

Question	Answer	Marks	Guidance
1	$\pm 3(x+4)(2x-1)(x-2)$	3	B1 for \pm B1 for 3, may be implied by a linear factor B1 for $(x+4)(2x-1)(x-2)$ and no extra terms; may be implied if 3 is included
2(a)	$2^{8(x+y)} \times 2^{4(-2x)} = 2^{3(-x+3y)}$	M1	For attempt at a common factor, must have at least one correct
	$y = 3x$	A1	Must show sufficient detail
2(b)	$x^2 + 3(9x^2) = 56$ or $\frac{y^2}{9} + 3y^2 = 56$	M1	For obtaining an equation in terms of one variable using <i>their</i> $y = 3x$ with attempt to solve to obtain $x =$, or $y =$
	$x = \sqrt{2}, y = 3\sqrt{2}$ or exact equivalent $x = -\sqrt{2}, y = -3\sqrt{2}$ or exact equivalent	2	A1 for a correct pair
3	$b = \frac{3}{8}$	B1	
	$6 = a + c$ or $0 = -\frac{a}{2} + c$	M1	For using either intercept with <i>their</i> b
	$c = 2$	A1	
	$a = 4$	A1	
4	$\ln(4x+3)$	B1	
	$2\ln(8a+7) - 2\ln(3)$ ($= \ln 16$)	M1	Dep for correct application of limits in <i>their</i> $k \ln(4x+3)$
	$(2)\ln \frac{8a+7}{3}$ oe	M1	Dep for use of division rule
	$\ln 16 = 2\ln 4$ oe	B1	
	$a = \frac{5}{8}$ only	A1	
5(a)	${}^{15}C_3 k^3 = -29120$ oe	M1	
	$k = -4$	A1	

Question	Answer	Marks	Guidance
5(b)	${}^{12}C_8(8y^2)^4\left(-\frac{1}{2y}\right)^8$ or ${}^{12}C_4(8y^2)^4\left(-\frac{1}{2y}\right)^8$	M1	
	7920	A1	
6	$b = 12$	2	M1 for attempt at differentiation
	$-27a + 99 - 3b + c = 0$ $a + 11 + b + c = 16$	2	M1 for attempt at $p(-3) = 0$ or $p(1) = 16$
	$a = 2$ $c = -9$	2	M1 for attempt to solve <i>their</i> equations
7(a)	$e^{5y} = mx^3 + c$ soi	B1	
	$4.38 = -2.56m + c$ $9.84 = 6.54m + c$	M1	Must be using the coordinates correctly
	$m = 0.6, c = 5.92$	2	M1 dep for solution of <i>their</i> equations
	$y = \frac{1}{5} \ln(0.6x^3 + 5.92)$	A1	
	Alternative		
	$e^{5y} = mx^3 + c$ soi	B1	
	Gradient = $\frac{5.46}{9.1}$ ($= m$)	M1	Must be using the coordinates correctly
	$4.38 = -2.56m + c$ or $9.84 = 6.54m + c$	M1	Must be using the coordinates correctly
	$m = 0.6, c = 5.92$	A1	
$y = \frac{1}{5} \ln(0.6x^3 + 5.92)$	A1		
7(b)	$0.6x^3 + 5.92 > 0$	M1	Allow use of <i>their</i> $\frac{1}{5} \ln(0.6x^3 + 5.916)$
	$x > -2.14$	2	M1 dep for a correct method of solution to obtain $x > \dots$

Question	Answer	Marks	Guidance
8	$(f'(x) =) k(3x+5)^{\frac{1}{3}} (+c)$	M1	
	$(f'(x) =) (3x+5)^{\frac{1}{3}} (+c)$	A1	Allow unsimplified
	$(f'(1) =) 6 = (3+5)^{\frac{1}{3}} + c$	M1	Dep M1 for use of given condition
	$f'(x) = (3x+5)^{\frac{1}{3}} + 4$ soi	A1	
	$m(3x+5)^{\frac{4}{3}}$	M1	
	$(f(x) =) m(3x+5)^{\frac{4}{3}} + cx + d$	M1	Dep M1, FT on their c
	$(f(1) =) 20 = m(8)^{\frac{4}{3}} + c + d$	M1	Dep M1, FT on their c
	$(f(x) =) \frac{1}{4}(3x+5)^{\frac{4}{3}} + 4x + 12$	A1	
9(a)	$\frac{dy}{dx} = \frac{(x+1)(-3e^{-3x+2}) - e^{-3x+2}}{(x+1)^2}$	3	B1 for $-3e^{-3x+2}$ M1 for correct attempt at differentiation of a quotient A1 all terms apart from $-3e^{-3x+2}$ correct
	$\frac{e^{-3x+2}(-3x-4)}{(x+1)^2}$	2	M1 dep for attempt to obtain the given form, allow sign errors
9(b)	$e^{-3x+2} \neq 0$	B1	
	$x = -\frac{4}{3}$	B1	FT on their $-3x-4$ $\frac{dy}{dx}$ must be in the correct form
	$y = -3e^6$	B1	
10(a)	$ar^2 = 6$ $ar^7 = 1458$ soi	B1	
	$r^5 = 243$	B1	
	$r = 3$	B1	
	$a = \frac{2}{3}$	B1	

