BOSTES | BOARD OF STUDIES TEACHING & EDUCATIONAL STANDARDS NSW

2014 HSC Mathematics Marking Guidelines

Section I

Multiple-choice Answer Key

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

Section II

Question 11 (a)

Criteria	Marks
• Provides a correct answer	2
• Attempts to use $\sqrt{5}+2$, or equivalent merit	1

Sample answer:

$$\begin{aligned}\frac{1}{\sqrt{5}-2} &= \frac{\sqrt{5}+2}{\left(\sqrt{5}-2\right)\left(\sqrt{5}+2\right)} \\ &= \frac{\sqrt{5}+2}{5-4} \\ &= \sqrt{5}+2\end{aligned}$$

Question 11 (b)

Criteria	Marks
• Provides a correct answer	2
• Finds product of the form $\left(3x+a\right)\left(x+b\right)$, or equivalent merit	1

Sample answer:

$$3x^2+x-2=\left(3x-2\right)\left(x+1\right)$$

Question 11 (c)

Criteria	Marks
• Finds correct derivative	2
• Attempts to use quotient rule, or equivalent merit	1

Sample answer:

$$y=\frac{x^3}{x+1}$$

$$\frac{dy}{dx}=\frac{3x^2(x+1)-x^3}{(x+1)^2}=\frac{(2x+3)x^2}{(x+1)^2}$$

Question 11 (d)

Criteria	Marks
• Finds correct primitive	2
• Writes integral in the form $\int (x+3)^{-2}\,dx$, or equivalent merit	1

Sample answer:

$$\int \frac{1}{(x+3)^2}\,dx = \int (x+3)^{-2}\,dx$$

$$= -(x+3)^{-1} + C$$

Question 11 (e)

Criteria	Marks
• Provides a correct solution	3
• Finds a correct primitive	2
• Finds a primitive of the form $a\cos\frac{x}{2}$, or equivalent merit	1

Sample answer:

$$\int_0^{\frac{\pi}{2}} \sin\frac{x}{2}\,dx = \left[-2\cos\frac{x}{2}\right]_0^{\frac{\pi}{2}}$$

$$= -2\cos\frac{\pi}{4} + 2\cos 0$$

$$= -\sqrt{2} + 2$$

$$= 2 - \sqrt{2}$$

Question 11 (f)

Criteria	Marks
• Finds the correct equation for the curve	2
• Finds a correct primitive for $4x - 5$, or equivalent merit	1

Sample answer:

$f'(x) = 4x - 5$

$f(x) = 2x^2 - 5x + C$

$3 = f(2) = 8 - 10 + C$ (using that the curve passes through (2,3))

$\therefore C = 5$

$f(x) = 2x^2 - 5x + 5$

Question 11 (g)

Criteria	Marks
• Finds the correct perimeter	2
• Finds the length of the circular arc, or equivalent merit	1

Sample answer:

Arc length:

$$l = r\theta$$

$$= 8 \times \frac{\pi}{7} = \frac{8\pi}{7}$$

$$\text{Perimeter} = \left(8 + 8 + \frac{8\pi}{7}\right) \text{cm}$$

$$= \left(16 + \frac{8\pi}{7}\right) \text{cm}$$

Question 12 (a)

Criteria	Marks
• Finds the correct value	2
• Finds the number of terms in the series, or equivalent merit	1

Sample answer:

$$2+5+8+\cdots+1094$$
$$T_n = 2+3(n-1)$$
$$1094 = 2+3(n-1)$$
$$1092 = 3(n-1)$$
$$n = 364+1 = 365$$
$$S_n = \frac{n}{2}(a+l)$$
$$S_{365} = \frac{365}{2}(2+1094)$$
$$= 200020$$

Question 12 (b) (i)

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

Sample answer:

$$\frac{y-4}{x-0} = \frac{1-4}{6-0}$$
$$6y-24 = -3x$$
$$3x+6y-24 = 0$$
$$x+2y-8 = 0$$

Question 12 (b) (ii)

Criteria	Marks
• Provides a correct solution	2
• Attempts to use an appropriate formula, or equivalent merit	1

