Question			Answer	Mark	AO	Guidance
4	(a)		$\frac{dy}{dx} = 2x$.	M1	3.1a	
			Gradient of tangent at (1, 1) is 2 Gradient of normal at (1, 1) $= -\frac{1}{2}$	A1	1.1	For correct gradient of either tangent or normal
			Equation of normal is $y - 1 = -\frac{1}{2}(x - 1)$	M1*	1.1	Using their gradient of normal and (1,1) to form an equation or $y = -\frac{1}{2}x + \frac{3}{2}$ (must find a value for c for this mark to be awarded) FT their gradient of normal (not = 2)
			At B: $x^2 = -\frac{1}{2}x + \frac{3}{2}$	M1 dep*	3.1a	Substituting $y = x^2$ and attempting to solve (may see quadratic in x or y)
			$2x^2 + x - 3 = 0$	A1	1.1	Correct quadratic in x or y, in any form or $4y^2 - 13y + 9 = 0$
			B is $(-\frac{3}{2}, \frac{9}{4})$	A1	1.1	Allow (-1.5,2.25). Accept x=…, y=… but must see both.
				[6]		
4	(b)		$AB^2 = \left(1 - \left(-\frac{3}{2}\right)\right)^2 + \left(1 - \frac{9}{4}\right)^2$ $(= \frac{125}{16})$ $OB^2 = \left(\frac{3}{2}\right)^2 + \left(\frac{9}{4}\right)^2$ $(= \frac{117}{16})$ $OA^2 = 2$	M1	2.1	or $AB = \frac{5\sqrt{5}}{4}$ or $OB = \frac{3\sqrt{13}}{4}$ or $OA = \sqrt{2}$ Attempt to find all three, squared or not (may see on diagram)
			$\cos\alpha = \frac{\frac{117}{16}+2-\frac{125}{16}}{2\times\sqrt{\frac{117}{16}}\times\sqrt{2}}$	M1 dep	1.1	Correct use of cos rule in any form, FT their AB, OB & OA
			$\cos\alpha = \frac{1}{\sqrt{26}}$ OR $\tan\alpha = \frac{\sqrt{26-1}}{1}$ $\tan\alpha = 5$	A1	1.1	Must be exact and come from exact working for cos α. Must see an exact intermediate step – either $\frac{1}{\sqrt{26}}$ or $\frac{\sqrt{26-1}}{1}$. Decimals used throughout can achieve max [2/3] M1M1A0 Do not penalise candidates who write down α =78.69…° but the final answer must come from exact working (not BC).

			Alternative method (1)			
			$tan\ \beta = \frac{9}{4} \div \frac{3}{2} = \frac{3}{2}, \tan\gamma = 1$	**M1**		Attempt to find $\tan\beta$ & $\tan\gamma$ β and γ are the angles made by OB and OA respectively with the horizontal (Alternatively with angles to the vertical, $\tan\beta = \frac{2}{3}$)
			$\tan\alpha = -\tan(\beta+\gamma) = -\frac{\frac{3}{2}+1}{1-\frac{3}{2}\times 1}$	**M1 dep**		Correct use of $\tan(180-\theta) = -\tan\theta$ and $\tan(A+B)$ formula using their $\tan\beta$ & $\tan\gamma$ (or, with angles to the vertical, $\tan\alpha = \frac{1+\frac{2}{3}}{1-\frac{2}{3}\times 1}$)
			$= 5$	**A1**		Must be exact and come from exact working. Do not penalise candidates who write down $\alpha = 78.69\ldots°$ but the final answer must come from exact working (not BC).
			Alternative method (2)			
			$\tan BOx = \frac{9}{4} \div (-\frac{3}{2}) = -\frac{3}{2}$, $\tan AOx = 1$			
			$\tan(BOx - AOx)$	**M1**		Attempt find $\tan BOx$ & $\tan AOx$ and use $\tan(\theta - \varphi)$ formula
			$= \frac{-\frac{3}{2}-1}{1+(-\frac{3}{2})\times 1}$	**M1 dep**		Correct use of $\tan(\theta - \varphi)$ using their $\tan BOx$ & $\tan AOx$
			$= 5$	**A1**		Must be exact and come from exact working.
			Alternative method (3)			
			$\overrightarrow{OB}\cdot\overrightarrow{OA} = -\frac{3}{2} + \frac{9}{4} = \sqrt{2} \times \frac{3\sqrt{13}}{4}\cos\alpha$	**M1**		Attempt $\overrightarrow{OB}\cdot\overrightarrow{OA}$
			$\cos\alpha = \frac{\frac{3}{4}}{\sqrt{2\times\frac{117}{16}}}$	**M1 dep**		Correct dot product with exact values
			$\cos\alpha = \frac{1}{\sqrt{26}}$ OR $\tan\alpha = \frac{\sqrt{26-1}}{1}$ $\tan\alpha = 5$	**A1**		Must be exact and come from exact working for $\cos\alpha$. Must see an exact intermediate step – either $\frac{1}{\sqrt{26}}$ or $\frac{\sqrt{26-1}}{1}$.
				[3]		