Question Number	Scheme	Marks
	N.B. Answers to (a) and (b) should be in terms of **i** and **j**, but only penalise once. Column vectors can be used in working.	
7(a)	$\mathbf{v}_B = (20\sin\alpha)\mathbf{i} + (20\cos\alpha)\mathbf{j}$ oe e.g. use of Pythagoras but must get to an answer	M1
	$= 16\mathbf{i} + 12\mathbf{j}$ (km h^{-1})	A1 (2)
7(b)	(**s** =) (10**i** + 5**j**) + t(16**i** + 12**j**) or $(10+16t)\mathbf{i} + (5+12t)\mathbf{j}$	M1 A1 **ft** (2)
7(c)	$\overrightarrow{AB} = \mathbf{s} - \mathbf{r} = (10\mathbf{i} + 5\mathbf{j}) + t(16\mathbf{i} + 12\mathbf{j}) - \left[20\mathbf{j} + 40t\mathbf{i}\right]$	M1
	$\overrightarrow{AB} = \left[(10 - 24t)\mathbf{i} + (12t - 15)\mathbf{j}\right]$ km *	A1* (2)
7(d)	$10 - 24t = 0$ and $12t - 15 = 0$ **OR** $40t = 10 + 16t$ and $20 = 5 + 12t$	M1
	$t = \frac{5}{12}$ and $\frac{5}{4}$ or one correct t value which is then used in the other equation **correctly** to show that the equation is not true.	A1
	Different *t* values oe so never collide*	A1* (3)
	ALT 1:	
	$(10 - 24t)^2 + (12t - 15)^2 = 0$ (i.e. $720t^2 - 840t + 325 = 0$) M1	
	$(-840)^2 - 4 \times 720 \times 325$ $(= -230,400)$ < 0 A1 Or roots $\frac{7 \pm 4i}{12}$ (calculator)	
	No real roots oe so never collide* A1* **N.B.** Must see justification for 'no real roots' to score either of the A marks.	
	ALT 2:	
	Finds minimum value of $720t^2 - 840t + 325$ or its square root using derivative or completing the square or calculator M1	
	80 or $\sqrt{80}$ or $\overrightarrow{AB} = -4\mathbf{i} - 8\mathbf{j}$ (at $t = \frac{7}{12}$) A1	
	so never collide* A1*	
7(e)	$10 - 24t = 12t - 15$ oe	M1
	$t = \frac{25}{36}$ or 0.69 or better	A1
	$\overrightarrow{AB} = \left[(10 - 24 \times \frac{25}{36})\mathbf{i} + (12 \times \frac{25}{36} - 15)\mathbf{j}\right]$ (km)	M1
	$AB = 20\frac{\sqrt{2}}{3}$, 9.4 or better (km)	A1 (4)
		(13)

	Notes	
7(a)	M1: Condone sign errors and sin/cos confusion but both components must be resolved. Allow if they use $\cos(\frac{3}{5})$ or similar. If $12\mathbf{i}+16\mathbf{j}$ appears without working, award M1A0.	
	A1: cao	
7(b)	M1: Correct structure, condone slips	
	A1**ft**: ft on their answer to (a)	
7(c)	M1: Allow $\mathbf{r}-\mathbf{s}$. $\mathbf{r}$ and $\mathbf{s}$ must be substituted.	
	A1*: Correct given answer, correctly obtained **N.B.** Need to see $\overrightarrow{AB}$ at the start or finish for the A1* and answer must be **exactly** as printed, ignoring [] and km.	
7(d)	M1: They may use $\mathbf{r}=\mathbf{s}$ with both **i** and **j** cpts equated.	
	A1: Need both *t* values. Accept 0.42 or better and 1.25.	
	A1*: Correct conclusion	
7(e)	M1: Correct method	
	A1: cao	
	M1: Sub their calculated *t* value into $\overrightarrow{AB}$ or $\overrightarrow{BA}$, seen or implied, oe. Note that this is an independent M mark.	
	A1: cao	