}{dr} = 4\pi r^2$$

$$\begin{aligned}\frac{dr}{dt} &= \frac{dr}{dV} \cdot \frac{dV}{dt} \\ &= \frac{1}{4\pi r^2} \cdot 10 \\ &= \frac{5}{2\pi r^2} \text{ cm s}^{-1}\end{aligned}$$

Question 11 (g)

Criteria	Marks
• Provides correct solution	3
• Finds the primitive of $x - \sin x$ OR • Finds the two relevant areas, or equivalent merit	2
• Considers the function $x - \sin x$ OR • Calculates the area of the triangle OR • Considers the difference of two areas, or equivalent merit	1

Sample answer:

$$\text{Area} = \int_0^{\frac{\pi}{2}} (x - \sin x)\,dx$$

$$= \left[\frac{x^2}{2} + \cos x\right]_0^{\frac{\pi}{2}}$$

$$= \left(\frac{\pi^2}{8} + 0\right) - (0 + 1)$$

$$= \frac{\pi^2}{8} - 1$$

Question 12 (a)

Criteria	Marks
• Provides correct solution	3
• Obtains the solution $a = 1$, or equivalent merit	2
• Obtains the equation $a^2(a+5)+2(a-4)=0$, or equivalent merit	1

Sample answer:

$$\begin{pmatrix} a^2 \\ 2 \end{pmatrix} \cdot \begin{pmatrix} a+5 \\ a-4 \end{pmatrix} = 0 \qquad \text{as vectors are } \perp$$

$$\begin{aligned} a^2(a+5)+2(a-4) &= 0 \\ a^3+5a^2+2a-8 &= 0 \end{aligned}$$

Let $a = 1$

$$\begin{aligned} 1^3+5(1)^2+2(1)-8 &= 1+5+2-8 \\ &= 0 \end{aligned}$$

$\therefore\ a-1$ is a factor.

Using sum and product of roots:

$$\begin{aligned} \alpha+\beta+\gamma &= -5 \\ 1+\beta+\gamma &= -5 \\ \beta+\gamma &= -6 \end{aligned}$$

$$\beta\gamma = 8$$

$$\therefore\ \beta = -4, \quad \gamma = -2$$

Hence, roots are $1, -2, -4$

Answers could include:

- Inspection and equating of coefficients
- Division of polynomials
- Other methods may also be used

Question 12 (b)

Criteria	Marks
• Provides correct solution	3
• Obtains correct primitive, or equivalent merit	2
• Obtains a correct expression for the volume, or equivalent merit	1

Sample answer:

$$V = \pi \int_1^2 \left(x^3\right)^2 dx$$

$$= \pi \left[\frac{x^7}{7} \right]_1^2$$

$$= \frac{\pi}{7}(128 - 1)$$

$$= \frac{127\pi}{7}$$

Question 12 (c)

Criteria	Marks
• Provides correct solution	3
• Finds the *z*-score, or equivalent merit	2
• Obtains relevant standard deviation, or equivalent merit	1

Sample answer:

$$\sigma = \sqrt{np(1-p)}$$

$$= \sqrt{100 \times 0.31 \times 0.69}$$

$$= \sqrt{21.39}$$

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

$$= \frac{35 - 31}{\sqrt{21.39}}$$

$$\doteqdot 0.86$$

From normal distribution graph

$$P(\geq 35\% \text{ make a donation}) = 1 - 0.8051$$

$$= 0.1949$$

$$= 19.49\%$$

Question 12 (d)

Criteria	Marks
• Provides correct proof	3
• Establishes that $p(n) \Rightarrow p(n+1)$ is true, or equivalent merit	2
• Establishes base case, or equivalent merit	1

Sample answer:

Base case $n = 1$ $\quad 2^{3\times 1} + 13 = 2^3 + 13$

$= 8 + 13$

$= 21$ (which is divisible by 7)

