2023 HSC Mathematics Advanced Marking Guidelines

Section I

Multiple-choice Answer Key

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

Section II

Question 11

Criteria	Marks
• Provides correct solution	2
• Finds the common difference, or equivalent merit	1

Sample answer:

$d = 7 - 3 = 4$

$d = 4$
$a = 3$

$$\begin{aligned} t_{15} = a + (15 - 1)d &= 3 + 14 \times 4 \\ &= 59 \end{aligned}$$

Question 12 (a)

Criteria	Marks
• Provides correct solution	1

Sample answer:

$$\begin{aligned} E(X) &= \sum x\, P(x) \\ &= 0 \times 0 + 1 \times 0.3 + 2 \times 0.5 + 3 \times 0.1 + 4 \times 0.1 \\ &= 2 \end{aligned}$$

Question 12 (b)

Criteria	Marks
• Provides correct solution	2
• Attempts to find Var(X), or equivalent merit	1

Sample answer:

$$\begin{aligned} \mathrm{Var}(X) &= E\left(X^2\right) - \mu^2 \\ &= E\left(X^2\right) - [E(X)]^2 \\ &= \sum x^2\, P(x) - 4 \\ &= 0 \times 0 + 1^2 \times 0.3 + 2^2 \times 0.5 + 3^2 \times 0.1 + 4^2 \times 0.1 - 4 \\ &= 0.8 \end{aligned}$$

$$\begin{aligned} \text{Standard deviation} &= \sqrt{0.8} \\ &= 0.8944\ldots \\ &= 0.9 \qquad \text{(to 1 decimal place)} \end{aligned}$$

Question 13

Criteria	Marks
• Provides correct solution	2
• Attempts to find antiderivative, or equivalent merit	1

Sample answer:

$$\frac{dP}{dt} = 3000e^{2t}$$

$$\therefore \quad P = \frac{3000}{2}e^{2t} + C$$

$$= 1500e^{2t} + C$$

When $t = 0$, $P = 4000$

$$\therefore \; 4000 = 1500e^{2\times 0} + C$$

$$\therefore \quad C = 2500$$

So $P(t) = 1500e^{2t} + 2500$

Question 14

Criteria	Marks
• Provides correct solution	3
• Correctly finds slope of tangent, or equivalent merit	2
• Attempts to find the correct derivative, or equivalent merit	1

Sample answer:

$$y = (2x+1)^3$$

$$y' = 3 \times (2x+1)^2 \times 2$$

$$= 6(2x+1)^2$$

When $x = 0$ $y' = 6$

Equation of tangent given by:

$$y - 1 = 6(x - 0)$$
$$y - 1 = 6x$$
$$y = 6x + 1$$

Question 15 (a)

Criteria	Marks
• Provides correct solution	2
• Identifies the correct factor from the table	1

Sample answer:

$$\text{Amount} = \frac{\$450\,000}{13.181}$$

$$= \$34\,140 \qquad \text{(to the nearest dollar)}$$

Question 15 (b)

Criteria	Marks
• Provides correct solution	3
• Provides the correct interest rate and the correct number of periods, or equivalent merit	2
• Multiplies a factor from the table by \$8535, or equivalent merit	1

Sample answer:

$$r = \frac{6}{4}\%$$

$$= 1.5\%$$

$$n = 10 \times 4$$

$$= 40$$

$$\text{Amount} = \$8535 \times 54.268$$

$$= \$463\,177.38$$

Question 16

Criteria	Marks
• Provides correct solution	4
• Calculates the arc length AND the length of line segment *PQ*, or equivalent merit	3
• Calculates the arc length OR the length of line segment *PQ*, or equivalent merit	2
• Attempts to calculate the perimeter of the shape by adding some appropriate portions, or equivalent merit	1

Sample answer:

$$\text{Arc length } PQ = \frac{110}{360} \times 2 \times \pi \times 2.1$$
$$= 4.03171\ldots$$

$$\text{Length } PQ = \sqrt{2.1^2 + 2.1^2 - 2 \times 2.1 \times 2.1 \times \cos 110^\circ}$$
$$= 3.4404\ldots$$

$$\text{Total perimeter} = (3.6 \times 2) + 8.0 + (8.0 - 3.4404) + 4.0317$$
$$= 23.7913$$
$$= 23.8 \text{ m}$$