Question	Answer	Marks	Guidance
10(b)	$r = 2\cos\theta$	B1	
	$-\frac{1}{2} < \cos\theta < \frac{1}{2}$ $-1 < 2\cos\theta < 1$ $ 2\cos\theta < 1$	B1	
	$-90^\circ < \theta < -60^\circ$	B1	
	$60^\circ < \theta < 90^\circ$	B1	
11	$4x + k\cos 3x$	M1	
	$4x - \frac{2}{3}\cos 3x$	A1	
	$\left(\frac{4\pi}{3} - k\cos\pi\right) - \left(\frac{4\pi}{18} - k\cos\frac{\pi}{6}\right)$	M1	M1 dep for correct application of limits
	Area under the curve $\frac{10\pi}{9} + \frac{2}{3} + \frac{\sqrt{3}}{3}$	A2	A1 for one correct term
	When $x = \frac{\pi}{18}$, $y = 5$	B1	May be seen on the diagram
	When $x = \frac{\pi}{3}$, $y = 4$	B1	May be seen on the diagram
	Area of trapezium = $\frac{5\pi}{4}$	B1	For area of trapezium
	Shaded area = $\frac{2}{3} + \frac{\sqrt{3}}{3} - \frac{5\pi}{36}$	A1	

Question	Answer	Marks	Guidance
12(a)	$2(\cot^2 \theta + 1) - 5 = 5 \cot \theta$ soi	B1	
	$2 \cot^2 \theta - 5 \cot \theta - 3 = 0$	M1	For attempt to obtain a 3-term quadratic in terms of $\cot \theta$, equated to zero
	$(2 \cot \theta + 1)(\cot \theta - 3) = 0$	M1	M1 dep for attempt to factorise, or use of quadratic formula oe
	$\tan \theta = -2, \tan \theta = \frac{1}{3}$	M1	M1 dep for obtaining in terms of $\tan \theta$, using <i>their</i> factors
	$-161.6^\circ, -63.4^\circ, 18.4^\circ, 116.6^\circ$	3	M1 for a correct solution A1 for another correct solution A1 for a further 2 correct solutions and no extras in the range
	Alternative		
	$2(\cot^2 \theta + 1) - 5 = 5 \cot \theta$ soi	B1	
	$2 \cot^2 \theta - 5 \cot \theta - 3 = 0$	M1	For attempt to obtain a 3-term quadratic in terms of $\cot \theta$, equated to zero
	$3 \tan^2 \theta + 5 \tan \theta - 2 = 0$	M1	M1 dep for attempt to obtain a 3-term quadratic in terms of $\tan \theta$, equated to zero
	$(3 \tan \theta - 1)(\tan \theta + 2) = 0$ $\tan \theta = -2, \tan \theta = \frac{1}{3}$	M1	M1 dep for attempt to factorise, or use of quadratic formula oe and obtaining $\tan \theta = \dots$
$-161.6^\circ, -63.4^\circ, 18.4^\circ, 116.6^\circ$	3	M1 for a correct solution A1 for another correct solution A1 for a further 2 correct solutions and no extras in the range	
10(b)	$\sin(2\phi + 1.5) = \frac{2}{3}$ $2\phi + 1.5 = 0.7297\dots$ soi	M1	
	$2\phi + 1.5 = 2.4119$ or 7.0129 or 8.6591	A1	
	$0.456, 2.76, 3.6[0]$	3	M1 for correct order of operations A1 for one correct solution A1 for a further 2 correct solutions and no extras in the range.