Therefore true for $n = 1$

Assume true for $n = k$ ie $2^{3k} + 13 = 7M$ where M is a positive integer

Prove true for $n = k + 1$ ie $2^{3(k+1)} + 13 = 7N$ where N is a positive integer

$$\begin{aligned} \text{LHS} &= 2^{3k+3} + 13 \\ &= 2^{3k} \cdot 2^3 + 13 \\ &= (7M - 13)8 + 13 \quad \text{using assumption} \\ &= 7M \times 8 - 104 + 13 \\ &= 7M \times 8 - 91 \\ &= 7(8M - 13) \\ &= 7N \quad \text{where } N = 8M - 13 \text{ which is an integer} \end{aligned}$$

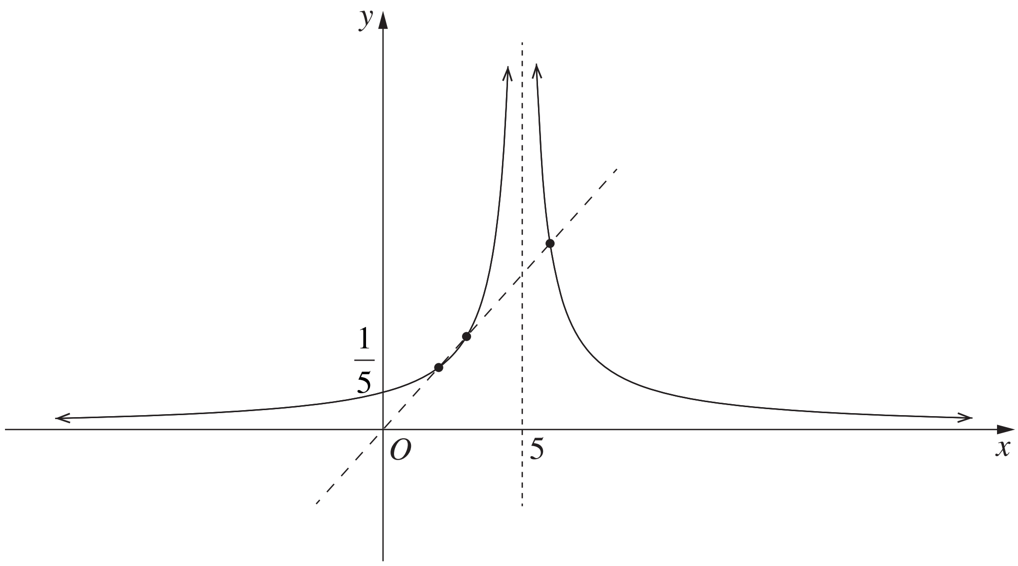
$7N$ is divisible by 7, as required.

Hence, by mathematical induction, $2^{3n} + 13$ is divisible by 7, for all integers $n \geq 1$.

Question 12 (e)

Criteria	Marks
• Provides correct solution	3
• Obtains the three critical points 2, 3 and 6, or equivalent merit	2
• Recognises the two cases OR • Observes that $x = 6$ is a critical point OR • Graphs the two curves on the same axis, or equivalent merit	1

Sample answer:



$x > 5$

$$\frac{x}{6} = \frac{1}{x-5}$$
$$x^2 - 5x = 6$$
$$x^2 - 5x - 6 = 0$$
$$(x-6)(x+1) = 0$$
$$x = 6 \quad \text{since } x > 5$$
$$\therefore [6, \infty)$$

$x < 5$

$$\frac{x}{6} = \frac{-1}{x-5}$$
$$x^2 - 5x = -6$$
$$x^2 - 5x + 6 = 0$$
$$(x-2)(x-3) = 0$$
$$x = 2,\ 3 \quad \text{since } x < 5$$
$$\therefore [2, 3]$$

$\therefore$ Solution is $[2, 3] \cup [6, \infty)$

Question 13 (a) (i)