Question 17

Criteria	Marks
• Provides correct solution	2
• Recognises the integral is of the form $k\int f'(x)[f(x)]^n\,dx$, or equivalent merit	1

Sample answer:

$$\int x\left(x^2+1\right)^{\frac{1}{2}}\,dx$$

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

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

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

Question 18 (a)

Criteria	Marks
• Correctly plots both points on the graph	3
• Calculates $\bar{x}$ and $\bar{y}$, and plots this point on the grid, or equivalent merit	2
• Calculates $\bar{x}$ or $\bar{y}$, or equivalent merit	1

Sample answer:

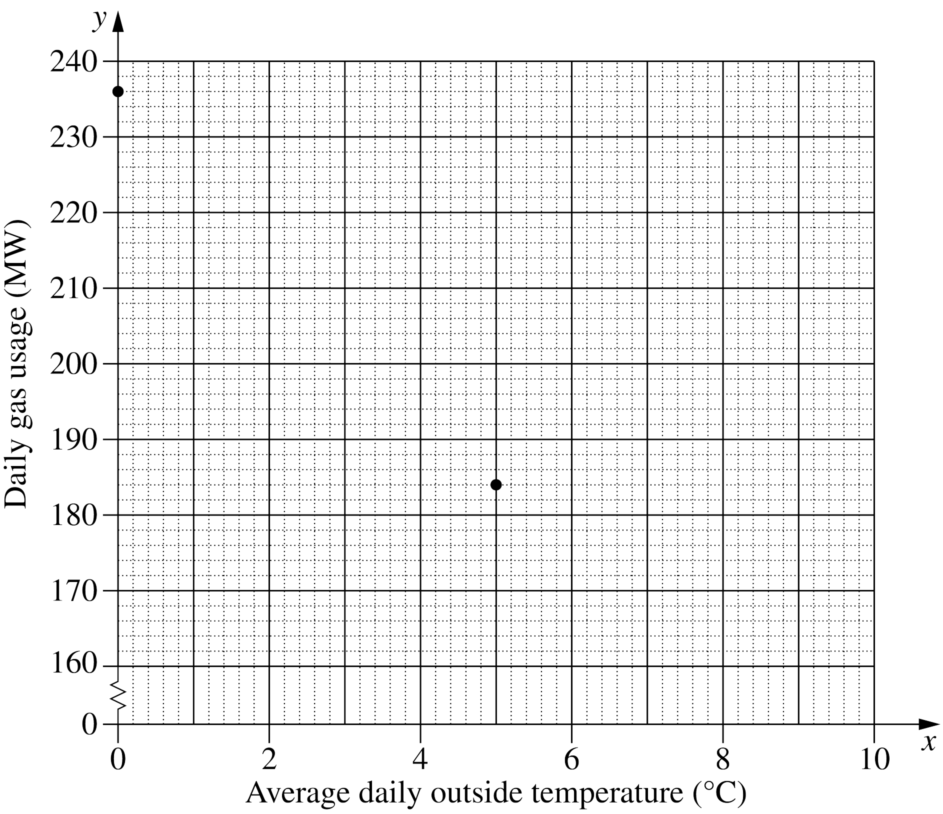
$$\bar{x} = \frac{0+0+0+2+5+7+8+9+9+10}{10}$$

$$= 5$$

$$\bar{y} = \frac{1840}{10}$$

$$= 184$$

$$\therefore \left(\bar{x}, \bar{y}\right) = (5, 184)$$



Question 18 (b)

Criteria	Marks
• Provides correct solution	2
• Finds the slope of the regression line, or equivalent merit	1

Sample answer:

$$\text{Slope of regression line} = \frac{184 - 236}{5}$$

$$= -10.4$$

Gas usage = 236 – 10.4 × temperature

ie $y = 236 - 10.4x$

Question 18 (c)

Criteria	Marks
• Identifies one problem with predicting using the regression line	1

