Question Number	Scheme	Marks
8(a)	$\mathbf{r} = (13\mathbf{i} + 5\mathbf{j}) + t(3\mathbf{i} - 10\mathbf{j})$	M1 A1
		(2)
8(b)	$\mathbf{s} = (3\mathbf{i} - 5\mathbf{j}) + t(15\mathbf{i} + 14\mathbf{j})$	M1 A1
	$\overrightarrow{AB} = \mathbf{s} - \mathbf{r}$	M1
	=	
	$\overrightarrow{AB} = (12t - 10)\mathbf{i} + (24t - 10)\mathbf{j}$ km *	A1 *
		(4)
8(c)	$AB^2 = (12t - 10)^2 + (24t - 10)^2$ ($720t^2 - 720t + 200$)	M1
	Differentiate and equate to 0 **OR** Complete square **OR** **use** $t = \dfrac{-b}{2a}$	M1
	$1440t - 720 = 0$ oe $\qquad 720(t - \frac{1}{2})^2 + 20$	A1
	Solve for t $\qquad$ Use $(t - \frac{1}{2})^2 \geq 0$ $\qquad t = \dfrac{720}{2 \times 720}$	DM1
	Substitute their value of t into their AB expression	M1
	$\sqrt{20}$ oe (km) 4.5 or better	A1
	OR for last 5 marks:	
	Complete method	M1
	$720t^2 - 720t + 200 = D^2$ i.e. $720t^2 - 720t + 200 - D^2 = 0$	A1
	(For real t, $720^2 \geq 4 \times 720(200 - D^2)$	DM1
	Solve for D, ($D \geq \sqrt{20}$)	M1
	$\sqrt{20}$ oe (km) 4.5 or better	A1
		(6)
8(d)	Use $\overrightarrow{AB} = -4\mathbf{i} + 2\mathbf{j}$ at $t = \frac{1}{2}$ to obtain a relevant angle e.g. 26.56°.. Allow e.g. $\tan\alpha$ = ½ or $\tan^{-1}\dfrac{1}{2}$	M1
	Bearing is 297° or better	A1
		(2)
		(14)
	Notes for question 8	
	Accept column vectors through out apart from the answer for (b)	
8(a)	M1 Expression with correct structure	
	A1 cao	
8(b)	M1 Expression with correct structure	
	A1 cao	
	M1 Allow difference in either order	
	A1* Correct given expression correctly obtained **N.B.** $\overrightarrow{AB} = (-10 + 12t)\mathbf{i} + (-10 + 24t)\mathbf{j}$ is A0	
8(c)	M1 Correct expression (with or without square root)	
	M1 Attempt to differentiate (at least one power decreasing by 1) or to complete the square	
	A1 Correct equation or expression	
	DM1 Dependent on previous M for finding the critical value for t **OR** For the completing the square method, for 'ignoring' the $(t - \frac{1}{2})^2$ term.	

Question Number	Scheme	Marks
	M1 Substitute their t (it may not be clear where it has come from but it *must be non-zero*) into their AB expression (must have square root)	
	A1 cao	
8(d)	M1 Using their t value to obtain $\overrightarrow{AB}$ and a relevant angle	
	A1 cao	

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