Sample answer:

$$\text{Perpendicular distance } = \left|\frac{ax_1 + by_1 + c}{\sqrt{a^2 + b^2}}\right|$$

$$\begin{aligned}\text{perpendicular distance } &= \frac{|3 + 2 \times 0 - 8|}{\sqrt{1^2 + 2^2}} \\ &= \frac{5}{\sqrt{5}} \\ &= \sqrt{5}\end{aligned}$$

Question 12 (b) (iii)

Criteria	Marks
• Finds the correct area	2
• Finds the length of AC, or equivalent merit	1

Sample answer:

$$\text{Area} = \frac{1}{2}\text{base} \times \text{height}$$

$$\begin{aligned}\text{base} = AC &= \sqrt{(6-0)^2 + (1-4)^2} \\ &= \sqrt{36 + 9} \\ &= \sqrt{45} \\ &= 3\sqrt{5}\end{aligned}$$

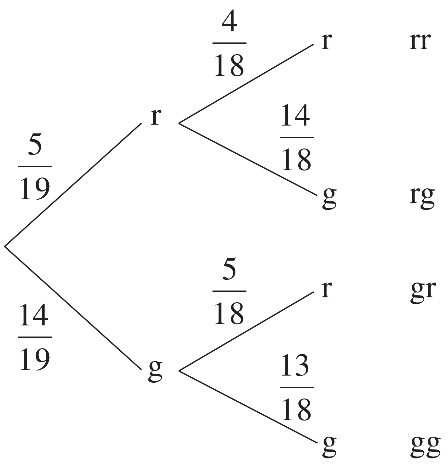
Height is $\sqrt{5}$ (from part (ii))

$$\begin{aligned}\text{Area} &= \frac{1}{2} \times 3\sqrt{5} \times \sqrt{5} \\ &= \frac{15}{2}\end{aligned}$$

Question 12 (c) (i)

Criteria	Marks
• Draws a correct diagram, including probability on each branch	2
• Draws a correct tree diagram	1

Sample answer:



Question 12 (c) (ii)

Criteria	Marks
• Finds the correct probability	1

Sample answer:

$$P(rg) + P(gr) = \frac{5}{19} \cdot \frac{14}{18} + \frac{14}{19} \cdot \frac{5}{18}$$
$$= \frac{70}{171}$$

Question 12 (d) (i)

Criteria	Marks
• Finds the correct x–coordinate	1

Sample answer:

y values are equal at A

$$2x = -2x^2 + 8x$$
$$2x^2 - 6x = 0$$
$$2x(x-3) = 0$$
$$x = 0 \text{ or } x = 3$$

The x coordinate of point A is 3 (since $x = 0$ corresponds to point *0*).

Question 12 (d) (ii)

Criteria	Marks
• Finds the correct area	3
• Finds a correct expression for the area, and attempts to evaluate it	2
• Attempts to express the area as a difference, or equivalent merit	1

Sample answer:

Area is below the parabola but above line, so

$$\text{Area} = \int_0^3 \left(-2x^2 + 8x\right) - 2x\, dx$$
$$= \int_0^3 -2x^2 + 6x\, dx$$
$$= \left[\frac{-2x^3}{3} + 3x^2\right]_0^3$$
$$= -18 + 27$$
$$= 9 \text{ units}^2$$

Question 13 (a) (i)

Criteria	Marks
• Finds the correct derivative	1

Sample answer:

$$y = 3 + \sin 2x$$

$$\frac{dy}{dx} = 2\cos 2x$$

Question 13 (a) (ii)

Criteria	Marks
• Finds a correct primitive	2
• Finds a primitive of the form $a \log f(x)$, or equivalent merit	1

Sample answer:

$$\int \frac{\cos 2x}{3 + \sin 2x}\, dx = \frac{1}{2}\int \frac{2\cos 2x}{3 + \sin 2x}\, dx$$

This is of the form $\frac{f'(x)}{f(x)}$ with $f(x) = 3 + \sin 2x$.