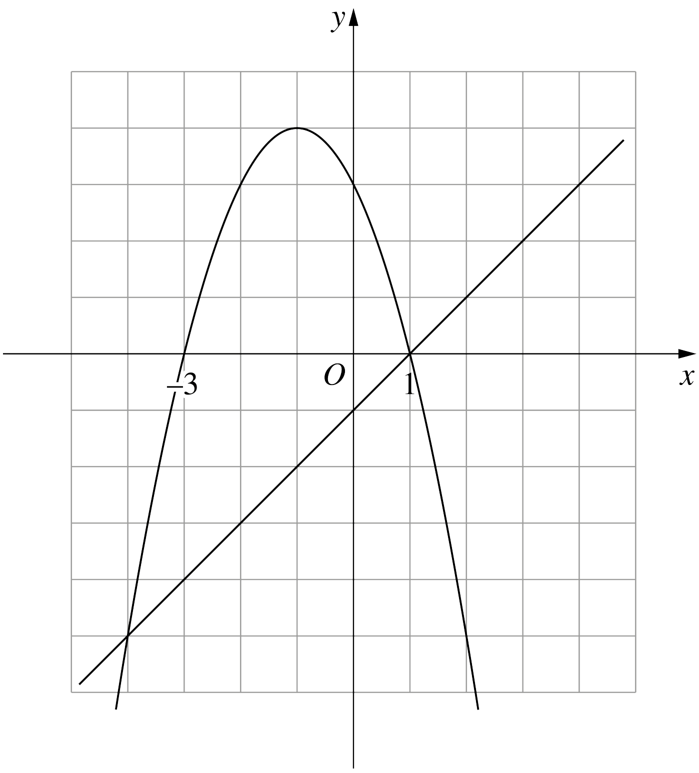
Sample answer:

When temperature is 23°C, the regression equation provides a negative answer, which is not physically possible (negative gas usage).

Question 19 (a)

Criteria	Marks
• Provides correct graphs	2
• Provides a sketch of $f(x)$, or equivalent merit	1

Sample answer:



Question 19 (b)

Criteria	Marks
• Provides correct solution	2
• Finds that the graphs intersect at $x = -4$, or equivalent merit	1

Sample answer:

The graphs meet when
$x - 1 = (1 - x)(3 + x)$

$\therefore \quad x = 1 \quad \text{or} \quad 3 + x = -1$
ie $\quad x = 1 \quad \text{or} \quad x = -4$

From part (a), $-4 < x < 1$.

Question 20

Criteria	Marks
• Provides correct solution	3
• Provides $\theta - 60° = 240°, 300°$, or equivalent merit	2
• Recognises that $\sin 60° = \frac{\sqrt{3}}{2}$	1

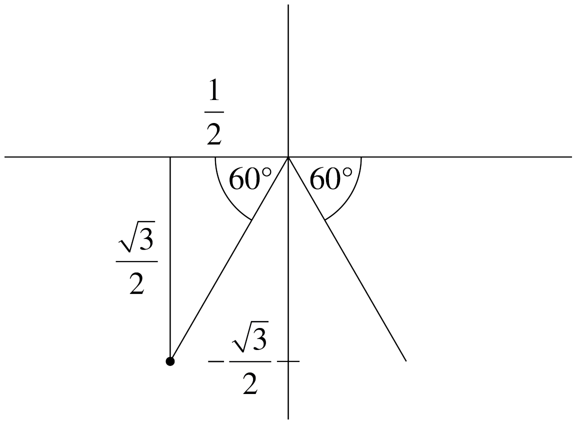
Sample answer:

$$0° \le \theta \le 360°$$
$$-60° \le \theta - 60° \le 300°$$

$$\sin(\theta - 60°) = -\frac{\sqrt{3}}{2}$$

$$\theta - 60° = 240° \text{ or } 300° \text{ or } -60°$$

$$\theta = 300°, 360°, 0°$$



Question 21

Criteria	Marks
• Provides correct solution	3
• Finds r^4, or equivalent merit	2
• Writes $ar^3 = 48$, or equivalent merit	1

Sample answer:

Let a = first term and r = common ratio

Then $ar^3 = 48$ ——— (1)

and $ar^7 = \frac{3}{16}$ ——— (2)

