Question Number	Scheme	Marks
1.(a)	$(5,-4)$	B1
(b)	$(3,4)$	B1
(c)	$(3,-2)$	B1
(d)	$(3,0)$	B1
		(4) **(4 marks)**

Allow the coordinates to be given separately. Eg $(5,-4)$ as $x=5, y=-4$

Question Number	Scheme	Marks
2.(a)	$2x^2+3x=\frac{1}{2}x+3=0 \Rightarrow 4x^2+5x-6=0$	M1
	$(4x-3)(x+2)=0 \Rightarrow x=\frac{3}{4},-2$	dM1 A1
	$x=\frac{3}{4}, y=\frac{27}{8} \quad x=-2, y=2$	ddM1 A1
		(5)
(b)	Chooses outside (for *x*) $\quad x \leqslant -2,\ x \geqslant \frac{3}{4}$	M1A1
		(2)
		(7 marks)

M1 Sets equations equal to each other and attempts to put in quadratic form

dM1 Attempts to solve 3TQ= 0

A1 $x=\frac{3}{4},-2$

ddM1 Finds at least one *y* coordinate from their *x* coordinate

A1 Both correct pairs $x=\frac{3}{4}, y=\frac{27}{8} \quad x=-2, y=2$

(b)

M1 Chooses the outside region for their *x* values

A1 $x \leqslant -2,\ x \geqslant \frac{3}{4}$

Question Number	Scheme	Marks
3.(a)	$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{3}{16}x^2-2x^{-\frac{1}{2}}-\frac{8}{x^2}$	M1A1 A1
		(3)
(b)	$\left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\vert_{x=4}=\frac{3}{16}\times4^2-2\times\frac{1}{\sqrt{4}}-\frac{8}{4^2}=\left(\frac{3}{2}\right)$	M1
	Method for gradient of normal is $-\frac{2}{3}$	dM1
	$y+2=-\frac{2}{3}(x-4)\Rightarrow 2x+3y-2=0$	M1 A1
		(4) **(7 marks)**

(a)
M1 For reducing the power by one on any x term
A1 Two terms correct (but may be un simplified)
A1 All terms correct (and now simplified). Accept exact simplified equivalents. Eg $\frac{3x^2}{16}-\frac{2}{\sqrt{x}}-8x^{-2}$

(b)
M1 For substituting $x=4$ into their $\frac{\mathrm{d}y}{\mathrm{d}x}$
dM1 For the correct method of using the negative reciprocal to find the equation of the tangent
M1 For an attempt at finding the equation of the normal. It is for using a changed gradient and the point $(4,-2)$ Condone one error on the sign of the 4 and -2.
If the form $y=mx+c$ is used they must proceed to c = ...
A1 $2x+3y-2=0$ or any integer multiple

Question Number	Scheme	Marks
4 (i)	Attempts to write in powers of 2 $\frac{4^a}{2^{3b}} = 32\sqrt{2} \Rightarrow \frac{2^{2a}}{2^{3b}} = 2^5 \times 2^{\frac{1}{2}}$	M1
	Uses correct index laws $2^{2a-3b} = 2^{5.5}$	M1
	Forms equation in a and b and makes a the subject $2a - 3b = 5.5 \Rightarrow a = ...$	ddM1
	$\Rightarrow a = 1.5b + 2.75$	A1
		(4)
(ii)	$3x = \sqrt{2}x + 14 \Rightarrow x = \frac{14}{3-\sqrt{2}}$	M1
	$\Rightarrow x = \frac{14}{(3-\sqrt{2})} \times \frac{(3+\sqrt{2})}{(3+\sqrt{2})} =$	dM1
	$\Rightarrow x = 2(3+\sqrt{2})$ oe	A1
		(3)
		(7 marks)

(a)

M1 For attempting to write each term in the same power (usually 2 but could be 4 etc)

M1 Uses a correct index law seen on one side

ddM1 Uses correct index laws on both sides, and, after setting the indexes equal to each other, makes *a* the subject

A1 $a = 1.5b + 2.75$ oe

(b)

M1 For attempting to collect the terms in *x* on one side of the equation, factorising and making *x* the subject

dM1 For rationalising

A1 $x = 2(3+\sqrt{2})$ oe

....

