Question Number	Scheme	Marks
9. (a)	$\frac{1}{4}$	B1 **(1)**
(b)	$f'(x)=\frac{3}{\sqrt{x}}\ln(4x)+6\sqrt{x}\times\frac{1}{x}$	M1 A1
	Sets $\frac{3}{\sqrt{x}}\ln(4x)+6\sqrt{x}\times\frac{1}{x}=0\Rightarrow\ln(4x)=-2$	dM1
	$Q\left(\frac{1}{4e^2},-\frac{6}{e}\right)$	A1 A1 **(5)**
(c)	Attempts $-2\times y$ co-ordinate of Q	M1
	Range $g(x)\geqslant\frac{12}{e}$	A1ft **(2)**
		(8 marks)

(a)

B1: $\frac{1}{4}$ or exact equivalent. May be seen as the x coordinate in a coordinate pair.

(b)

M1: Attempts to differentiate using the product rule and achieves $f'(x)=\frac{a}{\sqrt{x}}\ln(4x)+b\sqrt{x}\times\frac{1}{x}$

A1: $f'(x)=\frac{3}{\sqrt{x}}\ln(4x)+6\sqrt{x}\times\frac{1}{x}$. Note the $\frac{1}{x}$ may be seen as $\frac{4}{4x}$

dM1: Sets $f'(x)=0$ and proceeds to $\ln(4x)=k$. The "=0" may be implied by the attempt to solve. Condone attempts where multiplying through by $\sqrt{x}$ occurs before setting equal to 0.

A1: $x=\frac{1}{4e^2}$ oe but allow awrt 0.034 following correct equation.

A1: $Q\left(\frac{1}{4e^2},-\frac{6}{e}\right)$ Both coordinates correct and simplified, but may be listed separately, x=…, y = … and allow if y is found in (c). Accept negative powers of e, but must be simplified coefficients and simplified powers.

(c)

M1: Attempts $-2\times$ their y co-ordinate of Q. Also allow following decimal answer

A1ft: Range $g(x)\geqslant\frac{12}{e}$ following through on their negative y value for Q. Accept with y instead of g(x) and wtih negative powers or expression in e following their (b), e.g. $y\geqslant 12e^{-1}$ Accept decimals following a decimal answer to (b). Do not accept f(x).

Question Number	Scheme	Marks
10.(a)	$x = 3\cos 2y \Rightarrow \left(\frac{\mathrm{d}x}{\mathrm{d}y} =\right) -6\sin 2y$	M1 A1
		(2)
(b)	E.g. $\frac{\mathrm{d}x}{\mathrm{d}y} = -6\sqrt{1-kx^2}$ or $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1}{\text{their}\,\frac{\mathrm{d}x}{\mathrm{d}y}}$	M1
	$\frac{\mathrm{d}y}{\mathrm{d}x} = -\frac{1}{6\sqrt{1-\cos^2 2y}} = -\frac{1}{6\sqrt{1-\left(\frac{x}{3}\right)^2}} = -\frac{1}{2\sqrt{9-x^2}}$	dM1 A1
		(3)
(c)	Sets $\frac{\mathrm{d}y}{\mathrm{d}x} = -\frac{1}{2\sqrt{9-x^2}} = -\frac{1}{4}$	
	$x^2 = 5 \Rightarrow a = \sqrt{5}$	M1 A1
	$\sqrt{5} = 3\cos 2y \Rightarrow b = \frac{1}{2}\arccos\left(\frac{\sqrt{5}}{3}\right)$	dM1 A1
Alt (c)	Sets $\frac{\mathrm{d}y}{\mathrm{d}x} = -\frac{1}{6\sin 2y} = -\frac{1}{4}$	
	$\Rightarrow \sin 2y = \frac{2}{3} \Rightarrow y = \frac{1}{2}\arcsin\left(\frac{2}{3}\right)$	M1A1
	$x = 3\cos 2y = 3\sqrt{1-\sin^2\left(\arcsin\frac{2}{3}\right)} = \sqrt{5}$	dM1 A1
		(4)
		(9 marks)

(a)

M1: $\left(\frac{\mathrm{d}x}{\mathrm{d}y} =\right) k\sin 2y$ Alt: $x = 3\left(2\cos^2 y - 1\right) \Rightarrow \left(\frac{\mathrm{d}x}{\mathrm{d}y} =\right) k\cos y \sin y$ (oe with sine identity etc)

A1: $\left(\frac{\mathrm{d}x}{\mathrm{d}y} =\right) -6\sin 2y$ Alt: $\left(\frac{\mathrm{d}x}{\mathrm{d}y} =\right) -12\cos y \sin y$

(b)

M1: Either

- Uses $\sin^2 2y + \cos^2 2y = 1$ with $x = 3\cos 2y$ to find $\sin 2y$ in terms of x (condone slips with the 3 when rearranging)
- Or uses $\frac{\mathrm{d}y}{\mathrm{d}x} = 1 \div \frac{\mathrm{d}x}{\mathrm{d}y}$

dM1: Uses both of the above to find $\frac{\mathrm{d}y}{\mathrm{d}x}$ in terms of x.