2018 HSC Mathematics Extension 1
Marking Guidelines

Section I

Multiple-choice Answer Key

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

Section II

Question 11 (a) (i)

Criteria	Marks
• Provides correct proof	

Sample answer:

$$
\begin{aligned}
P(1) &= 1^3 - 2(1)^2 - 5(1) + 6 \\
&= 1 - 2 - 5 + 6 \\
&= 0
\end{aligned}
$$

$\therefore\ x = 1$ is a zero of $P(x)$

Question 11 (a) (ii)

Criteria	Marks
• Finds correct solution	2
• Correctly divides by $x - 1$, or equivalent merit	1

Sample answer:

$$
\begin{array}{r|l}
 & x^2 - x - 6 \\
\hline
x - 1 & x^3 - 2x^2 - 5x + 6 \\
 & \underline{x^3 - x^2} \\
 & \quad -x^2 - 5x \\
 & \quad \underline{-x^2 + x} \\
 & \qquad -6x + 6 \\
 & \qquad \underline{-6x + 6}
\end{array}
$$

$$
\begin{aligned}
\therefore P(x) &= (x-1)\left(x^2 - x - 6\right) \\
&= (x-1)(x+2)(x-3)
\end{aligned}
$$

other zeros are –2, 3

Question 11 (b)

Criteria	Marks
• Provides correct solution	2
• Obtains correct linear equation, or equivalent merit	1

Sample answer:

$$\log_2 5 + \log_2 (x-2) = 3$$
$$\log_2 \left(5(x-2)\right) = 3$$
$$5(x-2) = 2^3$$
$$5x - 10 = 8$$
$$5x = 18$$
$$x = \frac{18}{5} \text{ or } 3\frac{3}{5}$$

Question 11 (c)

Criteria	Marks
• Provides correct solution	2
• Correctly finds R, or equivalent merit	1

Sample answer:

$$\sqrt{3}\sin x + \cos x = R\sin(x+\alpha),\ R > 0,\ 0 \le \alpha \le \frac{\pi}{2}$$
$$= R\sin x\cos\alpha + R\cos x\sin\alpha$$

$$\therefore\ R\cos\alpha = \sqrt{3} \qquad ①$$
$$R\sin\alpha = 1 \qquad ②$$

$$② \div ① \qquad \tan\alpha = \frac{1}{\sqrt{3}}$$
$$\alpha = \frac{\pi}{6}$$

$$②^2 + ①^2 \qquad R^2\left(\sin^2\alpha + \cos^2\alpha\right) = 1 + 3$$
$$R^2 = 4$$
$$R = 2 \quad (R > 0)$$

$$\therefore\ \sqrt{3}\sin x + \cos x = 2\sin\left(x + \frac{\pi}{6}\right)$$

Question 11 (d)

Criteria	Marks
• Provides correct solution	2
• Attempts to use secant theorem resulting in a quadratic equation, or equivalent merit	1

Sample answer:

$$x(x+2) = 3(3+5)$$
$$x^2 + 2x = 24$$
$$x^2 + 2x - 24 = 0$$
$$(x+6)(x-4) = 0$$
$$x = -6 \text{ or } 4$$

But $x > 0 \therefore x = 4$

Question 11 (e) (i)

Criteria	Marks
• Provides correct answer	1

Sample answer:

Domain $\quad 4x - 1 \neq 0$

$$4x \neq 1$$
$$x \neq \frac{1}{4}$$

Domain: all real $x \neq \frac{1}{4}$

Question 11 (e) (ii)

Criteria	Marks
• Provides correct solution	2
• Successfully deals with the denominator, or equivalent merit	1

Sample answer:

$$f(x) < 1$$

$$\frac{1}{4x-1} < 1 \qquad x \neq \frac{1}{4}$$

$$(4x-1)^2 \times \frac{1}{4x-1} < (4x-1)^2 \times 1$$

$$4x-1 < (4x-1)^2$$

$$0 < (4x-1)^2 - (4x-1)$$

$$0 < (4x-1)(4x-1-1)$$

$$0 < (4x-1)(4x-2)$$

$$0 < 2(4x-1)(2x-1)$$

$$\therefore x < \frac{1}{4},\ x > \frac{1}{2}$$

Question 11 (f)

Criteria	Marks
• Provides correct solution	3
• Obtains correct integral in terms of u, including the limits, or equivalent merit	2
• Attempts to use the substitution, or equivalent merit	1