Hence, $\int \frac{\cos 2x}{3 + \sin 2x}\, dx = \frac{1}{2}\ln\left(3 + 2\sin x\right) + c.$

Question 13 (b) (i)

Criteria	Marks
• Provides a correct solution	1

Sample answer:

$$M = Ae^{-kt}$$

$$\frac{dM}{dt} = -kAe^{-kt}$$

$$= -kM$$

Question 13 (b) (ii)

Criteria	Marks
• Provides a correct solution	3
• Finds the value of k, or equivalent merit	2
• Finds the value of A, or equivalent merit	1

Sample answer:

When $t = 0, \quad M = 20$

$$20 = Ae^{-k0} = A$$

$$\therefore M = 20e^{-kt}$$

When $t = 300, \quad M = 10$

$$10 = 20e^{-300k}$$

$$\frac{1}{2} = e^{-300k}$$

$$-300k = \log\frac{1}{2} = -\log 2$$

$$k = \frac{\log 2}{300}$$

When $t = 1000$

$$M = 20e^{-1000k}$$

$$= 20e^{-\frac{10}{3}\log 2}$$

$$= 1.984\ldots$$

$\therefore$ The amount remaining after 1000 years is approximately 1.98 kg

Question 13 (c) (i)

Criteria	Marks
• Provides a correct solution	2
• Finds $\frac{dx}{dt}$, or equivalent merit	1

Sample answer:

$$v = \frac{dx}{dt} = 1 + \frac{1}{(1+t)^2}$$

$$a = \frac{d^2x}{dt^2} = -\frac{2}{(1+t)^3}$$

$$< 0 \text{ as } (1+t)^3 > 0 \text{ for } t \geq 0.$$

Question 13 (c) (ii)

Criteria	Marks
• Finds the correct value	1

Sample answer:

$$\lim_{t \to \infty} \left(1 + \frac{1}{(1+t)^2} \right)$$

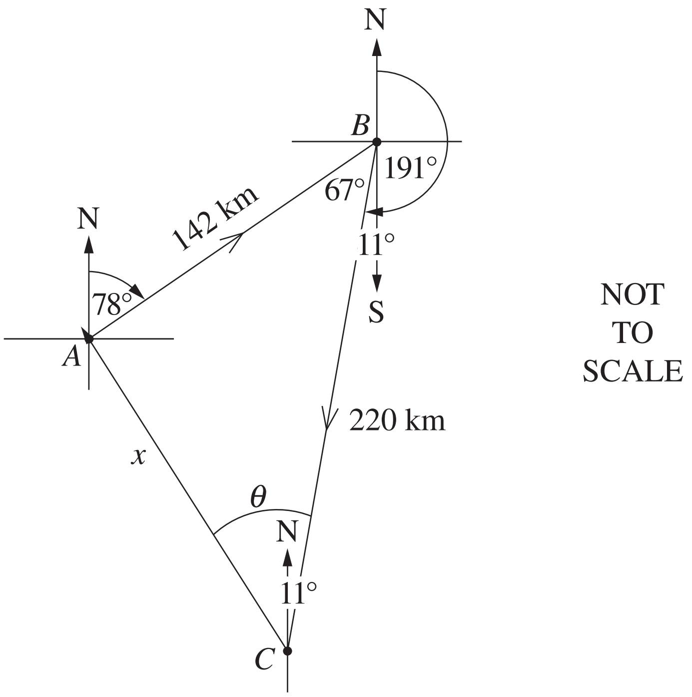
$$= 1 \text{ since } \frac{1}{(1+t)^2} \to 0 \text{ as } t \to \infty$$

velocity $\to 1$ as t becomes large.