Dividing (2) by (1),

$$\frac{ar^7}{ar^3} = \frac{\frac{3}{16}}{48}$$

$$\therefore r^4 = \frac{1}{256}$$

$$\therefore r = \pm\frac{1}{4}$$

If $r = \frac{1}{4}$ $\quad a\left(\frac{1}{4}\right)^3 = 48$ $\quad \therefore a = 3072$

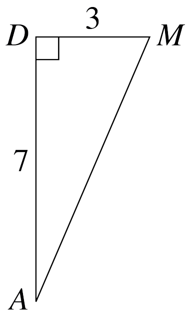
If $r = -\frac{1}{4}$ $\quad a\left(-\frac{1}{4}\right)^3 = 48$ $\quad \therefore a = -3072$

Question 22

Criteria	Marks
• Provides correct solution	3
• Finds the length of *AM*, or equivalent merit	2
• Indicates that triangle *ADM* is useful, or equivalent merit	1

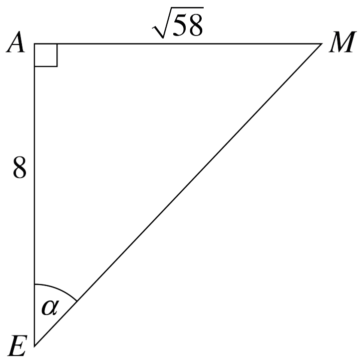
Sample answer:

Find AM



$$\begin{aligned} AM^2 &= 3^2 + 7^2 \\ &= 9 + 49 \\ &= 58 \\ AM &= \sqrt{58} \end{aligned}$$

Triangle AME,



$$\text{So} \quad \tan\alpha = \frac{\sqrt{58}}{8}$$

$$\alpha = 43.59°$$

$$\text{so } \alpha = 44° \qquad \text{(to the nearest degree)}$$

Question 23

Criteria	Marks
• Provides correct solution	4
• Finds the correct proportion of the group of koalas, or equivalent merit	3
• Finds the correct probability from the table, or equivalent merit	2
• Calculates the correct z value, or equivalent merit	1

Sample answer:

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

$$= \frac{11.93-10.40}{1.15}$$

$$= 1.33 \quad \text{(2 decimal places)}$$

$\therefore$ Probability from table = 0.9082

P(more than 11.93) $= 1 - 0.9082$

$= 0.0918$

Number of koalas $= 0.0918 \times 400$

$= 36.72$

$= 36$ (accept 37 as well)

Question 24 (a)

Criteria	Marks
• Provides correct solution	1

Sample answer:

$$50 = (x-2)(y-1)$$

$$\frac{50}{x-2} = y-1$$

So $\quad y = \dfrac{50}{x-2} + 1 \quad$ as required.

Question 24 (b)

Criteria	Marks
• Provides correct solution	4
• Finds $x = 12$, or equivalent merit	3
• Finds A', or equivalent merit	2
• Finds an expression for the Area in terms of x, or equivalent merit	1

Sample answer:

Area of concrete path is $2y + x - 2$

$$A = 2\left(\frac{50}{x-2}+1\right)+x-2$$

$$A = 2\left(\frac{50}{x-2}\right)+2+x-2$$

$$A = \frac{100}{x-2}+x$$

$$= 100(x-2)^{-1}+x$$

$$A' = 100\left(-1(x-2)^{-2}\right)+1$$

$$= \frac{-100}{(x-2)^2}+1$$

$A' = 0$ when $\frac{-100}{(x-2)^2} = -1$

$$100 = (x-2)^2$$

$$\pm 10 = x-2$$

$$x = 12 \text{ or } -8$$

Since x is a distance, discard -8.

Stationary point at $x = 12$.

x	11	12	13
A'	$\frac{-100}{81}+1$	0	$\frac{-100}{121}+1$
	$\searrow$	$-$	$\nearrow$

So there is a minimum turning point at $x = 12$.

The minimum area of the path is when $x = 12$.