Sample answer:

$$I = \int_{-3}^{0} \frac{x}{\sqrt{1-x}}\,dx$$

Let $u = 1 - x$

$du = -dx$

$x = -3 \rightarrow u = 4$

$x = 0 \rightarrow u = 1$

$$= \int_{4}^{1} \frac{1-u}{\sqrt{u}}(-du)$$

$$= \int_{1}^{4} u^{-\frac{1}{2}} - u^{\frac{1}{2}}.du$$

$$= \left[2u^{\frac{1}{2}} - \frac{2}{3}u^{\frac{3}{2}} \right]_1^4$$

$$= 2(2) - \frac{2}{3}(8) - \left(2(1) - \frac{2}{3}(1) \right)$$

$$= 4 - 5\frac{1}{3} - 1\frac{1}{3}$$

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

Question 12 (a)

Criteria	Marks
• Provides correct solution	2
• Rewrites the integrand using double angle result, or equivalent merit	1

Sample answer:

$$\int \cos^2(3x)\,dx$$

$$= \frac{1}{2}\int \cos(6x) + 1\,dx \qquad \text{since } \cos^2\theta = \frac{1}{2}(\cos 2\theta + 1)$$

$$= \frac{1}{2}\left(\frac{1}{6}\sin 6x + x\right) + c$$

$$= \frac{1}{12}\sin 6x + \frac{x}{2} + c$$

Question 12 (b) (i)

Criteria	Marks
• Provides correct proof	1

Sample answer:

$$\frac{h}{20} = \sin\theta$$

$$h = 20\sin\theta$$

$$\frac{dh}{d\theta} = 20\cos\theta$$

Question 12 (b) (ii)

Criteria	Marks
• Provides correct solution	2
• Uses related rates to find an expression for $\frac{dh}{dt}$, or equivalent merit	1

Sample answer:

When $h = 15 \qquad \theta = ?$

$$\sin\theta = \frac{15}{20} = \frac{3}{4}$$

$$\theta = \sin^{-1}\left(\frac{3}{4}\right)$$

we want $\qquad \frac{dh}{dt} = \frac{dh}{d\theta} \times \frac{d\theta}{dt}$

$\frac{dh}{d\theta}$ when $h = 15 \qquad \frac{dh}{d\theta} = 20\cos\left(\sin^{-1}\left(\frac{3}{4}\right)\right)$

and $\qquad \frac{d\theta}{dt} = 1.5$ radians/minute (given)

so
$$\frac{dh}{dt} = 20\cos\left(\sin^{-1}\left(\frac{3}{4}\right)\right) \times 1.5$$
$$= 30\cos\left(\sin^{-1}\left(\frac{3}{4}\right)\right)$$
$$= 19.8$$

Question 12 (c) (i)

Criteria	Marks
• Provides correct proof	1

Sample answer:

$$f(x) = \sin^{-1}x + \cos^{-1}x$$

$$f'(x) = \frac{1}{\sqrt{1^2 - x^2}} - \frac{1}{\sqrt{1^2 - x^2}}$$
$$= 0$$

Question 12 (c) (ii)

Criteria	Marks
• Provides correct proof	1

Sample answer:

$f(x) = \sin^{-1} x + \cos^{-1} x$

Since $f'(x) = 0$

$f(x)$ must have a constant value on its domain, so only need to find $f(a)$ for some a.

When $x = 0$

$f(0) = \sin^{-1} 0 + \cos^{-1} 0$

$= 0 + \frac{\pi}{2} = \frac{\pi}{2}$

or

Let $m = \sin^{-1} x$

$\sin m = x$

$\therefore \cos\left(\frac{\pi}{2} - m\right) = x$

Let $\frac{\pi}{2} - m = \cos^{-1} x$

$\therefore \sin^{-1} x + \cos^{-1} x = m + \frac{\pi}{2} - m$

$= \frac{\pi}{2}$

Question 12 (c) (iii)

Criteria	Marks
• Provides correct sketch	1

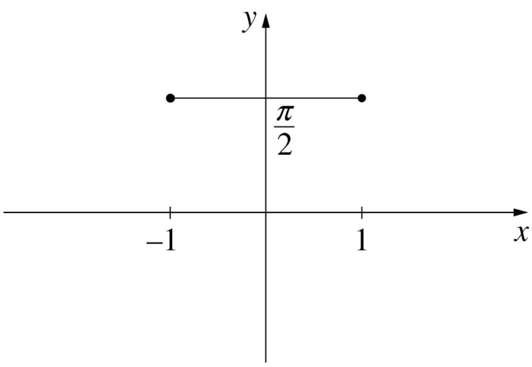
Sample answer:

Sketch $f(x) = \sin^{-1} x + \cos^{-1} x$

domain $\sin^{-1} x$ is $-1 \le x \le 1$

$\cos^{-1} x$ is $-1 \le x \le 1$

so domain $f(x)$ is $-1 \le x \le 1$



Question 12 (d)

Criteria	Marks
• Provides correct solution	2
• Obtains correct probability for 10 people completing the trek, or equivalent merit	1

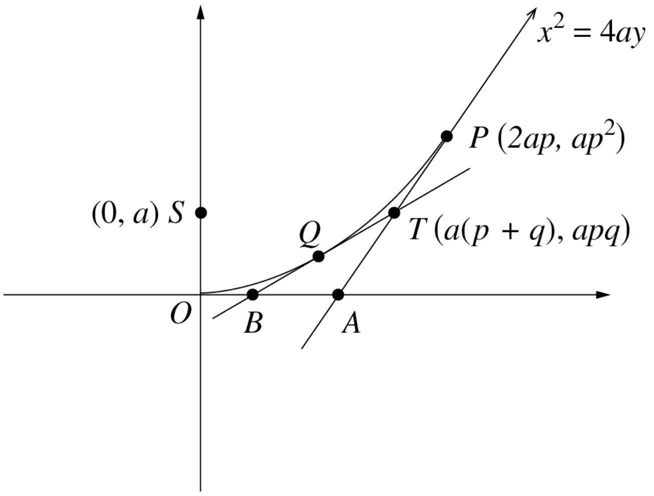
Sample answer:

$$\binom{12}{10}(0.75)^{10}(0.25)^2 + \binom{12}{11}(0.75)^{11}(0.25) + \binom{12}{12}(0.75)^{12}$$

Question 12 (e) (i)

Criteria	Marks
• Provides correct solution	2
• Finds the gradient of AS, or equivalent merit	1

Sample answer:



Tangent at P $\quad y = px - ap^2$

so the coordinates of A are $(ap, 0)$

the line joining A and S has slope
$$= \frac{a - 0}{0 - ap}$$
$$= -\frac{a}{ap}$$
$$= -\frac{1}{p}$$

slope of tangent $\times$ slope of AS
$$= -\frac{1}{p} \times p$$
$$= -1$$

lines are perpendicular

so $\angle PAS = 90°$

Question 12 (e) (ii)

Criteria	Marks
• Provides correct explanation	1

Sample answer:

$\angle PAS = 90°$ which means $\angle TAS = 90°$

similarly we could show that

$\angle QBS = 90°$ so $\angle TBS = 90°$

So we have equal angles subtended on the same chord (on the same arc).

So the points A, B, S and T are concyclic points.

Question 12 (e) (iii)

Criteria	Marks
• Provides correct solution	2
• Correctly substitutes S and T into the distance formula, or equivalent merit	1

Sample answer:

ST is the diameter of the circle since $\angle TAS = \angle TBS = 90°$

so we want the length of interval ST

coordinates of $S = (0, a)$ coordinates $T = (a(p+q), apq)$

$$\begin{aligned}\text{distance} &= \sqrt{\left(a(p+q)-0\right)^2 + (apq-a)^2}\\ &= \sqrt{a^2(p+q)^2 + a^2(pq-1)^2}\\ &= \sqrt{a^2\left(p^2+2pq+q^2+p^2q^2-2pq+1\right)}\\ &= a\sqrt{p^2+q^2+1+p^2q^2}\\ &= a\sqrt{\left(p^2+1\right)\left(q^2+1\right)}\end{aligned}$$

Question 13 (a)

Criteria	Marks
• Provides correct proof	3
• Correctly sets up S_{k+1} as the sum of S_k and T_{k+1}, or equivalent merit	2
• Proves true for $n = 1$, or equivalent merit	1

Sample answer:

RTP: $2 - 6 + 18 - 54 + \ldots + 2(-3)^{n-1} = \dfrac{1-(-3)^n}{2}$

Show true for $n = 1$:

$$\text{LHS} = 2(-3)^{1-1} = 2 \times 1 = 2$$

$$\text{RHS} = \frac{1-(-3)^1}{2} = \frac{1+3}{2} = 2$$

LHS $=$ RHS $\therefore$ true for $n = 1$

Assume true for $n = k$:

$$2 - 6 + 18 - 54 + \ldots + 2(-3)^{k-1} = \frac{1-(-3)^k}{2}$$

If $n = k$ is true, show true for $n = k + 1$.

$$\begin{aligned}
\text{LHS} &= 2 - 6 + 18 - 54 + \ldots + 2(-3)^{k-1} + 2(-3)^k \\
&= \frac{1-(-3)^k}{2} + 2(-3)^k \\
&= \frac{1-(-3)^k + 4(-3)^k}{2} \\
&= \frac{1-(-3)(-3)^k}{2} \\
&= \frac{1-(-3)^{k+1}}{2}
\end{aligned}$$

$\therefore$ true for $n = k + 1$.

Hence, by the process of mathematical induction $2 - 6 + 18 - 54 + \ldots + 2(-3)^{n-1} = \dfrac{1-(-3)^n}{2}$.

Question 13 (b) (i)

Criteria	Marks
• Provides correct solution	2
• States correct domain, or equivalent merit	1

Sample answer:

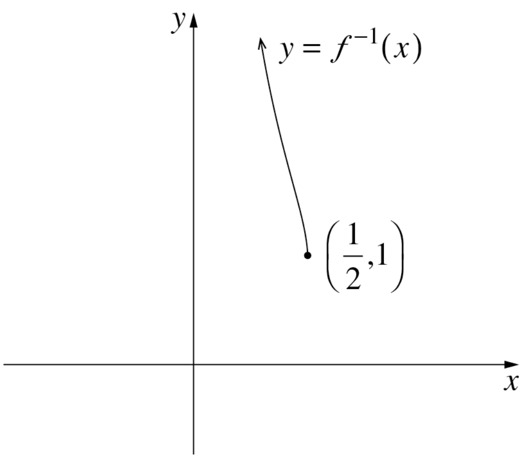
Domain: all real x, $0 < x \le \dfrac{1}{2}$

Range: all real, $y \ge 1$

Question 13 (b) (ii)

Criteria	Marks
• Provides correct sketch	1

Sample answer:



Question 13 (b) (iii)

Criteria	Marks
• Provides correct solution	3
• Correctly solves the resulting quadratic equation, or equivalent merit	2
• Correctly interchanges x and y, or equivalent merit	1

Sample answer:

Let $y = \dfrac{x}{x^2+1}$

$$x^2y + y = x$$

$$x^2y - x + y = 0$$

$$x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \times y \times y}}{2y}$$

$$= \frac{1 \pm \sqrt{1-4y^2}}{2y}$$

when $x = 2,\ y = \dfrac{2}{5}$

$$\therefore\ x = \frac{1 + \sqrt{1-4y^2}}{2y}$$

$$\therefore\ f^{-1}(x) = \frac{1 + \sqrt{1-4x^2}}{2x}$$

Question 13 (c) (i)

Criteria	Marks
• Provides correct solution	2
• Attempts to solve $y = 0$, or equivalent merit	1

Sample answer:

The object hits the ground, after $t = 0$ when

$$\begin{aligned} 0 &= y(t) \\ &= Vt\sin\theta - \frac{gt^2}{2} \\ &= t\left(V\sin\theta - \frac{gt}{2}\right) \end{aligned}$$

As $t > 0$ we have

$$t = \frac{2V\sin\theta}{g}$$

$$\begin{aligned} x &= Vt\cos\theta \\ &= \frac{2V^2\sin\theta\cos\theta}{g} \\ &= \frac{V^2}{g}\sin 2\theta \end{aligned}$$

Thus the range, at angle θ, is $\dfrac{V^2}{g}\sin 2\theta$.