Criteria	Marks
• Provides correct explanation	1

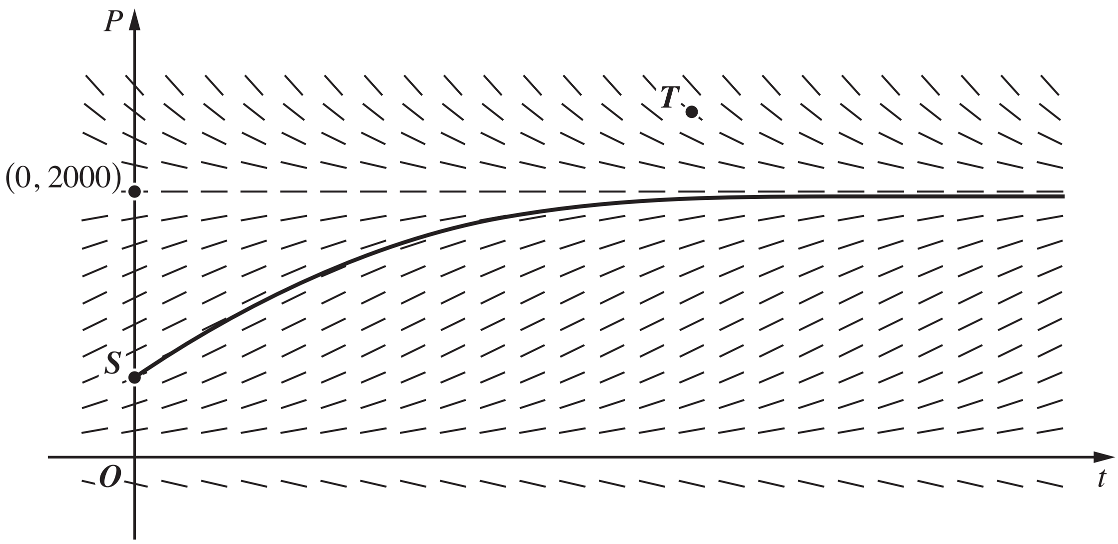
Sample answer:

All graphs passing through T must be decreasing to the left of T. So the y-intercept of such a curve, if any y-intercept, must be above T. The point S isn't above T so S can't be on any such curve.

Question 13 (a) (ii)

Criteria	Marks
• Provides correct sketch	1

Sample answer:



Question 13 (a) (iii)

Criteria	Marks
• Provides correct solution	2
• Obtains the equation $\frac{d^2P}{dt^2} = 0$, or equivalent merit	1

Sample answer:

Rate of growth is a maximum when $\frac{dP}{dt}$ is a maximum.

ie when $\frac{d^2P}{dt^2} = 0$

$$0 = 1 \times (2000 - P) - P$$
$$2P = 2000$$
$$P = 1000$$

From the direction field it can be seen that the slope at $P = 1000$ is the maximum slope. (Rather than a minimum slope or other type of stationary point.)

Question 13 (b) (i)

Criteria	Marks
• Provides correct proof	2
• Expands $\left(\cos^2 x + \sin^2 x\right)^2$, or equivalent merit	1

Sample answer:

$$\begin{aligned}\cos^4 x + \sin^4 x &= \left(\cos^2 x + \sin^2 x\right)^2 - 2\cos^2 x \sin^2 x \\ &= 1^2 - \frac{1}{2}(2\cos x \sin x)^2 \\ &= 1 - \frac{1}{2}\sin^2 2x \\ &= 1 - \frac{1}{2}\left(1 - \cos^2 2x\right) \\ &= 1 - \frac{1}{2} + \frac{1}{2}\cos^2 2x \\ &= \frac{1}{2} + \frac{1}{2}\cos^2 2x \\ &= \frac{1 + \cos^2 2x}{2}\end{aligned}$$

Answers could include:

• Use of double angle formula

Question 13 (b) (ii)

Criteria	Marks
• Provides correct solution	3
• Obtains correct primitive, or equivalent merit	2
• Obtains correct integral involving $\cos 4x$, or equivalent merit	1

Sample answer:

$$\begin{aligned}
\int_0^{\frac{\pi}{4}} \left(\cos^4 x + \sin^4 x\right) dx &= \frac{1}{2}\int_0^{\frac{\pi}{4}} \left(1 + \cos^2 2x\right) dx, \qquad \text{using part (i)} \\
&= \frac{1}{2}\int_0^{\frac{\pi}{4}} \left(1 + \frac{1}{2}(1 + \cos 4x)\right) dx \\
&= \frac{1}{2}\int_0^{\frac{\pi}{4}} \left(\frac{3}{2} + \frac{1}{2}\cos 4x\right) dx \\
&= \frac{1}{2}\left[\frac{3x}{2} + \frac{1}{2}\cdot\frac{\sin 4x}{4}\right]_0^{\frac{\pi}{4}} \\
&= \left[\frac{3x}{4} + \frac{1}{16}\sin 4x\right]_0^{\frac{\pi}{4}} \\
&= \left(\frac{3}{4}\left(\frac{\pi}{4}\right) + \frac{1}{16}\sin \pi\right) - (0 + 0) \\
&= \frac{3\pi}{16} + 0 \\
&= \frac{3\pi}{16}
\end{aligned}$$