Question 25 (a)

Criteria	Marks
• Provides correct solution	1

Sample answer:

$$A_1 = 10\,000(1.004) - M$$

$$A_2 = \left(10\,000(1.004) - M\right)(1.004) - M$$

$$= 10\,000(1.004)^2 - M(1.004) - M \qquad \text{as required.}$$

Question 25 (b)

Criteria	Marks
• Provides correct solution	3
• Provides an expression for A_n involving the sum of a geometric series, or equivalent merit	2
• Finds an expression for A_n using part (a), or equivalent merit	1

Sample answer:

$$A_n = 10\,000(1.004)^n - M\left(1 + 1.004 + \cdots + 1.004^{n-1}\right)$$

$$= 10\,000(1.004)^n - \frac{M\left(1.004^n - 1\right)}{0.004}$$

$$= 10\,000(1.004)^n - \frac{M}{0.004} \times 1.004^n + \frac{M}{0.004}$$

$$= 10\,000(1.004)^n - 250M \times 1.004^n + 250M$$

$$A_n = \left(10\,000 - 250M\right)(1.004)^n + 250M$$

Question 25 (c)

Criteria	Marks
• Provides correct solution	2
• Identifies $A_n > 0$ and $n = 100$, or equivalent merit	1

Sample answer:

$A_{100} > 0$

$$(10\,000 - 250M)(1.004)^{100} + 250M > 0$$

$$10\,000 \times 1.004^{100} - 250M \times 1.004^{100} + 250M > 0$$

$$14\,906.34886 - 250M\left(1.004^{100} - 1\right) > 0$$

$$14\,906.34886 - 250M \times 0.4\,9063 > 0$$

$$14\,906.34886 > 122.6587\ldots M$$

$$\frac{14\,906.34886}{122.6587\ldots} > M$$

$$121.527 > M$$

The largest amount Jia could withdraw is \$121.52.

Question 26 (a)

Criteria	Marks
• Provides correct solution	2
• Finds the antiderivative, or equivalent merit	1

Sample answer:

$$\frac{dx(t)}{dt} = -1.5\pi \sin\left(\frac{5\pi}{4}t\right)$$

$$x(t) = \int -1.5\pi \sin\left(\frac{5\pi}{4}t\right) dt$$

$$= \frac{-1.5\pi}{\frac{5\pi}{4}} \times -\cos\left(\frac{5\pi}{4}t\right) + k$$

When $t = 0$ $x = 11.2$

So $11.2 = 1.2\cos(0) + k$

$11.2 = 1.2 + k$

$k = 10$

$$x(t) = 1.2\cos\left(\frac{5\pi}{4}t\right) + 10$$

Question 26 (b)

Criteria	Marks
• Provides correct solution	2
• Finds the period, or equivalent merit	1

Sample answer:

$$\text{Period} = \frac{2\pi}{\frac{5\pi}{4}} = 1.6$$

$10 \div 1.6 = 6.25$

$\therefore$ Number of complete periods in 10 seconds is 6.

$\therefore$ Reaches closest point to camera 6 times.

Question 27 (a)

Criteria	Marks
• Provides correct solution	3
• Finds the value of *b* and *c*, or equivalent merit	2
• Finds value of *c*, or equivalent merit	1

Sample answer:

$c = 7$ Since the absolute value graph has been shifted by 7 vertically

$b = 6$ Shifted by 6 to the right

Let $x = 3$, $y = -5$

$$f(3) = a|3-6| + 7 = -5$$

$$3a + 7 = -5$$

$$3a = -12$$

$$a = -4$$

$\therefore a = -4, \quad b = 6, \quad c = 7$

Question 27 (b)

Criteria	Marks
• Provides correct solution	2
• Finds that $m < \frac{7}{6}$, or equivalent merit	1

Sample answer:

Line joining (6, 7) with (0, 0) has slope $\frac{7}{6}$

m must be less than $\frac{7}{6}$ to cut the graph in two places.

Slope of right side of graph is -4

m must be greater than -4 or it will only cut graph once

Hence $-4 < m < \frac{7}{6}$.

