Question	Scheme	Marks	Notes
7a	Energy equation	M1	Q requires energy. Need all terms and dimensionally correct. Condone sign error.
	$\frac{1}{2}mv^2 = \frac{1}{2}m(9+4) + mg \times 20$	A1	Correct unsimplified equation
	$v = 20\,(20.1)\,(\text{ms}^{-1})$	A1	2 sf or 3 sf only. Not $9\sqrt{5}$
		(3)	
7b	Complete method to find the direction as an angle	M1	Complete method to find trig ratio for a relevant angle
	$\cos\alpha = \frac{3}{\text{their (a)}}$	A1ft	Correct unsimplified equation for a relevant angle. Follow their part (a)
	$\alpha = 81°\,(81.4°)$ below the horizontal	A1	Or equivalent. 2 sf or 3 sf. Needs to be clear on a diagram or in words where the angle is measured. Accept "to the horizontal"
		(3)	
7b alt	Complete method to find the direction as a vector in **i** and **j** or as a column vector	M1	
	Component = $\sqrt{(a)^2 - 9}$	A1ft	Correct unsimplified equation. Follow their part (a)
	Direction $3\mathbf{i} - 19.9\mathbf{j}$	A1	2 sf or 3 sf. ISW after correct vector seen
		(3)	
7c	Form an equation in t	M1	Complete method using *suvat* Condone sign errors.
	e.g. $-20 = 2t - \frac{1}{2}gt^2$ or $(-20.1...)\sin\alpha = 2 - gt$	A1	Correct unsimplified equation
	$t = 2.2\,(2.23)\,(\text{s})$	A1	2 sf or 3 sf only
		(3)	
7d	Perpendicular velocity $= 3\mathbf{i} - \lambda\mathbf{j}$	B1	Horizontal component unchanged and vertical not equal to ± 2. Seen or implied
	$(3\mathbf{i} + 2\mathbf{j}).(3\mathbf{i} - \lambda\mathbf{j}) = 0$	M1	Complete method to solve for vertical component If using angles, they should be using $56.3°$ for the perpendicular direction.
	$\Rightarrow \mathbf{v} = \left((3\mathbf{i}) - \frac{9}{2}\mathbf{j}\right)(\text{ms}^{-1})$	A1	Correct vertical component seen or implied
	Use of *suvat* or use of energy to find relevant distance	dM1	Complete method to find the vertical component of perpendicular velocity. Dependent on the previous M1 Working with $3\mathbf{i} - 2\mathbf{j}$ is not equivalent work
	$\left(\frac{9}{2}\right)^2 = 2^2 + 2gs$ or $\frac{1}{2}m(13) + mgs = \frac{1}{2}m\left(9 + \frac{81}{4}\right)$	A1	Correct unsimplified equation for their distance
	$h = 20 - s = 19\,(19.2)$	A1	2 sf or 3 sf
		(6)	

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