Question 13 (c)

Criteria	Marks
• Provides correct solution	4
• Obtains both k and p in terms of the components of $\underset{\sim}{x}$, or equivalent merit	3
• Obtains k or p in terms of the components of $\underset{\sim}{x}$, or equivalent merit	2
• Writes $\dfrac{\underset{\sim}{a} \cdot \underset{\sim}{x}}{\underset{\sim}{a} \cdot \underset{\sim}{a}} \underset{\sim}{a}$ or $\dfrac{\underset{\sim}{b} \cdot \underset{\sim}{x}}{\underset{\sim}{b} \cdot \underset{\sim}{b}} \underset{\sim}{b}$, or equivalent merit	1

Sample answer:

Let $\underset{\sim}{x} = \begin{pmatrix} u \\ v \end{pmatrix}$

Then $k\underset{\sim}{a} = \dfrac{\underset{\sim}{a} \cdot \underset{\sim}{x}}{\underset{\sim}{a} \cdot \underset{\sim}{a}} \underset{\sim}{a}$

So $k = \dfrac{\underset{\sim}{a} \cdot \underset{\sim}{x}}{\underset{\sim}{a} \cdot \underset{\sim}{a}} = \dfrac{u + 3v}{10}$

$u + 3v = 10k$

Also $p\underset{\sim}{b} = \dfrac{\underset{\sim}{b} \cdot \underset{\sim}{x}}{\underset{\sim}{b} \cdot \underset{\sim}{b}} \underset{\sim}{b}$

So $p = \dfrac{\underset{\sim}{b} \cdot \underset{\sim}{x}}{\underset{\sim}{b} \cdot \underset{\sim}{b}} = \dfrac{2u - v}{5}$

$2u - v = 5p$

Solving $u + 3v = 10k$ ①

$2u - v = 5p$ ②

$3 \times$ ② $6u - 3v = 15p$

① $+ 3 \times$ ② $7u = 10k + 15p$

$$u = \frac{10k + 15p}{7}$$

$$\begin{aligned} v &= -5p + 2u \\ &= -5p + \frac{20k + 30p}{7} \\ &= \frac{20k - 5p}{7} \end{aligned}$$

$$\underset{\sim}{x} = \begin{pmatrix} \dfrac{10k + 15p}{7} \\ \dfrac{20k - 5p}{7} \end{pmatrix} = \frac{5}{7}\begin{pmatrix} 2k + 3p \\ 4k - p \end{pmatrix}$$

Question 13 (d)

Criteria	Marks
• Provides correct solution	3
• Changes the integrand into an appropriate form using algebra, or equivalent merit	2
• Obtains $\frac{du}{dx} = e^x - 2e^{-x}$, or equivalent merit	1

Sample answer:

$$\int \frac{e^{3x} - 2e^x}{4 + 8e^{2x} + e^{4x}}\,dx$$

Let $u = e^x + 2e^{-x}$

$$u^2 = e^{2x} + 4 + 4e^{-2x}$$

$$\frac{du}{dx} = e^x - 2e^{-x}$$

$$du = \left(e^x - 2e^{-x}\right)dx$$

$$4 + 8e^{2x} + e^{4x} = e^{2x}\left(4e^{-2x} + 8 + e^{2x}\right)$$

$$= e^{2x}\left(4e^{-2x} + 4 + e^{2x}\right) + 4e^{2x}$$

$$\int \frac{e^{3x} - 2e^x}{4 + 8e^{2x} + e^{4x}}\,dx = \int \frac{e^{2x}\left(e^x - 2e^{-x}\right)}{e^{2x}\left(4e^{-2x} + 4 + e^{2x}\right) + 4e^{2x}}\,dx$$

$$= \int \frac{\left(e^x - 2e^{-x}\right)dx}{\left(4e^{-2x} + 4 + e^{2x}\right) + 4}$$

$$= \int \frac{du}{u^2 + 4}$$

$$= \frac{1}{2}\tan^{-1}\frac{u}{2} + C$$

$$= \frac{1}{2}\tan^{-1}\left(\frac{e^x + 2e^{-x}}{2}\right) + C$$

Question 14 (a)

