

Question	Answer	Marks	Guidance
1	$2x^2 - (k+4)x + (k+4) (=0)$ $2x^2 + (-k-4)x + (k+4) (=0)$	B1	
	Discriminant: $(k+4)^2 - (4 \times 2 \times (k+4))$	M1	Use of discriminant to obtain 2 critical values using <i>their</i> 3 term quadratic
	± 4	A1	For critical values
	$k < -4$ $k > 4$	A1	
2(a)	$y = -\frac{1}{2}(x+5)(x+1)(x-2)$	3	B1 for negative soi B1 for $\frac{1}{2}$ soi B1 for $(x+5)(x+1)(x-2)$ or $x^3 + 4x^2 - 7x - 10$
2(b)	$-5 < x < -1$	B1	
	$x > 2$	B1	
3(a)	2	B1	
3(b)	6π or 1080°	B1	
3(c)		3	B1 for passing through $(-\pi, 0)$ and $(3\pi, -3)$ – must be a curve B1 for correct shape with max on y -axis and a min at $x = 3\pi$ B1 for passing through $(0, 1)$ and $(\pi, 0)$ only on the positive x -axis
4(a)	$a + 6d = 158$ $a + 9d = 149$	B1	For both equations, may be implied by a correct a and d
	$d = -3,$	B1	
	$a = 176$	B1	

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4(b)	$\frac{n}{2}(352+(n-1)(-3)) \quad (<0)$	M1	For correct attempt at sum formula with <i>their a</i> and <i>their d</i> ,
	$\frac{355}{3}$ or 118.3 oe	A1	
	119	A1	
5	$x^5 + 10x^3 + 40x + \dots$	3	M1 for attempt to expand $\left(x + \frac{2}{x}\right)^5$, with at least 2 correct terms A1 for $10x^3$ A1 for $40x$
	Term in x^2 : $(1 \times 40) - (3 \times 10)$	M1	For $(1 \times \textit{their } 40) \pm (3 \times \textit{their } 10)$
	10	A1	
6(a)	It is a one-one function because of the given restricted domain or because $x \geq -1$	B1	
6(b)		4	B1 for $y = f(x)$ for $x > -1$ only B1 for 1 on x-axis and -3 on y-axis for $y = f(x)$ B1 for $y = f^{-1}(x)$ as a reflection of $y = f(x)$ in the line $y = x$, maybe implied by intercepts with axes B1 for 1 on y-axis and -3 on x-axis for $y = f^{-1}(x)$

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7(a)	$\frac{dy}{dx} = \frac{(2x+1)\frac{6x}{3x^2-5} - 2\ln(3x^2-5)}{(2x+1)^2}$ or $\frac{dy}{dx} = (2x+1)^{-1} \frac{6x}{3x^2-5} - 2(2x+1)^{-2} \ln(3x^2-5)$	3	B1 for $\frac{6x}{3x^2-5}$ M1 for attempt at a quotient or equivalent product A1 for all terms other than $\frac{6x}{3x^2-5}$ correct
	When $x = \sqrt{2}$, $y = 0$	B1	May be implied
	When $x = \sqrt{2}$, $\frac{dy}{dx} = \frac{6\sqrt{2}}{2\sqrt{2}+1}$ or $\frac{24-6\sqrt{2}}{7}$ or 2.22 oe Normal: $y = -\frac{(2\sqrt{2}+1)}{6\sqrt{2}}(x-\sqrt{2})$ oe or $y = -\frac{7}{24-6\sqrt{2}}(x-\sqrt{2})$ oe or $y = -\frac{1}{2.22}(x-\sqrt{2})$ oe or $y = -\frac{4+\sqrt{2}}{12}(x-\sqrt{2})$ oe or $y = -\frac{9+4\sqrt{2}}{24+6\sqrt{2}}(x-\sqrt{2})$ oe $y = -0.451x + 0.638$	2	M1 for attempt at normal using <i>their</i> y and <i>their</i> perp gradient A1 Allow equivalent surd forms
7(b)	$\left(\frac{6\sqrt{2}}{2\sqrt{2}+1}\right)h$ or $\frac{24-6\sqrt{2}}{7}h$ or other equivalent surd forms, or 2.22h	B1	FT on <i>their</i> $\frac{dy}{dx}$ from (a)
8(a)	${}^{12}C_3 \times {}^9C_4 = 220 \times 126$ or ${}^{12}C_5 \times {}^7C_4 = 792 \times 35$ or ${}^{12}C_4 \times {}^8C_5 = 495 \times 56$ or other equivalents 27720	3	B1 for one correct combination in a product of 2 or 3 combinations Must be numeric B1 for a second appropriate combination in the same product Must be numeric
8(b)(i)	120	B1	
8(b)(ii)	48	B1	