Question 13 (c) (ii)

Criteria	Marks
• Provides correct proof	1

Sample answer:

$$\begin{aligned} \text{Horizontal range } &= \frac{V^2}{g}\sin 2\left(\frac{\pi}{2} - \theta\right) \\ &= \frac{V^2}{g}\sin(\pi - 2\theta) \\ &= \frac{V^2}{g}\sin 2\theta \end{aligned}$$

Question 13 (c) (iii)

Criteria	Marks
• Provides correct solution	3
• Finds h_α, or equivalent merit	2
• Finds time when maximum height is reached, or equivalent merit	1

Sample answer:

The maximum height, for angle θ, occurs when $\dot{y}(t) = 0$, that is

$$\begin{aligned} 0 &= \dot{y}(t) \\ &= V\sin\theta - gt \\ t &= \frac{V\sin\theta}{g} \\ y\left(\frac{V\sin\theta}{g}\right) &= \frac{V^2\sin^2\theta}{g} - \frac{V^2\sin^2\theta}{2g} \\ &= \frac{V^2\sin^2\theta}{2g} \end{aligned}$$

Thus $h_\alpha = \dfrac{V^2\sin^2\alpha}{2g}$ and $h_\beta = \dfrac{V^2\sin^2\beta}{2g}$, but

$$\sin\beta = \sin\left(\frac{\pi}{2} - \alpha\right) = \cos\alpha$$

Thus

$$\begin{aligned} h_\alpha + h_\beta &= \frac{V^2\sin^2\alpha}{2g} + \frac{V^2\sin^2\beta}{2g} \\ &= \frac{V^2\sin^2\alpha}{2g} + \frac{V^2\cos^2\alpha}{2g} \\ &= \frac{V^2\left(\sin^2\alpha + \cos^2\alpha\right)}{2g} \\ &= \frac{V^2}{2g} \\ \frac{h_\alpha + h_\beta}{2} &= \frac{V^2}{4g} \end{aligned}$$

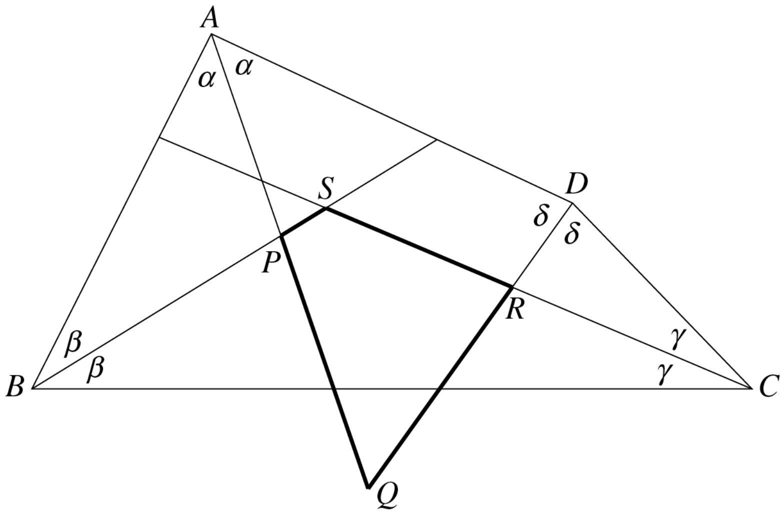
which depends only on V and g.

In fact, this is the height attained by the object when projected at $\dfrac{\pi}{4}$ to attain its maximum range.

Question 14 (a)

Criteria	Marks
• Provides correct proof	3
• Establishes a relationship between the angles of the quadrilateral $PQRS$ and the bisected angles, or equivalent merit	2
• Relates the sum of the bisected angles to the angle sum of the quadrilateral $ABCD$, or equivalent merit	1

Sample answer:



Let $\alpha = \frac{1}{2}\angle A$, $\beta = \frac{1}{2}\angle B$

$\gamma = \frac{1}{2}\angle C$ and $\delta = \frac{1}{2}\angle D$

as shown

Then $2\alpha + 2\beta + 2\gamma + 2\delta = 360°$ ($\angle$ sum quadrilateral)

$\therefore \alpha + \beta + \gamma + \delta = 180°$

$\angle PSR = \angle BSC = 180° - (\beta + \gamma)$ ($\angle$ sum of $\triangle BSC$)

$\angle PQR = \angle AQD = 180° - (\alpha + \delta)$ ($\angle$ sum of $\triangle AQD$)

$\therefore \angle PSR + \angle PQR = 2 \times 180° - (\alpha + \beta + \gamma + \delta)$

$= 2 \times 180° - 180°$

$= 180°$

$\therefore PQRS$ is cyclic (opposite angles are supplementary)

Question 14 (b) (i)