Criteria	Marks
• Provides correct solution	4
• Obtains correct domain or range, or equivalent merit	3
• Integrates to obtain relation with constant evaluated, or equivalent merit	2
• Separates the variables, or equivalent merit	1

Sample answer:

$$\frac{dy}{dx} = e^{x+y} = e^x e^y$$

$$\int e^{-y}\,dy = \int e^x\,dx$$

$$-e^{-y} = e^x + k$$

$y = 0,\ x = 0$

$$-1 = 1 + k$$

$$k = -2$$

$$-e^{-y} = e^x - 2$$

$$e^{-y} = 2 - e^x$$

$$-y = \ln\left(2 - e^x\right)$$

$$y = -\ln\left(2 - e^x\right)$$

$$e^x < 2$$

$$x < \ln 2$$

Domain is $(-\infty, \ln 2)$

To find the range:

$x \longrightarrow -\infty$

$e^x \longrightarrow 0$

$y \longrightarrow -\ln 2$

$x \longrightarrow \ln 2$

$e^x \longrightarrow 2$

$\ln\left(2 - e^x\right) \longrightarrow -\infty$

$y \longrightarrow \infty$

and $\dfrac{dy}{dx} = e^{x+y} > 0$ so graph is increasing

Range is $(-\ln 2, \infty)$

Question 14 (b)

Criteria	Marks
• Provides correct solution	3
• Correctly completes one of two cases, or equivalent merit	2
• Recognises that $f(x)$ needs to be monotonically increasing or monotonically decreasing, or equivalent merit	1

Sample answer:

As $f(x)$ is defined and differentiable for all reals, it will have an inverse if $f'(x) \geq 0$ always or $f'(x) \leq 0$ always.

$$f'(x) = \frac{k\left(1+x^2\right) - kx(2x)}{\left(1+x^2\right)^2} + \frac{1}{1+x^2}$$

$$= \frac{(k+1) - kx^2 + x^2}{\left(1+x^2\right)^2}$$

$$= \frac{(k+1) + (1-k)x^2}{\left(1+x^2\right)^2} \quad \left(\text{and } \left(1+x^2\right)^2 \text{ is positive}\right)$$

Case 1: $f'(x) \geq 0$

$(k+1) + (1-k)x^2$ will always be greater or equal to zero if and only if $(1-k) \geq 0$ and $(k+1) \geq 0$.

$\therefore \quad k \leq 1$ and $k \geq -1$

ie $\quad -1 \leq k \leq 1$

Case 2: $f'(x) \leq 0$

$(k+1) + (1-k)x^2$ will always be less than or equal to zero if and only if $(1-k) \leq 0$ and $(k+1) \leq 0$.

$\therefore \quad k \geq 1$ and $k \leq -1$

ie no solution

Hence, if $-1 \leq k \leq 1$, then $f'(x)$ is increasing and so has an inverse.

Question 14 (c) (i)

Criteria	Marks
• Provides correct explanation	1

Sample answer:

The graphs of $\tan^{-1}(3x)$ and $\tan^{-1}(10x)$ are $y = \tan^{-1}(x)$ shrunk horizontally.