Question 28

Criteria	Marks
• Provides correct solution	4
• Finds the *x*-coordinate of *R* AND the antiderivative for *y*	3
• Finds the *x*-coordinate of *R* OR the antiderivative for *y*	2
• Attempts to solve $\frac{dy}{dx} = 1$, or equivalent merit	1

Sample answer:

$$\frac{dy}{dx} = 3x^2 - 6x - 8$$

Tangent at $(-1, 6)$ is $y = x + 7$

Slope of tangent is 1.

Solve $\frac{dy}{dx} = 1$ ie

$$\begin{aligned} 3x^2 - 6x - 8 &= 1 \\ 3x^2 - 6x - 9 &= 0 \\ 3(x^2 - 2x - 3) &= 0 \\ 3(x - 3)(x + 1) &= 0 \end{aligned}$$

So x coordinate of R is 3.

When $\frac{dy}{dx} = 3x^2 - 6x - 8$

$y = x^3 - 3x^2 - 8x + k$ and when $x = -1$ $y = 6$.

So

$$\begin{aligned} 6 &= (-1)^3 - 3(-1)^2 - 8(-1) + k \\ 6 &= -1 - 3 + 8 + k \\ 6 - 4 &= k \\ k &= 2 \end{aligned}$$

When $x = 3$

$$\begin{aligned} y &= x^3 - 3x^2 - 8x + 2 \\ &= 27 - 27 - 24 + 2 \\ &= -22 \end{aligned}$$

$\therefore$ Coordinates of R are $(3, -22)$.

Question 29 (a)

Criteria	Marks
• Provides correct solution	2
• Finds the derivative of $f(x)$, or equivalent merit	1

Sample answer:

Mode of X will be when $f(x)$ has a maximum.

$$f(x) = 12x^2 - 12x^3, \qquad 0 \le x \le 1$$

$$\begin{aligned} f'(x) &= 24x - 36x^2 \\ &= 12x(2 - 3x) \end{aligned}$$

$f'(x) = 0$ when $x = 0$ and when $2 - 3x = 0$

$$x = \frac{2}{3}$$

Discard $x = 0$ since $f(0) = 0$ so

the mode of X is $\frac{2}{3}$.

Question 29 (b)

Criteria	Marks
• Provides correct solution	2
• Expresses $F(x)$ as an integral of $f(x)$, or equivalent merit	1

Sample answer:

$$F(x) = \int_0^x 12t^2(1-t)\,dt$$

$$= \int_0^x 12t^2 - 12t^3\,dt$$

$$= \left[4t^3 - 3t^4\right]_0^x$$

$$= 4x^3 - 3x^4$$

Question 29 (c)

Criteria	Marks
• Provides correct solution	2
• Substitutes the mode from part (a) into their cumulative distribution function, or equivalent merit	1

Sample answer:

When $x = \frac{2}{3}$ $\quad 4x^3 - 3x^4 = 4 \times \left(\frac{8}{27}\right) - 3 \times \left(\frac{16}{81}\right)$

$$= 0.59$$

The probability of the variable being less than $\frac{2}{3}$ is greater than 0.5, therefore the mode is greater than the median.

Question 30 (a)

Criteria	Marks
• Provides correct solution	3
• Finds the *x* values of the stationary points, or equivalent merit	2
• Finds correct derivative, or equivalent merit	1

Sample answer:

$$f(x) = e^{-x} \sin x$$

$$f'(x) = e^{-x} \cos x + -e^{-x} \sin x$$
$$= e^{-x}(\cos x - \sin x)$$

$$f'(x) = 0 \quad \text{when} \quad \cos x = \sin x$$
$$x = \frac{\pi}{4} \text{ or } \frac{5\pi}{4}$$
$$\text{so} \quad f(x) = e^{-\frac{\pi}{4}} \sin \frac{\pi}{4} \quad \text{or} \quad e^{-\frac{5\pi}{4}} \sin \frac{5\pi}{4}$$

The two stationary points are

$$\left(\frac{\pi}{4}, \frac{e^{-\frac{\pi}{4}}}{\sqrt{2}} \right) \quad \text{and} \quad \left(\frac{5\pi}{4}, \frac{-e^{-\frac{5\pi}{4}}}{\sqrt{2}} \right)$$

approx. approx.