Alt

M1 Makes $\sqrt{2}x$ the subject and squares both sides $2x^2 = (3x-14)^2 \rightarrow$

dM1 Re-arranging and solving $0 = x^2 - 12x + 28 \Rightarrow (x-6)^2 - 8 = 0 \Rightarrow x = ...$

A1 $6 + \sqrt{8}$ oe

Question Number	Scheme	Marks
5. (a)	Correct attempt for AB Eg $AB^2 = 3^2 + 3^2 - 2\times3\times3\times\cos 1.25$ (3.51)	M1
	Correct attempt at arc length $ACB = 3\times(2\pi - 1.25)$ (15.10)	M1
	Perimeter of pond $= 3.51058.. + 15.09955.. = 18.61$ m	dM1 A1
		(4)
(b)	Attempts area AOB = $\frac{1}{2}\times3\times3\times\sin 1.25$ (4.27)	M1
	Attempts area $AOBCA$ = $\frac{1}{2}\times3^2\times(2\pi - 1.25)$ (22.65)	M1
	Attempts volume of pond = $(4.2704.. + 22.6493...)\times1.5 = 40.4\,\text{m}^3$	dM1 A1
		(4)
		(8 marks)

(a)

M1 Scored for a correct attempt for the length of AB
See scheme. Also accept $2\times3\sin 0.625$ or awrt 3.51

M1 Attempts $r\theta$ with $r = 3$ and $\theta = (2\pi - 1.25)$ or awrt 5.03
A correct method is implied by an arc length of awrt 15.1

dM1 Attempts to add two values found by a correct method

A1 Awrt 18.61 m

(b)

M1 Attempts area AOB
See scheme. Allow $3\cos 0.625\times3\sin 0.625$ or awrt 4.27

M1 Attempts area $\frac{1}{2}r^2\theta$ with $r = 3, \theta = (2\pi - 1.25)$ or awrt 5.03
A correct method is implied by an area for the sector of awrt 22.65

dM1 Attempts volume of pond = $("4.27" + "22.65")\times1.5$

A1 Awrt 40.4 m^3

Question Number	Scheme	Marks
6.(a)	Attempts gradient $PR=\frac{8-2}{-5+1}=-\frac{3}{2}$	B1
	Coordinates of $M=(3,5)$	B1
	Attempts parallel line through M $y-5=-\frac{3}{2}(x-3)\Rightarrow 3x+2y-19=0$	M1 A1
		(4)
(b) (i)	Substitutes $y=8\Rightarrow 3x+2y-19=0\Rightarrow x=1$	M1 A1
(ii)	9 units ^{2}	A1
		(3)
		(7 marks)

(a)

B1 Gradient $PR=-\frac{3}{2}$ oe

B1 Coordinates of $M=(3,5)$

M1 Attempts parallel line through M

A1 $k(2y+3x-19)=0$ where $k\neq 0, k\in \mathbb{Z}$

(b)

M1 Substitutes $y=8$ in their $3x+2y-19=0\Rightarrow x=...$

A1 $x=1$ $y=8$

B1 9 units ^{2}

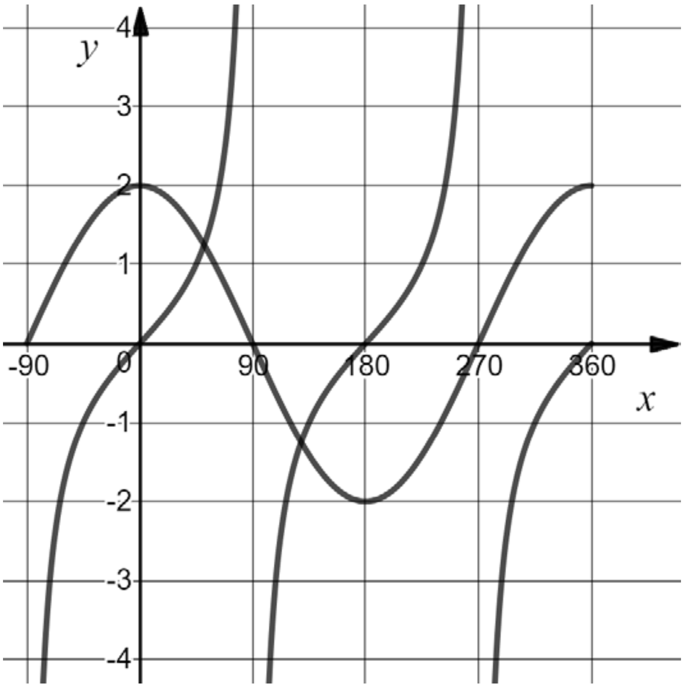
(b) Alternative method using similar triangles.