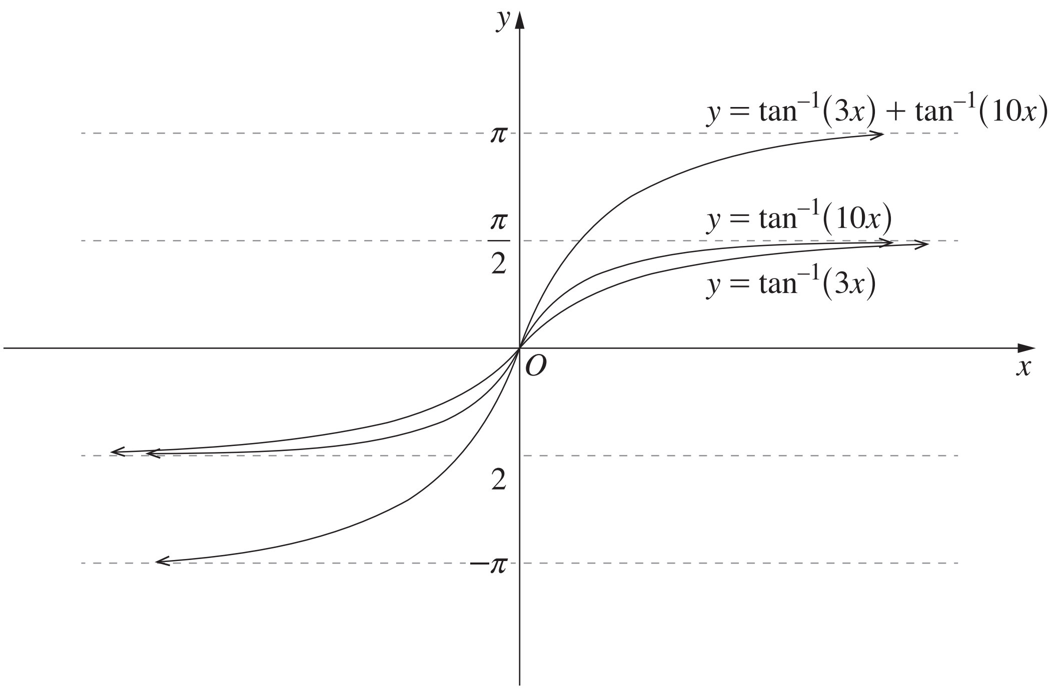
Both are increasing functions with a range $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$.

Adding gives an increasing function, considering large values of x shows the range of $\tan^{-1}(3x) + \tan^{-1}(10x)$ is $(-\pi, \pi)$.

For $-\pi < \theta < \pi$ the line $y = \theta$ will cross the graph of $y = \tan^{-1}(3x) + \tan^{-1}(10x)$ at exactly one point.

So, $\tan^{-1}(3x) + \tan^{-1}(10x) = \theta$ has exactly one solution.

Answers could include:



Question 14 (c) (ii)

Criteria	Marks
• Provides correct solution	2
• Obtains correct quadratic equation for x, or equivalent merit	1

Sample answer:

$$\tan^{-1}(3x) + \tan^{-1}(10x) = \frac{3\pi}{4}$$

$$\tan\left(\tan^{-1}(3x) + \tan^{-1}(10x)\right) = \tan\frac{3\pi}{4}$$

$$\frac{\tan\left(\tan^{-1}(3x)\right) + \tan\left(\tan^{-1}(10x)\right)}{1 - \tan\left(\tan^{-1}(3x)\right)\tan\left(\tan^{-1}(10x)\right)} = -1$$

$$\frac{3x + 10x}{1 - (3x)(10x)} = -1$$

$$13x = -1 + 30x^2$$

$$30x^2 - 13x - 1 = 0$$

$$(2x - 1)(15x + 1) = 0$$

$$x = \frac{1}{2}, \quad -\frac{1}{15}$$

When $x = \frac{1}{2}$, $\tan^{-1}\left(\frac{3}{2}\right) + \tan^{-1}(5) > 0$

When $x = -\frac{1}{15}$, $\tan^{-1}\left(-\frac{3}{15}\right) + \tan^{-1}\left(-\frac{10}{15}\right) < 0$

The only solution is $x = \frac{1}{2}$.