Criteria	Marks
• Provides correct solution	3
• Obtains correct expansion of $\left(1+(1+x)^n\right)$ in terms of $(1+x)^k$, or equivalent merit	2
• Correctly applies the binomial theorem to one binomial expression to get the coefficient of x^r, or equivalent merit	1

Sample answer:

Consider the coefficients of x^r on both sides of the equation

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

Then in x^r on LHS = $\binom{n}{r} x^r 2^{n-r}$

$\therefore$ coefficient of $x^r = \binom{n}{r} 2^{n-r}$

$$\text{RHS} = \binom{n}{0} + \binom{n}{1}(1+x)^1 + \binom{n}{2}(1+x)^2 + \ldots + \binom{n}{r}(1+x)^r + \binom{n}{r+1}(1+x)^{r+1} + \ldots + \binom{n}{n}(1+x)^n$$

Coefficient of x^r = sum of coefficients of x^r for each term

$$= \binom{n}{r}\binom{r}{r} + \binom{n}{r+1}\binom{r+1}{r} + \binom{n}{r+2}\binom{r+2}{r} + \ldots + \binom{n}{n}\binom{n}{r}$$

Equating these gives the result.

Question 14 (b) (ii)

Criteria	Marks
• Provides correct solution	2
• Attempts to use the formula in part (i), or equivalent merit	1

Sample answer:

Selector A could choose a group of 4, 5, 6 … or 23 people. Then selector B chooses 4 from this group.

Hence number of ways

$$= \binom{23}{4}\binom{4}{4} + \binom{23}{5}\binom{5}{4} + \binom{23}{6}\binom{6}{4} + \ldots + \binom{23}{23}\binom{23}{4}$$

$$= \binom{23}{4} 2^{23-4}$$

$$= \binom{23}{4}\left(2^{19}\right)$$

$$= 4\,642\,570\,240$$

Question 14 (c) (i)

Criteria	Marks
• Provides correct proof	1

Sample answer:

In $\triangle ABC$ and $\triangle ACD$

$\angle ACB = \angle ADC$ (CD perpendicular to AB, $\triangle$ABC right-angled at C)

$\angle BAC = \angle CAD$ (common)

$\therefore \triangle ABC \parallel\!| \triangle ACD$ (equiangular)

Question 14 (c) (ii)

Criteria	Marks
• Provides correct proof	1

Sample answer:

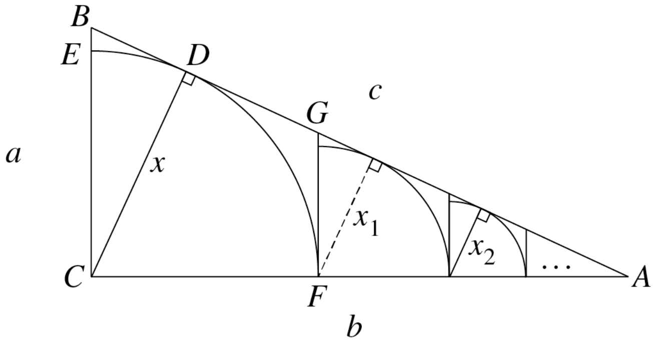
$\frac{x}{a} = \frac{b}{c}$ (corresponding sides of similar triangles)

$\therefore x = \frac{ab}{c}$

Question 14 (c) (iii)

Criteria	Marks
• Provides correct solution	4
• Correctly establishes a relationship between successive radii or area, or equivalent merit	3
• Attempts to use similarity to find a relationship between successive radii or area, or equivalent merit	2
• Finds an expression for the area of a quadrant in terms of a, b and c, or equivalent merit	1

Sample answer:



Since $\triangle ABC$ and $\triangle AGF$ are right-angled and angle A is common, then $\triangle ABC \,|||\, \triangle AGF$

$$\frac{GF}{a} = \frac{b-x}{b}$$

$$\frac{GF}{a} = \frac{1}{b}\left(b - \frac{ab}{c}\right)$$

$$\frac{GF}{a} = \frac{b}{b}\left(1 - \frac{a}{c}\right)$$

It follows then

$$\frac{x_1}{x} = 1 - \frac{a}{c}$$

$$x_1 = \left(1 - \frac{a}{c}\right)x$$

$$x_1 = (1 - \sin A)x$$

The ratio of the lengths of the radii are independent of a, b and c.

Hence, successive radii will be in the ratio $(1 - \sin A)$.

