QUESTION NUMBER	SCHEME	MARKS
N.B. Column vectors acceptable throughout apart from the answer to (b).		
7(a)	$\sqrt{12^2+16^2}=20\,(\text{km h}^{-1})$	M1 A1
		(2)
7(b)	$(19\mathbf{i}+22\mathbf{j})+t(12\mathbf{i}-16\mathbf{j})$	M1 A1
		(2)
7(c) **(i)**	Displacement vector $\overrightarrow{LS}=(19+12t-26)\mathbf{i}+(22-16t-15)\mathbf{j}$ or $\overrightarrow{SL}=(26-19-12t)\mathbf{i}+(15-22+16t)\mathbf{j}$	M1
	Correct with **i** and **j** collected $\overrightarrow{LS}=(12t-7)\mathbf{i}+(7-16t)\mathbf{j}$ or $\overrightarrow{SL}=(7-12t)\mathbf{i}+(16t-7)\mathbf{j}$	A1
	Use of Pythagoras to find the distance $\left\lvert\overrightarrow{LS}\right\rvert=\sqrt{(12t-7)^2+(7-16t)^2}$	M1
	Correct 3TQ $400t^2-392t+98$	A1
	Min occurs when $t = 0.49$	A1
	Alternative for last 3 marks: Closest when relative pv is perpendicular to relative velocity i.e $\left[(12t-7)\mathbf{i}+(7-16t)\mathbf{j}\right].(12\mathbf{i}-16\mathbf{j})=0$ $400t-196=0$ Min occurs when $t = 0.49$	M1 A1 A1
(ii)	$\sqrt{1.96}=1.4$ (km)	M1
	$1.4>1.3$ so it is safe for *S* to continue its course.	A1 **cso**
		(7)
	Alternative for (c)(i) and (ii):	
7(c)		
(i)	Path of *S*: $y-22=\frac{-16}{12}(x-19)$	M1
	Normal through *L*: $y-15=\frac{12}{16}(x-26)$	A1
	Solve for either *x* OR *y*	M1
	$x = 24.88$ OR $y = 14.16$	A1
	$24.88 = 12t + 19$ OR $14.16 = 22 - 16t$ => $t = 0.49$	A1
(ii)	$\sqrt{(26-24.88)^2+(15-14.16)^2}=1.4$	M1
	$1.4>1.3$ so it is safe for *S* to continue its course.	A1 **cso**
		(7)
	Alternative for (c)(i):	
	Path of *S*: $(19\mathbf{i}+22\mathbf{j})+t(12\mathbf{i}-16\mathbf{j})$	
	Normal through *L*: $(26\mathbf{i}+15\mathbf{j})+k(16\mathbf{i}+12\mathbf{j})$ oe	M1 A1
	Solve for *t*	M1
	$t = 0.49$	A2
		(5)
		(11)

	Notes for question 7	
(a)		
M1	Use of Pythagoras to find the speed. Since this is a 3,4,5 triangle the correct answer may appear without working.	
A1	cao	
(b)		
M1	Correct structure	
A1	Correct answer o.e. with **i**'s and **j**'s	
(c) (i)		
M1	Subtraction used to find the displacement vector $\overrightarrow{LS}$ or $\overrightarrow{SL}$	
A1	Correct components for $\overrightarrow{LS}$ or $\overrightarrow{SL}$ with **i**'s and **j**'s collected, seen or implied.	
M1	Use of Pythagoras with their components, which must have come from attempt at subtracting or adding **s** and **l**, to form a 3TQ for distance or distance squared.	
A1	Correct 3TQ, seen or implied, e.g allow $400t^2 - 392t + 96.31$	
A1	**cao** Note: The correct value $t = 0.49$ may appear without working as a result of the quadratic solver on a calculator. Other methods may include completing the square or differentiation. **N.B.** Correct 3TQ = 1.3^2 oe can score max M1A1M1A1	
(ii)		
M1	Use of their t value, which must have come from an attempt to minimise the distance LS, to find the shortest distance between S and L. Note: The correct value 1.4 may appear without working since the quadratic solver on a calculator will give a min value for d^2 as 1.96.	
A1cso	Correct conclusion by comparing 1.4 and 1.3. **N.B**. Accept e.g. '1.4 therefore it is safe'.	