Question	Answer	Marks	Guidance								
8(b)(iii)	Starts with 7 or 9 24	B1	May be implied by 12 and 12								
	Starts with 8 18	B1									
	42	B1									
	Alternative Ends with 3 18	(B1)									
	Ends with 7 or 9 24	(B1)	May be implied by 12 and 12								
	42	(B1)									
9(a)	$\frac{dy}{dx} = (2x-1) \times \frac{1}{2} \times 4(4x+3)^{-\frac{1}{2}} + 2(4x+3)^{\frac{1}{2}}$	3	B1 for $\frac{1}{2} \times 4(4x+3)^{-\frac{1}{2}}$ oe M1 for a correct attempt at a product A1 for all other terms correct								
	$\frac{dy}{dx} = 2(4x+3)^{-\frac{1}{2}}(2x-1+4x+3)$ or equivalent	M1	For attempt to simplify to the given form								
	$\frac{dy}{dx} = \frac{4(3x+1)}{(4x+3)^{\frac{1}{2}}}$	A1									
9(b)	$-\frac{1}{3}$	B1	FT on <i>their</i> $3x+1=0$								
9(c)	For a complete method using 2 nd derivative, or gradient or <i>y</i> values either side or one side of <i>their</i> stationary point e.g.	M1	Must be using values of $x > -\frac{3}{4}$								
	<table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td style="text-align: center;"><i>x</i></td> <td style="text-align: center;">$< -\frac{1}{3}$</td> <td style="text-align: center;">$-\frac{1}{3}$</td> <td style="text-align: center;">$> -\frac{1}{3}$</td> </tr> <tr> <td style="text-align: center;">$\frac{dy}{dx}$</td> <td style="text-align: center;">–</td> <td style="text-align: center;">0</td> <td style="text-align: center;">+</td> </tr> </tbody> </table>			<i>x</i>	$< -\frac{1}{3}$	$-\frac{1}{3}$	$> -\frac{1}{3}$	$\frac{dy}{dx}$	–	0	+
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<i>y</i>	< -2.15	–2.15	> -2.15								
Minimum	A1	Must be from correct work									

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10(a)	$p(2): 48 + 4a + 2b + 2 = 0$ $2a + b + 25 = 0$	B1	For $2a + b + 25 = 0$ or multiple
	$p(1) = -2p(0)$ $a + b + 12 = 0$	B1	For $a + b + 12 = 0$
	$a = -13, \quad b = 1$	2	M1 for attempt to solve <i>their</i> equations in a and b leading to 2 values A1 for both
10(b)(i)	$p\left(\frac{1}{2}\right) = \frac{6}{8} - \frac{13}{4} + \frac{1}{2} + 2$	M1	For attempt to find $p\left(\frac{1}{2}\right)$ using <i>their</i> a and b
	0	A1	
10(b)(ii)	$(x - 2)(2x - 1)(3x + 1)$	2	M1 for realising that 2 factors are known and 3 rd factor can be got by observation or algebraic long division, or for making use of $x - 2$ or $2x - 1$ in order to obtain a quadratic factor A1 Must see all factors together
11(a)	$\angle BOC = 1.5 \text{ rad}$	B1	
	$\sin 0.75 = \frac{BC/2}{r}$	M1	For a complete attempt to find BC – must be using a right-angled triangle to get required result – Given answer
	$BC = 2r \sin 0.75$	A1	
	Perimeter = $2r + 2r \sin 0.75 + 4r + 1.5r$	M1	Dep on first M mark for attempt at perimeter
	$r(7.5 + 2 \sin 0.75)$	A1	Given answer
11(b)	Area = $(2r + 2r \sin 0.75)r - \frac{1}{2}r^2(1.5 - \sin 1.5)$ Area = $3.36r^2 - 0.75r^2 + 0.4987r^2$	3	M1 for a correct plan M1 for $(2r + 2r \sin 0.75)r$, using <i>their</i> $2r \sin 0.75$ B1 for segment $\frac{1}{2}r^2(1.5 - \sin 1.5) = 0.251r^2$
	Area = $3.11r^2$	A1	

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12(a)(i)	Area under graph: $\frac{1}{2}(60+40)\times 30 + \frac{1}{2}(30+V)\times 30 \quad (=2775)$ or $\frac{1}{2}(20\times 30) + (40+30) + \frac{1}{2}(30+V)\times 30$	2	M1 for attempt to find the area under the graph Dep M1 on previous M mark for attempt to equate to 2775 and simplify in order to find V or $V - 30$
	55	A1	
12(a)(ii)	0	B1	
12(b)(i)	$v = 3\sin 2t \quad (+c)$	M1	Must have $\pm 3\sin 2t$
	$10 = c$	M1	Dep for attempt to find $+c$,
	$v = 3\sin 2t + 10$	A1	
12(b)(ii)	$s = -\frac{3}{2}\cos 2t + 10t + d$	M1	For attempt to integrate <i>their</i> v , must have $\pm\frac{3}{2}\cos 2t$
	$d = \frac{3}{2}$	M1	Dep on previous M mark for attempt to find d .
	$s = -\frac{3}{2}\cos 2t + 10t + \frac{3}{2}$	A1	