

Question	Answer	Marks	Partial Marks
1(a)	$x = 2, x = \frac{4}{5}$ oe	3	B1 for $x = 2$ M1 for $5x - 7 = \text{their } (-3)$ oe, soi or $25x - 35 = \text{their } (-15)$ oe, soi A1 for $x = \frac{4}{5}$ oe Alternative method B1 for $25x^2 - 70x + 40 = 0$ oe M1 for factorising e.g. $(5x - 4)(x - 2)$ A1 for $x = 2, \frac{4}{5}$
1(b)	Finds three correct critical values: -1.5 to -1.4 inclusive -0.4 0.8 to 0.9 inclusive	B1	
	A correct pair of inequalities: $x \leq -1.45$ and $-0.4 \leq x \leq 0.85$	B2	B1 for either inequality correct
2	$m = \frac{9-5}{8-6}$ oe	M1	
	$9 = \text{their } 2(8) + c$ oe or $5 = \text{their } 2(6) + c$ oe or $Y - 9 = \text{their } 2(X - 8)$ oe or $Y - 5 = \text{their } 2(X - 6)$ oe	M1	
	$\ln y = 2 \ln x - 7$	A1	
	Correct completion to answer: $y = e^{\ln x^2 - 7} = e^{-7} x^2$ nfw	A1	
	Alternative $\ln y = p + q \ln x$ soi	(B1)	
	$m = \frac{9-5}{8-6}$ oe	(M1)	
	$9 = \text{their } 2(8) + c$ oe or $5 = \text{their } 2(6) + c$	(M1)	
$y = e^{-7} x^2$	(A1)		

Question	Answer	Marks	Partial Marks
3	Uses $b^2 - 4ac$: $6^2 - 4(2k - 1)(k + 1)$	M1	
	$-8k^2 - 4k + 40$ [*0 where * is = or any inequality sign] oe	M1	dep on first M1 Condone one sign or arithmetic slip in simplification
	Factorises or solves <i>their</i> 3-term quadratic expression or equation for critical values	M1	e.g. $(5 + 2k)(8 - 4k)$ oe
	Finds correct critical values: -2.5 oe, 2	A1	
	$-2.5 \leq k \leq 2$	A1	mark final answer
4(a)(i)	$3 \times 10! \times 4$	M1	
	43 545 600 oe	A1	
4(a)(ii)	$5! \times 8 \times 7!$ oe	M1	
	4 838 400 oe	A1	
4(b)(i)	9C_3	M1	
	84	A1	
4(b)(ii)	${}^3C_1 \times {}^4C_1 \times {}^5C_1$ oe	M1	
	60	A1	
5	$\frac{dy}{dx} = \sec^2 x$	B1	
	$\frac{\delta y}{h} = \text{their } \frac{dy}{dx} \Big _{x=-\frac{\pi}{4}}$	M1	
	$2h$	A1	

Question	Answer	Marks	Partial Marks
6	$\frac{dy}{dx} = \frac{1}{5-3x} \times -3$	M2	M1 for $\frac{dy}{dx} = \frac{k}{5-3x}, k \neq -3$
	$\frac{dy}{dx} \Big _{x=-5} = -\frac{3}{20}$	A1	
	$y = \ln 20$ isw or 2.9957...	B1	
	$m_{\perp} = \frac{20}{3}$ oe	M1	FT $-\frac{1}{\text{their} \left(-\frac{3}{20}\right)}$
	$y - \ln 20 = \frac{20}{3}(x + 5)$ oe, isw or $y - 2.9957... = 6.67(x + 5)$ oe, isw	A1	FT <i>their</i> y and <i>their</i> perpendicular gradient
	-5.45 or -5.449[35...] rot to 4 or more significant figures	A1	
7(a)(i)	$(x - 8)^2 + (y - 5)^2 - 64 - 25 + 73 = 0$ oe	M1	
	(8, 5)	A1	
	$r = 4$	A1	
	Alternative Centre (8, 5)	(B1)	
	$r = \sqrt{(-8)^2 + (-5)^2 - 73}$ oe	(M1)	
	$r = 4$	(A1)	
7(a)(ii)	[Distance between (10, 6.5) and centre =] $\sqrt{(10 - 8)^2 + (6.5 - 5)^2}$	M1	FT <i>their</i> (8, 5)
	[Distance between (10, 6.5) and centre < radius] 2.5 oe < 4	A1	
7(b)	$[r_2 - r_1 =] 4 - 1.5 = 2.5$ [= distance between centres]	B1	
8(a)(i)	Uses correct Pythagorean identity in the left-hand side of the given identity e.g. $\frac{1 - \sin^2 2x}{1 + \sin 2x}$	M1	
	$\frac{(1 - \sin 2x)(1 + \sin 2x)}{1 + \sin 2x}$ oe and completion to given answer	A1	