Question 13 (d) (i)

Criteria	Marks
• Provides a correct solution	2
• Attempts to apply the cosine rule, or equivalent merit	1

Sample answer:



$\angle ABS = 78°$(parallel lines, alternate angles are equal)

$\angle SBC = 191° - 180° = 11°$

$\therefore \angle ABC = 78° - 11° = 67°$

Using Cosine rule,

$$AC^2 = 142^2 + 220^2 - 2 \times 142 \times 220 \times \cos 67°$$
$$= 44151.119\cdots$$
$$\therefore AC = \sqrt{44151.19}\cdots$$
$$= 210.121\cdots$$
$$= 210 \text{ km (approximately)}$$

Question 13 (d) (ii)

Criteria	Marks
• Finds the correct bearing	3
• Finds angle $\angle ACB$ or $\angle CAB$, or equivalent merit	2
• Attempts to use the sine or cosine rule to find $\angle ACB$ or $\angle CAB$, or equivalent merit	1

Sample answer:

Using Sine Rule,

$$\frac{\sin 67^\circ}{AC} = \frac{\sin\theta}{142}$$

$$\sin\theta = \frac{\sin 67^\circ \times 142}{210.12\cdots}$$

$$= 0.6220\cdots$$

$$\therefore\ \theta = \sin^{-1}\left(0.622\cdots\right)$$

$$= 38^\circ 28'$$

$$\angle NCB = 11^\circ \text{ (parallel lines, alternate to } \angle SBC)$$

$$\therefore \angle NCA = 38^\circ 28' - 11$$

$$= 27^\circ 28'$$

$$\therefore \text{Bearing} = 360^\circ - 27^\circ 28'$$

$$= 332^\circ 32'$$

$$\approx 333^\circ$$

Question 14 (a)

Criteria	Marks
• Provides a correct solution	3
• Finds the coordinates of the stationary point, or equivalent merit	2
• Finds the correct derivative, or equivalent merit	1

Sample answer:

$$y = e^x - ex$$

$$\frac{dy}{dx} = e^x - e$$

At stationary point $\frac{dy}{dx} = 0$

$$0 = e^x - e$$

$$e^x = e$$

$$x = 1$$

$$y = e - e \times 1 = 0$$

$(1,0)$ is stationary point.

Determine nature:

$$\frac{d^2y}{dx^2} = e^x$$

at $x = 1$, $\frac{d^2y}{dx^2} = e > 0 \qquad (cu)$

So (1,0) is a minimum stationary point.

Question 14 (b) (i)

Criteria	Marks
• Provides the correct answer	1

Sample answer:

$$\alpha + \beta = \frac{-8}{2} = -4$$

Question 14 (b) (ii)

Criteria	Marks
• Provides a correct solution	2
• Finds the value of $\alpha\beta$, or equivalent merit	1

Sample answer:

$$\begin{aligned} 6 &= \alpha^2\beta + \alpha\beta^2 \\ &= \alpha\beta(\alpha + \beta) \\ &= \alpha\beta(-4) \end{aligned}$$

$$\alpha\beta = \frac{-3}{2}$$

But, $\alpha\beta = \dfrac{k}{2}$

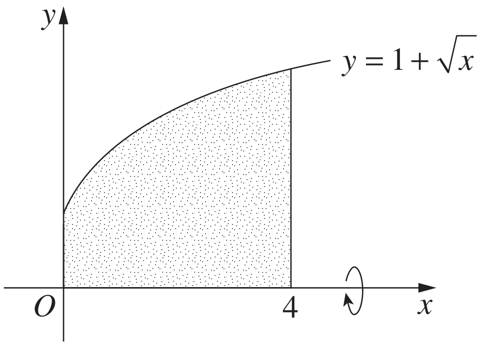
$\therefore \quad \dfrac{k}{2} = -\dfrac{3}{2}$

$k = -3$

Question 14 (c)

Criteria	Marks
• Provides a correct solution	3
• Writes the volume as an integral, and attempts to find a primitive, or equivalent merit	2
• Attempts to finds an integral for the volume, or equivalent merit	1

Sample answer:



$$V = \pi \int_0^4 y^2 \, dx$$

$$= \pi \int_0^4 \left(1 + \sqrt{x}\right)^2 dx$$

$$= \pi \int_0^4 \left(1 + 2\sqrt{x} + x\right) dx$$

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

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

$$= \pi \times \frac{68}{3}$$

$$\text{Volume} = \frac{68\pi}{3} \text{ unit}^3$$

Question 14 (d) (i)

Criteria	Marks
• Provides the correct answer	1

Sample answer:

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

Question 14 (d) (ii)

Criteria	Marks
• Provides a correct solution	2
• Recognises a geometric series, or equivalent merit	1

Sample answer:

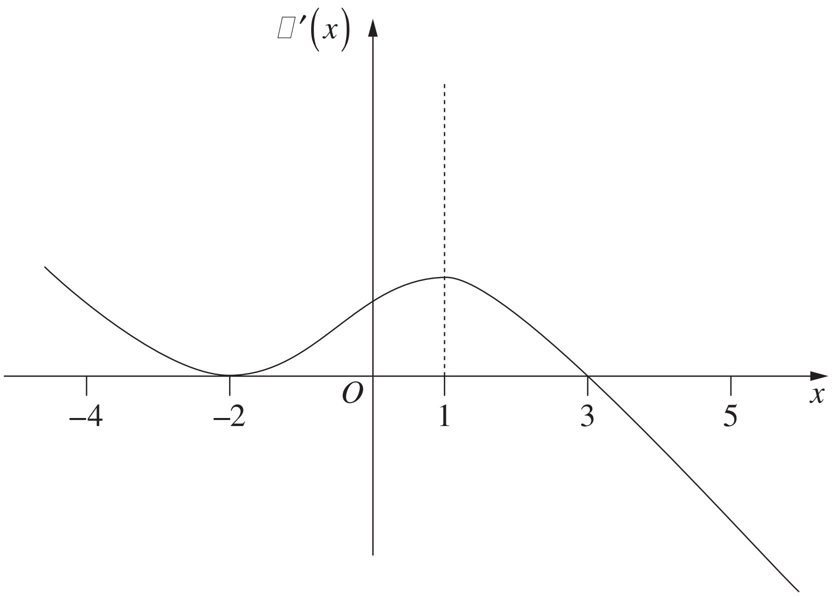
Amount remaining after many doses is $10 + \frac{10}{3} + 10\left(\frac{1}{3}\right)^2 + \cdots$

Limiting sum is $\frac{10}{1 - \frac{1}{3}} = 15$. Amount in body is no more than 15 mL.

Question 14 (e)

Criteria	Marks
• Correctly sketches the graph	3
• Sketches graph of the derivative correct at $x = 3$ and $x = -2$, or equivalent merit	2
• Sketches a graph of the derivative correct at $x = 3$, or equivalent merit	1

Sample answer:



Question 15 (a)

Criteria	Marks
• Provides a correct solution	3
• Finds two correct solutions of the equation	2
• Obtains a quadratic in cos *x*, or equivalent merit	1

Sample answer:

$$2\sin^2 x + \cos x - 2 = 0$$
$$2\left(1 - \cos^2 x\right) + \cos x - 2 = 0$$
$$-2\cos^2 x + \cos x = 0$$
$$\cos x\left(1 - 2\cos x\right) = 0$$

$\cos x = 0$ or $1 - 2\cos x = 0$

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

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

$x = \frac{\pi}{3}$ or $\frac{5\pi}{3}$

Solutions are $\frac{\pi}{2}, \frac{3\pi}{2}, \frac{\pi}{3}, \frac{5\pi}{3}$.

Question 15 (b) (i)

Criteria	Marks
• Provides a correct proof	2
• Establishes one pair of equal angles, or equivalent merit	1

Sample answer:

$RS \| FE$ so $\angle DSR = \angle DEF$ (corresponding angles)

Also $\angle RDS = \angle FDE$ (common angle)

so ΔDEF and ΔDSR are similar (equiangular)

Question 15 (b) (ii)

Criteria	Marks
• Provides a correct explanation	1

Sample answer:

$$\frac{DR}{DF} = \frac{DS}{DE}$$

$$= \frac{DS}{DS + SE} = \frac{x}{x + y}$$

Question 15 (b) (iii)

Criteria	Marks
• Provides a correct solution	2
• Uses expressions for the area of triangles, or equivalent merit	1

