Question Number	Scheme	Notes	Marks
9	$\frac{x^2}{9}+\frac{y^2}{4}=1,\quad y=kx-3$		
(a)	$\frac{x^2}{9}+\frac{(kx-3)^2}{4}=1\left(\text{or } \frac{x^2}{9}+\frac{k^2x^2-6kx+9}{4}=1\right)\Rightarrow 4x^2+9\left(k^2x^2-6kx+9\right)=36$ Substitutes to obtain a quadratic in x and eliminates fractions		M1
	$\left(9k^2+4\right)x^2-54kx+45=0$*	Correct proof with no errors	A1*
			(2)
(b)	$x=\frac{1}{2}\left(\frac{54k}{9k^2+4}\right)=\frac{27k}{9k^2+4}$ OR $x=\frac{54k\pm\sqrt{\text{discriminant}}}{2\left(9k^2+4\right)}$	Uses ½ sum of roots for the x coordinate OR Solve the equation (by formula), add the 2 roots and halve the result. Must reach x_m. Allow errors in the discriminant	M1
	$y=k\left(\frac{27k}{9k^2+4}\right)-3$ $y=\frac{27k^2-27k^2-12}{9k^2+4}=-\frac{12}{9k^2+4}$	Uses the straight line equation to find y as a single fraction, can be unsimplified Depends on first M mark of (b)	dM1
	$x=\frac{27k}{9k^2+4},\quad y=-\frac{12}{9k^2+4}$	Fully correct work	A1
			(3)
(c)	$x^2=\frac{729k^2}{\left(9k^2+4\right)^2}\Rightarrow x^2+py^2=\frac{729k^2+144p}{\left(9k^2+4\right)^2}$ Obtains an expression for x^2+py^2 using their coordinates obtained in (b) and obtains a common denominator		M1
	$\frac{729k^2+144p}{\left(9k^2+4\right)^2}=-\frac{12q}{\left(9k^2+4\right)}\Rightarrow 729k^2+144p=-12q\left(9k^2+4\right)$ $729k^2+144p=81\left(9k^2+\frac{16}{9}p\right)$ $\Rightarrow \frac{16}{9}p=4\Rightarrow p=...$ Correct strategy to obtain a value for p or for q Depends on the first M mark of (c)		dM1
	$p=\frac{9}{4}$ or $q=-\frac{27}{4}$ oe	Correct value (or for q if found first)	A1
	$-12q=81\Rightarrow q=...$	Correct strategy to obtain a value for the second variable Depends on both previous M marks	ddM1
	$\Rightarrow x^2+\frac{9}{4}y^2=-\frac{27}{4}y$ $p=\frac{9}{4}$ and $q=-\frac{27}{4}$ oe	Both values correct – can be embedded in the equation	A1
			(5)

(c) **Way 2**	$x=\dfrac{27k}{9k^2+4},\quad y=-\dfrac{12}{9k^2+4}\Rightarrow \dfrac{x}{y}=-\dfrac{27k}{12}\Rightarrow k=-\dfrac{4x}{9y}$ Obtains k in terms of x and y using their coordinates found in (b)		M1
	$k=-\dfrac{4x}{9y}\Rightarrow y=-\dfrac{12}{9\left(\dfrac{16x^2}{81y^2}\right)+4}$ or $x=\dfrac{27\left(-\dfrac{4x}{9y}\right)}{9\left(\dfrac{16x^2}{81y^2}\right)+4}$ dM1:Substitutes k into y or x to obtain a Cartesian equation A1: Any correct Cartesian equation Depends on the first M mark of (c)		dM1A1
	$\Rightarrow x^2+\dfrac{9}{4}y^2=-\dfrac{27}{4}y$	Rearranges to the form required Depends on both previous M marks of (c)	ddM1
		Correct equation or correct values stated	A1
			Total 10

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