Question	Answer	Marks	Partial Marks
8(a)(ii)	$\sin 2x = \frac{2}{3}$	M1	
	$x = \frac{1}{2} \sin^{-1} \left(\frac{2}{3} \right)$ soi	M1	dep on first M1
	20.9 or 20.905... rounded or truncated to 4 or more figures and 69.1 or 69.094... rounded or truncated to 4 or more figures	A2	with no incorrect values in range A1 for either angle correct, ignoring extra values
8(b)	$\tan \left(y - \frac{\pi}{2} \right) = \frac{1}{\sqrt{3}}$ soi	M1	
	$y = \frac{\pi}{6} + \frac{\pi}{2}$	M1	dep on first M1
	$\frac{2}{3}\pi$ oe or 2.09 or 2.094[39...] rot to 4 or more sig figs	A1	with no incorrect values in range
9(a)	[radius =] $\sqrt{8^2 + 15^2}$ or 17	B1	
	[angle AOB =] $\pi - 2 \tan^{-1} \frac{8}{15}$ oe or $\cos^{-1} \left(\frac{17^2 + 17^2 - 30^2}{2 \times 17 \times 17} \right)$ oe	M1	FT <i>their</i> 17 if necessary
	2.16[167...]	A1	
	$8 + 8 + 30 + 17 \times 2.16[167...]$	M1	FT <i>their</i> 17 and <i>their</i> 2.16[167...]
	82.7[485...]	A1	
9(b)	Complete correct plan including use of $\frac{1}{2}r^2\theta$	M1	
	432[.362...]	A1	

Question	Answer	Marks	Partial Marks
10(a)	Identifies the correct term: ${}^5C_2 \times (2k)^3 \times \left(-\frac{1}{k}\right)^2 [x x^2]$ oe, soi	B1	
	$10 \times \frac{8k^3}{k^2} = 160$ soi	M1	FT only for correct term with bracketing errors; condone one slip.
	$k = 2$ nfw	A1	
10(b)(i)	$1 + 18x + 135x^2$	B2	B1 for any 2 terms correct or for all 3 correct terms listed but not summed or M1 for a correct unsimplified expansion, e.g.: $1 + 6(3x) + 15(3x)^2$
10(b)(ii)	Uses constant/coefficient of x to find $a = -2$ only	B2	B1 for both $a = 2$ and -2 or for both $a = \frac{17}{9}$ and -2
	$b = 469$ only	B1	FT <i>their</i> calculated value of a
11(a)	$y = \frac{30}{x^2}$ oe	B1	
	$S = \pi x \sqrt{x^2 + \left(\text{their } \frac{30}{x^2}\right)^2}$	M1	FT <i>their</i> $\frac{30}{x^2}$ providing $10\pi = \frac{1}{3}\pi x^2 y$ was attempted
	Correct completion to given answer	A1	

Question	Answer	Marks	Partial Marks
11(b)	$\frac{d([\pi]\sqrt{x^6+900})}{dx} = [\pi \times] \frac{1}{2}(x^6+900)^{-\frac{1}{2}} \times 6x^5$	B2	B1 for $[\pi \times] (x^6+900)^{-\frac{1}{2}}, k \neq 3$ or 0
	Applies correct form of quotient or product rule, e.g.: $\frac{\pi x(3x^5(x^6+900)^{-\frac{1}{2}}) - \pi(x^6+900)^{\frac{1}{2}}}{x^2}$ or $-\pi x^{-2}(x^6+900)^{\frac{1}{2}} + \frac{\pi}{x}(3x^5(x^6+900)^{-\frac{1}{2}})$	M1	FT <i>their</i> $\frac{d([\pi]\sqrt{x^6+900})}{dx}$
	<i>their</i> $\frac{dS}{dx} = 0$ and attempt to solve	M1	dep on previous M1
	2.77 or 2.768[2...] rot to 4 or more sig figs or $\sqrt[6]{450}$ isw	A1	
12	x coordinate of $A = 6$ soi	B1	
	x coordinate of $B = 9$ soi	B1	
	$k - 3 = (9 - k)(k - 3)$	M1	
	$k = 8$ [therefore $C(8, 5)$]	A1	
	$(8 - 6) \times 5$ or 10 oe soi	B1	
	$\left[F(x) = \int_{\text{their } 8}^{\text{their } 9} (12x - 27 - x^2) dx = \right] \frac{12}{2}x^2 - 27x - \frac{x^3}{3}$	M2	M1 for 2 correct terms
	<i>their</i> $10 + F(\text{their } 9) - F(\text{their } 8)$	M1	dep on at least M1 for integration
	$\frac{38}{3}$ or $12\frac{2}{3}$ or 12.7 or 12.66[66...] rot to 4 or more sig figs nfw	A1	