Sample answer:

$$A_1 = \frac{1}{2} DR \times DS \sin D \quad \text{(using area formula: } A = \frac{1}{2} ab \sin C\text{)}$$

$$A = \frac{1}{2} DF \times DE \sin D$$

$$\frac{A_1}{A} = \frac{DR}{DF} \times \frac{DS}{DE}$$

$$= \frac{x}{x + y} \times \frac{x}{x + y} = \left(\frac{x}{x + y}\right)^2$$

$$\sqrt{\frac{A_1}{A}} = \frac{x}{x + y}$$

Question 15 (b) (iv)

Criteria	Marks
• Provides a correct solution	2
• Observes that $\triangle DEF$ and $\triangle SEQ$ are similar, or equivalent merit	1

Sample answer:

ΔSEQ is similar to ΔDEF and as in (iii) $\sqrt{\dfrac{A_2}{A}} = \dfrac{y}{x+y}$.

Hence $\sqrt{\dfrac{A_1}{A}} + \sqrt{\dfrac{A_2}{A}} = \dfrac{x}{x+y} + \dfrac{y}{x+y}$

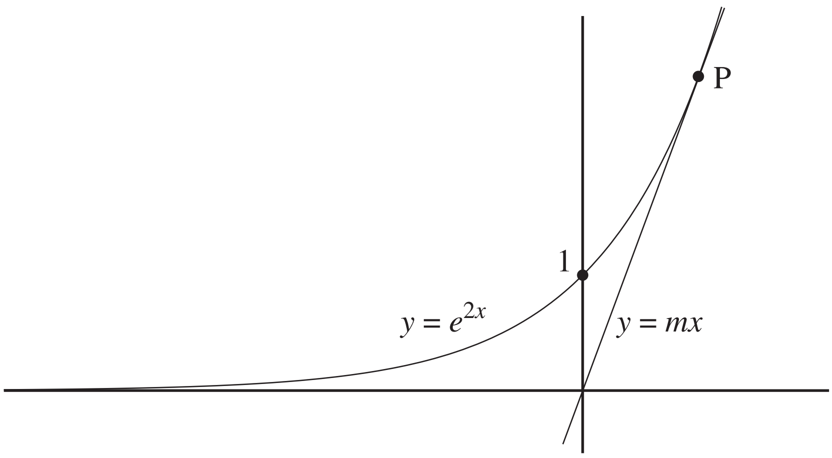
$= 1$

Thus $\sqrt{A_1} + \sqrt{A_2} = \sqrt{A}$.

Question 15 (c) (i)

Criteria	Marks
• Draws a correct sketch	1

Sample answer:



Question 15 (c) (ii)

Criteria	Marks
• Finds the coordinates of P	3
• Attempts to solve relevant simultaneous equations, or equivalent merit	2
• Attempts to use the fact that P lies on both curves, or equivalent merit	1

Sample answer:

At P the y-values of the line and the curve coincide:

$$y = mx = e^{2x} \qquad (1)$$

At P the slopes of the line and the tangent to the curve coincide:

$$m = \frac{d}{dx}e^{2x} = 2e^{2x} \qquad (2)$$

Substitute (1) into (2):

$$\begin{aligned} m &= 2mx \\ 1 &= 2x \\ x &= \frac{1}{2} \end{aligned}$$

P lies on the curve, so $y = e^{2\times\frac{1}{2}} = e$.

The coordinates of P are $\left(\frac{1}{2}, e\right)$.

Question 15 (c) (iii)

Criteria	Marks
• Finds the value of m	1

Sample answer:

At P, $mx = e^{2x}$

Using $x = \frac{1}{2}$ from (ii)

$$\begin{aligned} m &= 2e^{2\times\frac{1}{2}} \\ &= 2e \end{aligned}$$

Question 16 (a)

Criteria	Marks
• Provides a correct solution	3
• Correctly evaluates function values and uses them in Simpson's rule, or equivalent merit	2
• Identifies suitable function values, or equivalent merit	1

Sample answer:

Consider the following table of values of sec *x*.

x	$\frac{-\pi}{3}$	$\frac{-\pi}{6}$	0	$\frac{\pi}{6}$	$\frac{\pi}{3}$
$\cos x$	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$
$\sec x$	2	$\frac{2}{\sqrt{3}}$	1	$\frac{2}{\sqrt{3}}$	2