Question 14 (d)

Criteria	Marks
• Provides correct proof	4
• Explains why $\Delta < 0$ for their correct quadratic, or equivalent merit	3
• Obtains correct derivative of $\left[D(t)\right]^2$ or $D(t)$, or equivalent merit	2
• Obtains $\lvert D(t) \rvert$ or $\lvert D(t) \rvert^2$, or equivalent merit	1

Sample answer:

$$D^2 = V^2t^2\cos^2\theta + V^2t^2\sin^2\theta - Vgt^3\sin\theta + \frac{g^2t^4}{4}$$

$$= V^2t^2 - Vgt^3\sin\theta + \frac{g^2t^4}{4}$$

$$\frac{d\left(D^2\right)}{dt} = 2V^2t - 3Vgt^2\sin\theta + g^2t^3$$

$$= t\left(2V^2 - 3Vgt\sin\theta + g^2t^2\right)$$

$D(t)$ is increasing for all $t > 0$ when $\dfrac{d\left(D^2\right)}{dt} > 0$.

When $\Delta < 0$

$$9V^2g^2\sin^2\theta - 4 \times g^2 \times 2V^2 < 0$$

$$9V^2g^2\sin^2\theta - 8V^2g^2 < 0$$

As $V^2, g^2 \neq 0$ $\qquad 9\sin^2\theta - 8 < 0$

$$\sin^2\theta < \frac{8}{9}$$

For $0 \leq \theta \leq \frac{\pi}{2}, \sin\theta > 0$ $\qquad \therefore \sin\theta < \sqrt{\frac{8}{9}}$

$$\therefore \theta < \sin^{-1}\left(\sqrt{\frac{8}{9}}\right)$$

2024 HSC Mathematics Extension 1 Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	ME-F2 Polynomials	ME11-2
2	1	ME-C2 Further Calculus Skills	ME12-4
3	1	ME-A1 Working with Combinatorics	ME11-5
4	1	ME-T1 Inverse Trigonometric Functions	ME11-1
5	1	ME-T1 Inverse Trigonometric Functions	ME11-1
6	1	ME-F1 Further Work with Functions	ME11-2
7	1	ME-A1 Working with Combinatorics	ME11-5
8	1	ME-S1 The Binomial Distribution	ME12-5
9	1	ME-A1 Working with Combinatorics	ME11-5
10	1	ME-T3 Trigonometric Equations	ME12-3

Section II

Question	Marks	Content	Syllabus outcomes
11 (a) (i)	1	ME-V1 Introduction to Vectors	ME12-2
11 (a) (ii)	1	ME-V1 Introduction to Vectors	ME12-2
11 (b)	2	ME-F1 Further Work with Functions	ME11-2
11 (c)	3	ME-C2 Further Calculus Skills	ME12-1
11 (d)	2	ME-C2 Further Calculus Skills	ME12-1
11 (e)	1	ME-C2 Further Calculus Skills	ME12-1
11 (f)	2	ME-C1 Rates of Change	ME11-4
11 (g)	3	ME-C3 Applications of Calculus	ME12-4
12 (a)	3	ME-V1 Introduction to Vectors	ME12-2
12 (b)	3	ME-C3 Applications of Calculus	ME12-4
12 (c)	3	ME-S1 The Binomial Distribution	ME12-5
12 (d)	3	ME-P1 Proof by Mathematical induction	ME12-1
12 (e)	3	ME-F1 Further Work with Function	ME11-2
13 (a) (i)	1	ME-C3 Applications of Calculus	ME12-4
13 (a) (ii)	1	ME-C3 Applications of Calculus	ME12-4
13 (a) (iii)	2	ME-C3 Applications of Calculus	ME12-4
13 (b) (i)	2	ME-T2 Further Trigonometric Identities	ME11-3
13 (b) (ii)	3	ME-C2 Further Calculus Skills	ME12-4
13 (c)	4	ME-V1 Introduction to Vectors	ME12-2
13 (d)	3	ME-C2 Further Calculus Skills	ME12-7
14 (a)	4	ME-C3 Applications of Calculus	ME12-4
14 (b)	3	ME-C2 Further Calculus Skills	ME12-7

Question	Marks	Content	Syllabus outcomes
14 (c) (i)	1	ME-T1 Inverse Trigonometric Functions ME-T3 Trigonometric Equations	ME11-1, ME12-3
14 (c) (ii)	2	ME-T3 Trigonometric Equations	ME12-3
14 (d)	4	ME-C3 Applications of Calculus ME-V1 Introduction to Vectors	ME12-2, ME12-4