Question	Answer	Marks	Partial Marks
1	$a = 2$	**B1**	Allow embedded
	$b = 3$	**B1**	
	$c = -4$	**B1**	
2	$5x + 2 = 3x - 4$ $x = -3$	**B1**	
	$5x + 2 = -3x + 4$ $x = \frac{1}{4}$	**2**	**M1** for change of sign
	$\left\|2\left(\frac{1}{4}\right) - 3\right\| - \|-3 - 1\|$	**M1**	For correct substitution of *their* values for a and b
	$-\frac{3}{2}$	**A1**	
	Alternative $(5x + 2)^2 = (3x - 4)^2$ $16x^2 + 44x - 12 = 0$ oe	**(M1)**	For squaring and attempt to simplify to a 3-term quadratic equation equated to zero and attempt to solve
	$x = -3, \frac{1}{4}$	**(A2)**	**A1** for each
	$\left\|2\left(\frac{1}{4}\right) - 3\right\| - \|-3 - 1\|$	**(M1)**	For correct substitution of *their* values for a and b
	$-\frac{3}{2}$	**(A1)**	

Question	Answer	Marks	Partial Marks
3	$9kx + 1 = kx^2 + 3x(2k + 1) + 4$, leading to $kx^2 + x(3 - 3k) + 3$ [= 0] soi	**M1**	For equating the two equations and attempt to obtain a 3-term quadratic equation equated to zero.
	$(3 - 3k)^2 - (4 \times 3k)$	**M1**	**dep** on previous **M** mark for attempt to use the discriminant in any form
	$3k^2 - 10k + 3$ (< 0)	**M1**	**dep** on previous **M** mark for simplification to a 3-term quadratic equation in terms of k
	Critical values 3 and $\frac{1}{3}$	**A1**	For both
	$\frac{1}{3} < k < 3$	**A1**	
4(a)	Use of $\cot^2\theta + 1 = \operatorname{cosec}^2\theta$ leading to $\operatorname{cosec}\theta = \pm 5$ or other valid method	**2**	**M1** for use of correct identity or other valid method
	$\sin\theta = -\frac{1}{5}$ oe	**A1**	
4(b)	$\cos\theta = \frac{2\sqrt{6}}{5}$ oe	**2**	**M1** for $\cos\theta = \pm\sqrt{\frac{24}{25}}$ oe
5	$3y^2 + 2y - 1$ [= 0] oe or $4x^2 - 4x - 3$ [= 0] oe	**M1**	For obtaining a 3-term quadratic equation in y or x **and** an attempt to solve
	$x = \frac{3}{2}, y = \frac{1}{3}$ $x = -\frac{1}{2}, y = -1$	**A2**	**A1** for both x values correct or both y values correct or one correct pair
6(a)	Gradient of $PQ = \frac{12}{6}$, gradient of $QR = -\frac{4}{8}$ oe	**B1**	Must see sufficient detail e.g. difference in y-values/difference in x-values
	Product of gradients = –1 oe, so lines are perpendicular	**B1**	
6(b)	Midpoint of $PR = (3, -4)$	**2**	**B1** for each **FT** on *their* diameter
	$\text{Radius}^2 = 65$ oe	**2**	**M1** for correct method of finding the radius or radius^2 **FT** on *their* diameter
	$(x - 3)^2 + (y + 4)^2 = 65$ isw	**A1**	

Question	Answer	Marks	Partial Marks
7(a)	$2\pi r - 2r\theta + 2r\sin\theta$ or $2\pi r - 2r\theta + \sqrt{2r^2 - 2r^2\cos 2\theta}$	**3**	**B2** for 2 correct terms or **B1** for a correct arc length or chord length
7(b)	$\pi r^2 - r^2\theta + \frac{1}{2}r^2\sin 2\theta$	**3**	**B2** for 2 correct terms or **B1** for a correct sector area or correct area for triangle *ABC*
8(a)	$\frac{dy}{dx} = \tan x(3\cos 3x) + \sin 3x\sec^2 x$	**3**	**M1** for attempt at differentiation of a product **B1** for $3\cos 3x$ **A1** for all other terms correct
	$-3\sqrt{3}$	**A1**	
8(b)	$\frac{dy}{dt} = their\ \frac{dy}{dx} \times 3$	**M1**	
	$-9\sqrt{3}$	**A1**	
8(c)	$-3\sqrt{3}\,h$	**B1**	**FT** on *their* answer to **(a)**
9(a)	$\frac{(4x-1)(2x+1)-(4x-1)+4(2x+1)^2}{(2x+1)^2(4x-1)}$	**M1**	For attempt to obtain a single fraction An extra term of $(2x + 1)$ throughout must be dealt with correctly before awarding **M1**
	$\frac{24x^2+14x+4}{(2x+1)^2(4x-1)}$	**A1**	Must see sufficient detail of expansion and collecting terms correctly to obtain the given answer.

