Q	Marking instructions	AO	Marks	Typical solution
11(a)	Uses implicit differentiation to obtain $\pm 4y^3\frac{dy}{dx}$ or $\pm 8y\frac{dy}{dx}$ or $\pm 2x\frac{dx}{dy}$	3.1a	M1	$4y^3\frac{dy}{dx}=8y\frac{dy}{dx}-2x-3y-3x\frac{dy}{dx}$ $4y^3\frac{dy}{dx}-8y\frac{dy}{dx}+3x\frac{dy}{dx}=-2x-3y$ $\frac{dy}{dx}\left(4y^3-8y+3x\right)=-2x-3y$ $\frac{dy}{dx}=\frac{2x+3y}{8y-3x-4y^3}$
	Uses the product rule to obtain $\pm 3y\pm 3x\frac{dy}{dx}$ or $\pm 3x\pm 3y\frac{dx}{dy}$ Condone sign errors **OE**	3.1a	M1	
	Obtains fully correct equation $4y^3\frac{dy}{dx}=8y\frac{dy}{dx}-2x-3y-3x\frac{dy}{dx}$ or $4y^3=8y-2x\frac{dx}{dy}-3x-3y\frac{dx}{dy}$ **ACF**	1.1b	A1	
	Isolates their $\frac{dy}{dx}$ or $\frac{dx}{dy}$ terms correctly to one side of their equation Must have at least one of $\pm 4y^3\frac{dy}{dx}$ or $\pm 8y\frac{dy}{dx}$ or $\pm 3x\frac{dy}{dx}$ or $\pm 2x\frac{dx}{dy}$ or $\pm 3y\frac{dx}{dy}$ Need not be factorised	1.1a	M1	
	Completes argument to show $\frac{dy}{dx}=\frac{2x+3y}{8y-3x-4y^3}$ Must come from fully a correct method **AG**	2.1	R1	
	Subtotal		**5**	

Q	Marking instructions	AO	Marks	Typical solution
11(b)	Explains stationary/turning/max/ min/horizontal tangent when $\frac{dy}{dx}=0$	2.4	E1	At stationary points, $\frac{dy}{dx}=0$ $2x+3y=0$ $x=-\frac{3y}{2}$ $y^4=4y^2-\left(-\frac{3y}{2}\right)^2-3\left(-\frac{3y}{2}\right)y$ $y^4=4y^2-\frac{9y^2}{4}+\frac{9y^2}{2}$ $y^4=\frac{25y^2}{4}$ $y^2=0$ or $y^2=\frac{25}{4}$ $y^2=0$ not valid Therefore $y=\pm\frac{5}{2}$ Hence the area is approximately $5\times 12=60$ km^2
	Sets $\frac{2x+3y}{8y-3x-4y^3}=0$ or Sets $2x+3y=0$ **PI** by $x=-\frac{3y}{2}$ or $y=-\frac{2x}{3}$	1.1a	M1	
	Obtains $x=-\frac{3y}{2}$ or Obtains $y=-\frac{2x}{3}$	3.4	A1	
	Substitutes their expression for x or y into $y^4=4y^2-x^2-3xy$ Need not be simplified Condone missing bracket and/or sign errors	1.1a	M1	
	Deduces $y=\frac{5}{2}$ and $y=-\frac{5}{2}$ Ignore solutions to $y^2=0$	2.2a	A1	
	Completes reasoned argument using $y=\frac{5}{2}$ and $y=-\frac{5}{2}$ to show that area of the land is approximately $5\times 12=$ **60 km^2** Must have km^2 **AG** To be awarded R1, marks M1A1M1A1 must be scored as the minimum	3.2a	R1	
	Subtotal		**6**	

	Question 11 Total		**11**	