M1 Uses ratio $MQ:RQ=1:2\Rightarrow$ point N is at the mid-point of PQ

A1 $x=1$ $y=8$

A1 9 units ^{2}

Ratio MNQ: PQR = 1:4 $\rightarrow$ Area triangle MNQ = $\frac{1}{4}\times$ area triangle PQR $=\frac{1}{4}\times\left(\frac{1}{2}\times 12\times 6\right)=9$ units ^{2}

Question Number	Scheme		Marks
7.(a)		Attempt at $2\cos x$ Fully correct Attempt at $\tan x$ Fully correct	M1 A1 M1 A1 **(4)**
(b)(i) **(b)(ii)**	$2n$ $2n+1$		B1 B1 **(2)** **(6 marks)**

(a)

M1 Look for a symmetrical curve with maxima at 0 and 360, a minimum at 180 and passing through the x axis at 90 and 270. Ignore the curve for $x < 0$ for this mark. Condone a curve between -1 and 1

A1 Completely correct with reasonable curvature (not straight lines)

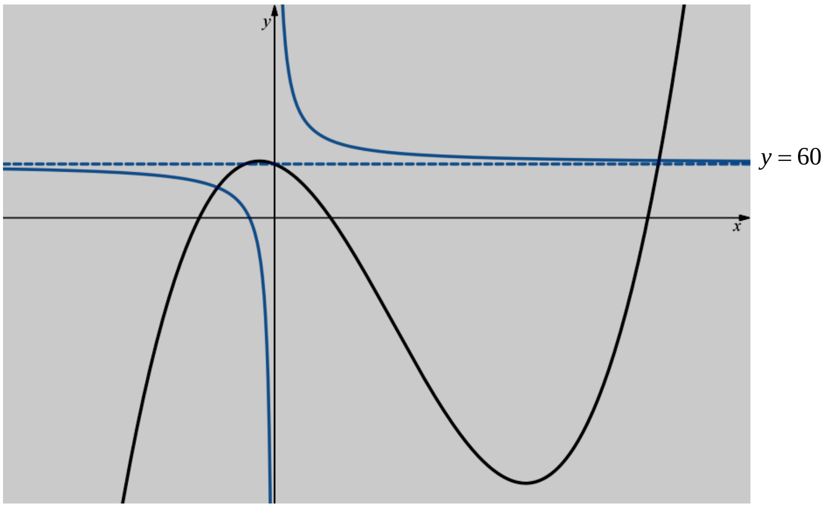
M1 Look for a curve crossing the x - axis at 0, 180 and 360 with asymptotes at 90 and 270 Ignore the curve for $x < 0$ for this mark.

A1 Completely correct with reasonable curvature

(b)

B1 For $2n$

B1 For $2n+1$

Question Number	Scheme	Marks
8. (a)	$(x+2)(x-10)(2x-3)>0 \Rightarrow \quad -2<x<\frac{3}{2}, \quad x>10$	M1 A1
		(2)
(b)	$y=(x+2)(x-10)(2x+3)=\left(x^2-8x-20\right)(2x-3)$	M1
	$=2x^3-16x^2-40x-3x^2+24x+60$	dM1
	$=2x^3-19x^2-16x+60$	A1
		(3)
		
(c)(i)	Shape for $y=\frac{k}{x}+60, x>0$	M1
	Shape and position for $y=\frac{k}{x}+60, x\in \mathrm{R}-\{0\}$- - -	A1
	$y=60$ (the asymptote) marked and in the correct position relative to $y=\mathrm{f}(x)$	A1
(ii)	Two roots	B1
		(4)
		(9 marks)

(a)

M1 For one of the intervals but condone for this mark $-2 \leqslant x \leqslant \frac{3}{2}$ or $x \geqslant 10$

A1 $-2<x<\frac{3}{2}, \quad x>10$

(b)

M1 Attempts to multiply two of the brackets together. Look for at least first and third terms correct

dM1 And then multiplies the result by the third bracket. Look for a cubic expression

A1 $=2x^3-19x^2-16x+60$

(c)