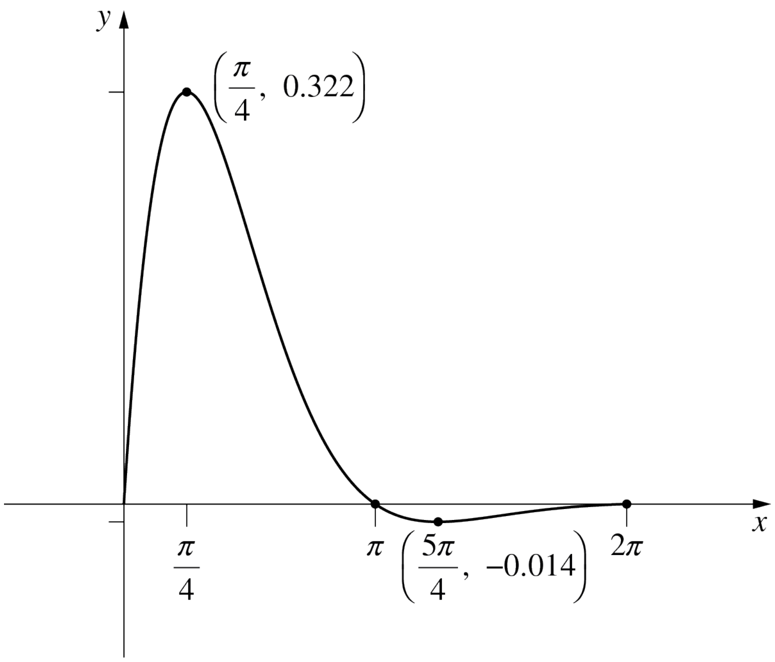
$$\left(\frac{\pi}{4}, 0.322 \right) \quad \text{and} \quad \left(\frac{5\pi}{4}, -0.014 \right)$$

Question 30 (b)

Criteria	Marks
• Provides correct graph	2
• Provides a graph with some correct features, or equivalent merit	1

Sample answer:

$f(x) = 0 \quad \text{when} \quad \sin x = 0 \qquad x = 0,\ \pi,\ 2\pi$



Question 31 (a)

Criteria	Marks
• Provides correct reason	1

Sample answer:

No, since $P(F|S) \neq P(F)$

Question 31 (b)

Criteria	Marks
• Provides correct solution	2
• Attempts to use conditional probability formula, or equivalent merit	1

Sample answer:

$$P(S|F) = \frac{P(S \cap F)}{P(F)}$$

$$\frac{1}{3} = \frac{P(S \cap F)}{\frac{3}{10}}$$

$$P(S \cap F) = \frac{1}{10}$$

$$P(F|S) = \frac{P(S \cap F)}{P(S)}$$

$$\frac{1}{8} = \frac{\frac{1}{10}}{P(S)} \qquad \left(\text{since } P(S \cap F) = P(F \cap S)\right)$$

$$P(S) = \frac{8}{10}$$

$$= \frac{4}{5}$$

Question 31 (c)

Criteria	Marks
• Provides correct answer	2
• Uses expression for complementary events, or equivalent merit	1

Sample answer:

$$1-\left(\frac{4}{5}\right)^4 \quad = \quad 1-\frac{256}{625} \quad = \quad \frac{369}{625} \quad = \quad 0.5904$$

Question 32 (a)

Criteria	Marks
• Provides correct solution	3
• Provides an antiderivative, or equivalent merit	2
• Provides an integral expression for the area, or equivalent merit	1

Sample answer:

$$\text{Shaded area} = \int_0^{\ln 2} e^{-2x} - \left(e^{-x} - \frac{1}{4}\right) dx$$

$$= \int_0^{\ln 2} e^{-2x} - e^{-x} + \frac{1}{4}\, dx$$

$$= \left[-\frac{1}{2}e^{-2x} + e^{-x} + \frac{1}{4}x\right]_0^{\ln 2}$$

$$= \left(-\frac{1}{2}e^{-2\ln 2} + e^{-\ln 2} + \frac{1}{4}\ln 2\right) - \left(-\frac{1}{2} + 1 + 0\right)$$

$$= -\frac{1}{2}e^{\ln\left(2^{-2}\right)} + e^{\ln\left(2^{-1}\right)} + \frac{1}{4}\ln 2 - \frac{1}{2}$$

$$= -\frac{1}{2} \times \frac{1}{4} + \frac{1}{2} + \frac{1}{4}\ln 2 - \frac{1}{2}$$

$$= \frac{1}{4}\ln 2 - \frac{1}{8}$$

Question 32 (b)

