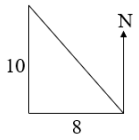
Question Number	Scheme	Marks
6 (a)	$\sqrt{10^2+15^2}$	M1
	$\sqrt{325}$ or $5\sqrt{13}$ (km h^{-1})	A1
		(2)
(b)	$\tan\theta = \pm\frac{10}{8}$ or $\tan\theta = \pm\frac{8}{10}$ o.e.	M1
	A correct relevant angle 51.340… or 38.659…	A1
	 Bearing = 321 $(^\circ)$	A1
		(3)
(c)	Method to find $\overrightarrow{SB}$ using difference of general position vectors.	M1
	Correct expression for S at time t $t(10\mathbf{i}+15\mathbf{j})$	A1
	Correct expression for B at time t $(50\mathbf{i}+10\mathbf{j})+t(-8\mathbf{i}+10\mathbf{j})$	A1
	$\overrightarrow{SB} = [(50\mathbf{i}+10\mathbf{j})+t(-8\mathbf{i}+10\mathbf{j})]-[t(10\mathbf{i}+15\mathbf{j})]$ Leading to $\overrightarrow{SB} = [(50-18t)\mathbf{i}+(10-5t)\mathbf{j}]$ *	A1*
		(4)
(d)	Equate each component of $\overrightarrow{SB}$ to zero	M1
	$50-18t=0 \Rightarrow t=\frac{25}{9}$ $10-5t=0 \Rightarrow t=2$	A1
	Times are not the same $\Rightarrow$ B and S do not collide	A1*
		(3)
(e)	Equate **i** and **j** components of $\overrightarrow{SB}$ $50-18t=10-5t$	M1
	$t=\frac{40}{13}$	A1
	Method to find distance, $\lvert\overrightarrow{SB}\rvert$ $d=\sqrt{\left(50-18\times\frac{40}{13}\right)^2+\left(10-5\times\frac{40}{13}\right)^2}$	dM1
	Correct answer = 7.6 (km) or better	A1
		(4)
		(16)
	Notes for Question 6	
6(a)		

M1	Correct use of Pythagoras. May be implied by a correct answer.	
A1	Must be exact.	
6(b)		
M1	Correct use of trigonometry to find a relevant angle.	
A1	Correct relevant angle seen eg 51.350… , 38.659…, Accept $\tan^{-1}\left(\frac{8}{10}\right), \tan^{-1}\left(\frac{10}{8}\right)$	
A1	Correct answer, must be to the nearest degree.	
6(c)		
M1	Method to find $\overrightarrow{SB}$. Must subtract two general position vectors of the form $\mathbf{r}_0 + t\mathbf{v}$ (accept collected **i** and **j**).	
A1	Correct expression for position of the ship at time t.	
A1	Correct expression for the position of the boat at time t.	
A1*	Obtain given answer from complete and correct working. Accept working in column vectors. Final answer must have correct **i**–**j** notation. Accept $\overrightarrow{SB}$ or SB. Allow missing units.	
(d)		
M1	Equate both **i** and **j** components to zero	
A1	Correct values for t	
A1*	Obtain given answer from fully correct working with conclusion. E.g. Following correct t values: 'do not collide'	
(d) ALT 1		
M1	Method to find the minimum value of d or d^2 $(349t^2 - 1900t + 2600)$ Eg • Completes the square: $349\left(t - \frac{950}{349}\right)^2 + \frac{4900}{349}$ • Differentiates and setting equal to 0: $698t - 1900 = 0 \Rightarrow t = \frac{950}{349}$ • Calculator: $\min d^2 = 14.04...$ or $\min d = 3.747...$ when $t = \frac{950}{349}$	
A1	Correct value for min d or d^2 identified: $\frac{4900}{349}$ or $\sqrt{\frac{4900}{349}}$	
A1*	Conclusion following correct working.	
(d) ALT 2		
M1	Method to find there are no real roots of the quadratic $349t^2 - 1900t + 2600$. May use the quadratic formula or discriminant or calculator but there must be evidence of finding 'no real roots', not just a statement.	
A1	• $d = \frac{1900 \pm \sqrt{1900^2 - 4(349)(2600)}}{2(349)} \Rightarrow$ roots $\frac{950 \pm 70i}{349}$ • Discriminant $= 1900^2 - 4(349)(2600) = -19\,600 < 0$	

A1*	**No real roots** oe so never collide. **N.B**. Must see justification for 'no real roots' to score either of the A marks. Correct conclusion from correct working	
(e)	**N.B.** For the last 2 marks, send the item to Review if a candidate appears to be affected by the SW/NE error.	
M1	Equate **i** and **j** components to find an equation in t	
A1	Correct value for t. Accept 3.1 or better.	
dM1	Dependent on previous M. Method to find distance using Pythagoras (square and add terms of $\overrightarrow{SB}$).	
A1	$\frac{70\sqrt{2}}{13}$ or 7.6 (km) or better (calculator display 7.614996105) Award at the point of a correct numerical expression then ISW	