Question	Answer	Marks	Partial Marks
9(b)	$\frac{1}{2}\ln(2x+1)$	**B1**	
	$\frac{1}{2(2x+1)}$	**B1**	Allow $\frac{-(2x+1)^{-1}}{-1\times 2}$ oe
	$\ln(4x-1)$	**B1**	
	$\left(\frac{1}{2}\ln 3+\frac{1}{6}+\ln 3\right)-\left(\frac{1}{2}\ln 2+\frac{1}{4}[+\ln 1]\right)$	**M1**	For correct application of limits, must have at least one logarithmic term Must be using individual fractions from part **(a)**. Fractions and logarithmic terms must be bracketed correctly and manipulated correctly
	$\frac{1}{2}\ln\frac{27}{2}-\frac{1}{12}$	**3**	**M1** for application of log laws using $\frac{1}{2}\ln 3+\ln 3-\frac{1}{2}\ln 2$ to obtain the correct form **A1** for $\frac{1}{2}\ln\frac{27}{2}$ **B1** for $-\frac{1}{12}$
10(a)	Velocity vector = $\begin{pmatrix}-8\\6\end{pmatrix}$	**2**	**M1** for obtaining 5 using the magnitude of the direction vector
	$\begin{pmatrix}30\\10\end{pmatrix}+\begin{pmatrix}-8\\6\end{pmatrix}t$	**B1**	**FT** for $\begin{pmatrix}30\\10\end{pmatrix}$ + (*their* velocity vector)t
10(b)	13	**B1**	

Question	Answer	Marks	Partial Marks
10(c)	$P: \begin{pmatrix} -50 \\ 70 \end{pmatrix}$ $Q: \begin{pmatrix} -30 \\ 30 \end{pmatrix}$	**M1**	For using $t = 10$ to find the position vector of each particle
	$\sqrt{20^2 + 40^2}$	**M1**	**dep** on previous **M** mark, for use of Pythagoras on the difference of the 2 position vectors
	$20\sqrt{5}$	**A1**	
11	$\frac{40n!}{(n-5)!5!} = \frac{2(n-1)(n+1)!}{(n-5)!6!}$ $40 = \frac{n^2-1}{3}$	**B2**	**B1** soi for simplifying numerical factorials to 3 **B1** for simplifying algebraic factorials to either $(n - 1)(n + 1)$ or $n^2 - 1$
	$n = 11$	**B1**	
12	$3 + \log_3 x = \frac{10}{\log_3 x}$ or $3 + \frac{1}{\log_x 3} = 10\log_x 3$	**B1**	For change of base
	$(\log_3 x)^2 + 3\log_3 x - 10 = 0$ or $10(\log_x 3)^2 - 3\log_x 3 - 1 = 0$ $\log_3 x = -5 \quad \log_3 x = 2$ or $\log_x 3 = -\frac{1}{5} \quad \log_x 3 = \frac{1}{2}$	**M1**	**dep** on previous **B** mark, for attempt to obtain a 3-term quadratic equation and attempt to solve to obtain 2 solutions of the form $\log_3 x = p$ or $\log_x 3 = q$
	$3^{-5} \quad 3^2$ isw	**2**	**A1** for each

Question	Answer	Marks	Partial Marks
13	$\frac{dy}{dx} = me^{3x} + 2x^2 \ (+ c)$	**M1**	
	$\frac{dy}{dx} = 2e^{3x} + 2x^2 \ (+ c)$	**A1**	
	$5 = 2 + c$ $c = 3$	**M1**	**dep** on previous **M** mark
	$y = pe^{3x} + qx^3 \ (+ cx + d)$	**M1**	
	$y = \frac{2}{3}e^{3x} + \frac{2}{3}x^3 \ (+ cx + d)$	**A1**	
	$\frac{5}{3} = \frac{2}{3} + d$ $d = 1$	**M1**	**dep** on previous **M** mark
	$y = \frac{2}{3}e^{3x} + \frac{2}{3}x^3 + 3x + 1$	**A1**	
14	$\frac{dy}{dx} = \frac{(2x+1)\frac{4}{(4x-1)} - 2\ln(4x-1)}{(2x+1)^2}$	**3**	**B1** for $\frac{4}{(4x-1)}$ **M1** for attempt at differentiating a quotient or correct product **A1** for all other terms correct
	At A, $x = \frac{1}{2}$	**B1**	
	Gradient at $A = 2$	**2**	**M1** for substitution of *their* x into *their* $\frac{dy}{dx}$
	Equation of normal $y = -\frac{1}{2}\left(x - \frac{1}{2}\right)$	**2**	**M1 dep** on previous **M1** for attempt at normal equation using *their* values
	Coordinates of B $\left(0, \frac{1}{4}\right)$	**A1**	