Criteria	Marks
• Provides correct solution	3
• Uses the discriminant to find $k > -\frac{1}{4}$, or equivalent merit	2
• Attempts to form a quadratic equation, or equivalent merit	1

Sample answer:

We want the equation $e^{-2x} = e^{-x} + k$ to have 2 solutions.

ie $e^{-2x} - e^{-x} - k = 0$ has 2 solutions
ie $\left(e^{-x}\right)^2 - \left(e^{-x}\right) - k = 0$ has 2 solutions

Using the quadratic formula,

$$e^{-x} = \frac{1 \pm \sqrt{1+4k}}{2}$$

For two real solutions we want $1 + 4k > 0$, ie $k > -\frac{1}{4}$

But for two solutions for e^{-x}, both the real solutions to the quadratic must be positive.

$\therefore \quad \sqrt{1+4k} < 1$

$\therefore \quad 1 + 4k < 1$

$\therefore \quad k < 0$

Hence $-\frac{1}{4} < k < 0$.

2023 HSC Mathematics Advanced Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	MA-S2 Descriptive Statistics and Bivariate Data Analysis	MA12-8
2	1	MA-S1 Probability and Discrete Probability Distributions	MA11-7
3	1	MA-F1 Working with Functions	MA11-1
4	1	MA-F1 Working with Functions	MA11-1
5	1	MA-C4 Integral Calculus	MA12-7
6	1	MA-C3 Applications of Differentiation	MA12-6
7	1	MA-C2 Differential Calculus	MA12-6
8	1	MA-E1 Logarithms and Exponentials	MA11-6
9	1	MA-F1 Working with Functions	MA11-2
10	1	MA-F2 Graphing Techniques	MA12-1

Section II

Question	Marks	Content	Syllabus outcomes
11	2	MA- M1 Modelling Financial Situations	MA12-6
12 (a)	1	MA-S1 Probability and Discrete Probability Distributions	MA11-7
12 (b)	2	MA-S1 Probability and Discrete Probability Distributions	MA11-7
13	2	MA-C4 Integral Calculus	MA12-7
14	3	MA-C2 Differential Calculus	MA12-6
15 (a)	2	MA-M1 Modelling Financial Situations	MA12-2
15 (b)	3	MA-M1 Modelling Financial Situations	MA12-2
16	4	MA-T1 Trigonometry and Measure of Angles	MA11-3
17	2	MA-C4 Integral Calculus	MA12-7
18 (a)	3	MA-S2 Descriptive Statistics and Bivariate Data Analysis	MA12-8
18 (b)	2	MA-S2 Descriptive Statistics and Bivariate Data Analysis	MA12-8
18 (c)	1	MA-S2 Descriptive Statistics and Bivariate Data Analysis	MA12-10
19 (a)	2	MA-F2 Graphing Techniques	MA12-1
19 (b)	2	MA-F2 Graphing Techniques	MA12-1, MA12-10
20	3	MA-T2 Trigonometric Functions and Identities	MA11-1
21	3	MA-M1 Modelling Financial Situations	MA12-4
22	3	MA- T1 Trigonometry and Measure of Angles	MA11-3
23	4	MA-S3 Random Variables	MA12-8
24 (a)	1	MA-F1 Working with Functions	MA11-2
24 (b)	4	MA-C3 Applications of Differentiation	MA12-3, MA12-10
25 (a)	1	MA-M1 Modelling Financial Situations	MA12-10
25 (b)	3	MA-M1 Modelling Financial Situations	MA12-4
25 (c)	2	MA-M1 Modelling Financial Situations	MA12-2

Question	Marks	Content	Syllabus outcomes
26 (a)	2	MA-C4 Integral Calculus	MA12-3
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27 (a)	3	MA-F2 Graphing Techniques	MA12-1
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