Using Simpson's rule

$$\int_{\frac{-\pi}{3}}^{\frac{\pi}{3}} \sec x \, dx \approx \frac{1}{3}\frac{\pi}{6}\left(\sec\left(\frac{-\pi}{3}\right) + 4\sec\left(\frac{-\pi}{6}\right) + 2\sec 0 + 4\sec\left(\frac{\pi}{6}\right) + \sec\left(\frac{\pi}{3}\right)\right)$$

$$= \frac{\pi}{18}\left(2 + \frac{8}{\sqrt{3}} + 2 + \frac{8}{\sqrt{3}} + 2\right)$$

$$= \frac{\pi}{18}\left(6 + \frac{16}{\sqrt{3}}\right)$$

$$= \frac{\pi}{9}\left(3 + \frac{8}{\sqrt{3}}\right)$$

Question 16 (b) (i)

Criteria	Marks
• Provides a complete explanation	2
• Explains the meaning of one term, or equivalent merit	1

Sample answer:

Start	1st month	500
End	1st month (add interest)	500 (1.003)
Start	2nd month (add principal)	500 (1.003) + 500 (1.01)
End	2nd month (add interest)	[500 (1.003) + 500 (1.01)] 1.003
		$= 500\,(1.003)^2 + 500\,(1.01)\,(1.003)$

Question 16 (b) (ii)

Criteria	Marks
• Provides a correct solution	3
• Finds a relevant geometric series, or equivalent merit	2
• Attempts to find an expression for the balance, or equivalent merit	1

Sample answer:

At the end of the 3rd month we have

$500\,(1.003)^3 + 500\,(1.01)\,(1.003)^2 + 500\,(1.01)^2\,(1.003)$

Following the pattern, at end of 60th month

$$B = 500\,(1.003)^{60} + 500\,(1.01)\,(1.003)^{59} + \cdots + 500\,(1.01)^{59}\,(1.003)$$

$$= 500\,(1.003)^{60} + 500\,(1.003)^{60}\,\frac{1.01}{1.003} + \cdots + 500\,(1.003)^{60}\left(\frac{1.01}{1.003}\right)^{59}$$

$$= 500\,(1.003)^{60}\left(1 + \frac{1.01}{1.003} + \left(\frac{1.01}{1.003}\right)^2 + \cdots + \left(\frac{1.01}{1.003}\right)^{59}\right)$$

$$= 500\,(1.003)^{60}\,\frac{\left(\frac{1.01}{1.003}\right)^{60} - 1}{\frac{1.01}{1.003} - 1}$$

$$= 44404.378\ \ldots$$

Question 16 (c) (i)

Criteria	Marks
• Provides a correct solution	2
• Finds an expression for the length of the frame, or equivalent merit	1

Sample answer:

Length of semi-circle = $\pi \times \frac{x}{2} = \frac{\pi x}{2}$

Perimeter of rectangle = $2x + 2y$

Length of material used:

$$10 = 2x + 2y + \frac{\pi x}{2}$$

$$5 = x + y + \frac{\pi x}{4}$$

$$y = 5 - x\left(1 + \frac{\pi}{4}\right)$$

Question 16 (c) (ii)

Criteria	Marks
• Provides a correct solution	2
• Attempts to relate area of glass and the amount of light, or equivalent merit	1

Sample answer:

$$\text{Area of semicircle } = \frac{1}{2}\pi\left(\frac{x}{2}\right)^2 \text{ m}^2 = \frac{\pi x^2}{8}\text{ m}^2$$

$$\text{Area of rectangle } = xy \text{ m}^2$$

$$\text{Amount of light coming through } = \left[1\left(\frac{\pi x^2}{8}\right) + 3(xy)\right]\text{units}$$

$$\text{ie } L = 3xy + \frac{\pi x^2}{8}$$

$$= 3x\left(5 - x - \frac{\pi x}{4}\right) + \frac{\pi x^2}{8}$$

$$= 15x - 3x^2 - \frac{3\pi x^2}{4} + \frac{\pi x^2}{8}$$

$$= 15x - x^2\left(3 + \frac{5\pi}{8}\right)$$

Question 16 (c) (iii)