Hence, $x_2 = \left(1 - \dfrac{a}{c}\right)^2 x$ etc

Area of quadrants

$$A = \frac{1}{4}\pi\left(x^2 + x^2{}_1 + x^2{}_2 + \dots\right)$$

$$A = \frac{1}{4}\pi\left(x^2 + \left(1 - \frac{a}{c}\right)^2 x^2 + \left(1 - \frac{a}{c}\right)^4 x^2 + \dots\right)$$

$$A = \frac{1}{4}\pi x^2\left(1 + \left(1 - \frac{a}{c}\right)^2 + \left(1 - \frac{a}{c}\right)^4 + \dots\right)$$

For the series

$$1 + \left(1 - \frac{a}{c}\right)^2 + \left(1 - \frac{a}{c}\right)^4 + \dots$$

$$a = 1, \quad r = \left(1 - \frac{a}{c}\right)^2$$

$$S_\infty = \frac{a}{1 - r}$$

$$S_\infty = \frac{1}{1 - \left(1 - \frac{a}{c}\right)^2}$$

$$S_\infty = \frac{c^2}{c^2 - (c - a)^2}$$

$$S_\infty = \frac{c^2}{c^2 - c^2 + 2ac - a^2}$$

$$= \frac{c^2}{a(2c - a)}$$

$$\therefore A = \frac{1}{4}\pi x^2 \times \frac{c^2}{a(2c - a)}$$

$$A = \frac{\pi}{4}\left(\frac{ab}{c}\right)^2 \times \frac{c^2}{a(2c - a)}$$

$$A = \frac{\pi}{4} \times \frac{ab^2}{(2c - a)}$$

$$A = \frac{\pi ab^2}{4(2c - a)}$$

Question 14 (c) (iv)

Criteria	Marks
• Provides correct solution	1

Sample answer:

Area of quadrants < area of $\triangle ABC$

$$\frac{\pi ab^2}{4(2c-a)} < \frac{ab}{2}$$

$$\frac{\pi}{4} < \frac{ab}{2} \times \frac{(2c-a)}{ab^2}$$

$$\frac{\pi}{4} < \frac{2c-a}{2b}$$

$$\frac{\pi}{2} < \frac{2c-a}{b}$$

2018 HSC Mathematics Extension 1 Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	16.3	PE3
2	1	6.6	PE6
3	1	5.7, 13.4	HE7
4	1	16.1	PE3
5	1	14.2E	HE3
6	1	16.4	HE7
7	1	14.3E	HE5
8	1	18.1	PE3
9	1	15.2	HE7
10	1	14.4E	HE5

Section II

Question	Marks	Content	Syllabus outcomes
11 (a) (i)	1	16.2	PE3
11 (a) (ii)	2	16.2	PE3
11 (b)	2	12.2	H3, HE7
11 (c)	2	5.9E, 13.1	HE7
11 (d)	2	2.10	PE3
11 (e) (i)	1	4.1	PE2
11 (e) (ii)	2	1.4E	PE3
11 (f)	3	11.5E	HE6
12 (a)	2	13.6E	HE7
12 (b) (i)	1	14.1E, 14.4E	HE3, HE5
12 (b) (ii)	2	14.1E, 14.4E	HE3, HE5
12 (c) (i)	1	15.5	HE4
12 (c) (ii)	1	15.2,15.4	HE4
12 (c) (iii)	1	15.3	HE4
12 (d)	2	18.2	HE3
12 (e) (i)	2	9.6	PE3
12 (e) (ii)	1	2.9	PE3
12 (e) (iii)	2	2.9, 6.5	PE3
13 (a)	3	7.4	HE2
13 (b) (i)	2	15.1	HE4
13 (b) (ii)	1	15.1E	HE4
13 (b) (iii)	3	15.1E	HE4
13 (c) (i)	2	14.3E	HE3
13 (c) (ii)	1	14.3E	HE3

Question	Marks	Content	Syllabus outcomes
13 (c) (iii)	3	14.3E	HE3
14 (a)	3	2.9E, 2.10E	PE3
14 (b) (i)	3	17.3	HE7
14 (b) (ii)	2	17.3	HE7
14 (c) (i)	1	2.3, 2.5	PE2, HE7
14 (c) (ii)	1	2.3, 2.5	PE2, HE7
14 (c) (iii)	4	7.3	PE2, PE6, HE7
14 (c) (iv)	1	1.4, 2.3, 2.5	PE2, PE6, HE7