See scheme

Question Number	Scheme	Marks
9.(a)	Attempts coordinate of P $9y^2 = 64 \Rightarrow y = -\dfrac{8}{3}$	M1 A1
	Equation of l_1 is $y = 2x - \dfrac{8}{3}$	A1
		(3)
(b)	Attempts to substitute $2x = y - k$ into $4x^2 + 9y^2 + 4xy = 64$	
	$(y-k)^2 + 9y^2 + 2(y-k)y = 64$	M1 A1
	$12y^2 - 4ky + k^2 - 64 = 0$ *	A1*
		(3)
(c)	Attempts $"b^2 - 4ac" = 0 \Rightarrow 16k^2 - 4\times12\times\left(k^2 - 64\right) = 0$	M1
	Critical values $k = \pm4\sqrt{6}$	A1
	Inside region $-4\sqrt{6} < k < 4\sqrt{6}$	dM1 A1
		(4)
		(10 marks)

(a)

M1 Sets $x = 0$ in $4x^2 + 9y^2 + 4xy = 64$ and attempts to find y

A1 $y = -\dfrac{8}{3}$

A1 $y = 2x - \dfrac{8}{3}$

(b)

M1 Attempts to substitute $2x = y - k$ into $4x^2 + 9y^2 + 4xy = 64$ to achieve an equation in y only

Alternatively substitutes $x = \dfrac{y-k}{2}$ into $4x^2 + 9y^2 + 4xy = 64$ to achieve an equation in y only

A1 A correct un-simplified equation $(y-k)^2 + 9y^2 + 2(y-k)y = 64$ not involving fractions

A1* cso $12y^2 - 4ky + k^2 - 64 = 0$

(c)

M1 Attempts $"b^2 - 4ac" = 0 \Rightarrow 16k^2 - 4\times12\times\left(k^2 - 64\right) = 0$ condoning poor bracketing

A1 For critical values of $k = \pm4\sqrt{6}$

dM1 Selects inside region for their critical values

A1 $-4\sqrt{6} < k < 4\sqrt{6}$

Question Number	Scheme	Marks
10. (i)	$\frac{2x-1}{4\sqrt{x}} = \frac{2x}{4\sqrt{x}} - \frac{1}{4\sqrt{x}} = \frac{1}{2}x^{\frac{1}{2}} - \frac{1}{4}x^{-\frac{1}{2}}$	M1 A1
	$\int \frac{2x-1}{4\sqrt{x}}\,dx = \frac{1}{3}x^{\frac{3}{2}} - \frac{1}{2}x^{\frac{1}{2}} + c$	dM1 A1 A1
		(5)
(ii)	$f(x) = \frac{1}{3}ax^3 + bx + c$	M1
	Substitutes $x = 3, y = 5$ into their $f(x) = \frac{1}{3}ax^3 + bx + c \Rightarrow 5 = 9a + 3b + c$	dM1
	Substitutes $x = 3, f'(x) = 4$ into $f'(x) = ax^2 + b \Rightarrow 4 = 9a + b$	M1
	Uses 'c' = -5 and solves simultaneously	dddM1
	$f(x) = \frac{1}{27}x^3 + 3x - 5$	A1
		(5) **(10 marks)**

(i)

M1 Attempts to write as a sum of terms. Award if any coefficient or any index is correct

A1 $\frac{1}{2}x^{\frac{1}{2}} - \frac{1}{4}x^{-\frac{1}{2}}$ oe. For example accept $\frac{1}{2}\sqrt{x} - \frac{1}{4\sqrt{x}}$

dM1 Raises the power by one. One index must have been correct $\rightarrow ...x^{\frac{3}{2}} + ...x^{\frac{1}{2}}$

A1 For one correct term either $\frac{1}{3}x^{\frac{3}{2}}$ or $-\frac{1}{2}x^{\frac{1}{2}}$

A1 Fully correct $\frac{1}{3}x^{\frac{3}{2}} - \frac{1}{2}x^{\frac{1}{2}} + c$ including the + c seen on one line.

Accept exact simplified equivalents such as $\frac{1}{3}\sqrt{x^3} - \frac{1}{2}\sqrt{x} + c$ or $\frac{\sqrt{x}}{6}(2x-3) + c$

(ii)

M1 Attempts to integrate and achieves $f(x) = ...ax^3 + bx(+c)$ with or without the + c

dM1 Substitutes $x = 3, y = 5$ into their $f(x) = ...ax^3 + bx + c \Rightarrow$ equation in a, b and c (Must now have + c)

M1 Substitutes $x = 3, f'(x) = 4$ into $f'(x) = ax^2 + b \Rightarrow$ equation in a and b

dddM1 Dependent upon all previous M's. It is for solving their two equation with c = -5 to find values for a and b .

A1 $f(x) = \frac{1}{27}x^3 + 3x - 5$