Criteria	Marks
• Provides a correct solution	3
• Justifies the x value is a maximum, or finds y, or equivalent merit	2
• Finds the x value of the stationary point, or equivalent merit	1

Sample answer:

At maximum stationary point, $\dfrac{dL}{dx} = 0$

$$\frac{dL}{dx} = 15 - 2x\left(3 + \frac{5\pi}{8}\right) = 0$$

$$15 = 2x\left(3 + \frac{5\pi}{8}\right)$$

$$x = \frac{15}{2\left(3 + \frac{5\pi}{8}\right)}$$

$$\frac{d^2L}{dt^2} = -2\left(3 + \frac{5\pi}{8}\right) < 0$$

so $x = \dfrac{15}{2\left(3 + \frac{5\pi}{8}\right)}$ gives maximum.

Exact value $\quad y = 5 - \left(\dfrac{15}{2\left(3 + \frac{5\pi}{8}\right)}\right)\left(1 + \dfrac{\pi}{4}\right)$

Decimal approximation for $\quad y \doteqdot 2.30$

$x \doteqdot 1.51$

Mathematics

2014 HSC Examination Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	1.1	P3
2	1	4.2	P5
3	1	12.3	H3
4	1	12.5	H3, H5
5	1	6.2	P4
6	1	1.3	P3
7	1	5.2	H5
8	1	7.3	H5
9	1	10.1, 10.3, 14.3	H5, H7
10	1	3.3	H5

Section II

Question	Marks	Content	Syllabus outcomes
11 (a)	2	1.1	P3
11 (b)	2	1.3	P3
11 (c)	2	8.8	P7, P8
11 (d)	2	11.2	H5, H8
11 (e)	3	13.7	H5, H8
11 (f)	2	10.8, 8.6	P6, H5, P8
11 (g)	2	13.1	H5
12 (a)	2	7.1	H5
12 (b) (i)	2	6.2	P4
12 (b) (ii)	2	6.5	P4
12 (b) (iii)	2	6.8	H2
12 (c) (i)	2	3.3	H5
12 (c) (ii)	1	3.3	H5
12 (d) (i)	1	1.4	P4
12 (d) (ii)	3	11.4	H8

Question	Marks	Content	Syllabus outcomes
13 (a) (i)	1	13.7	H5
13 (a) (ii)	2	11.2, 12.5, 13.7	H3, H5
13 (b) (i)	1	14.2	H3, H4
13 (b) (ii)	3	14.2	H3, H4
13 (c) (i)	2	14.3	H5
13 (c) (ii)	1	4.2, 14.3	H5, P4
13 (d) (i)	2	5.5	H2, H5, P4
13 (d) (ii)	3	5.4, 5.5	H2, H5, P4
14 (a)	3	10.2, 10.4, 12.4	H5
14 (b) (i)	1	9.2	P4
14 (b) (ii)	2	1.4, 9.2	P4
14 (c)	3	11.4	H8, H9
14 (d) (i)	1	7.2	H5
14 (d) (ii)	2	7.3	H5
14 (e)	3	10.2, 10.4	H7
15 (a)	3	5.2, 13.2	P4, H5
15 (b) (i)	2	2.3	P4, H9
15 (b) (ii)	1	2.5	H5, H9
15 (b) (iii)	2	2.5	H5, H9
15 (b) (iv)	2	2.5	H2, H5, H9
15 (c) (i)	1	4.2, 6.1, 12.3	P5, H3, H5
15 (c) (ii)	3	1.4, 10.1	H3, H5, H9
15 (c) (iii)	1	10.1	H3
16 (a)	3	11.3, 13.2	H5, H8
16 (b) (i)	2	7.5	H2, H5, H9
16 (b) (ii)	3	7.5	H5
16 (c) (i)	2	10.6	H4, H5, H9
16 (c) (ii)	2	10.6	H4, H5, H9
16 (c) (iii)	3	10.6	H5