Q	Scheme	Marks	Notes
7(a)	Horizontal distance	M1	equation with correct terms, condone sign errors
	$2ut = 80$	A1	correct equation
	Vertical distance or vertical speed	M1	equation with correct terms, condone sign errors
	$0 = ut - \frac{1}{2}gt^2$	A1	correct equation in t Alternatives include $-u = u - gt$ or $0 = u - g\,\frac{1}{2}t$
	Solve for u $\left(\text{e.g. } u \times \frac{80}{2u} = \frac{1}{2}g\frac{80^2}{4u^2}\right)$	DM1	Dependent on the two previous M marks
	$u = 14$*	A1*	obtain **given answer** correctly
	If they consistently have u horizontal and $2u$ vertically, then mark as a misread. M1A0M1A0M1A1 Fortuitously, they do obtain the given answer		
		(6)	
7(b)	$v^2 = (7\sqrt{17})^2 - 28^2$	M1	form an equation in v only (v is vertical component)
	$\Rightarrow v = 7$ (or -7)	A1	second value not needed
	Use of *suvat* to find the required time Check their logic. Have they found the time speed is $< 7\sqrt{17}$ or the time the speed is $> 7\sqrt{17}$?	DM1	Dependent on the first M mark. Complete method to obtain the required time. condone sign errors
	$7 = 14 - gt \Rightarrow t = \frac{5}{7} = 0.71...$	A1	Obtain a relevant value of t
	Total time = $2 \times \frac{5}{7} = 1.4$ or 1.43 (s)	A1	For the required time to 2 sf or 3 sf A0 for $\frac{10}{7}$; follows the use of an approximate value for g
	The misread from (a) will give $v = \pm\sqrt{637} = \pm 7\sqrt{13}$ (± 25.2), critical value of time $t = 0.282$, required time 0.56 (s)		No further penalty for the misread if the penalty is already applied in (a)
		(5)	

7(b) alt	$\frac{1}{2}m(28^2+14^2)-\frac{1}{2}m(7\sqrt{17})^2=mgh$	M1	form an equation in *h* only
	$\Rightarrow h = 7.5$	A1	Correct only
	Use of *suvat* to find the required time Check their logic. Have they found the time speed is $< 7\sqrt{17}$ or the time the speed is $> 7\sqrt{17}$?	DM1	Dependent on the first M mark. Complete method to obtain the required time, condone sign errors
	$7.5 = 14t - \frac{1}{2}\times 9.8t^2 \quad \Rightarrow t = \frac{5}{7}, t = \frac{15}{7}$	A1	Obtain at least one relevant value for *t*
	Total time $= \frac{20}{7} - \left(\frac{15}{7} - \frac{5}{7}\right) =$ 1.4 or 1.43(s)	A1	For the required time to 2 sf or 3 sf A0 for $\frac{10}{7}$; follows the use of an approximate value for *g*
	The misread from (a) will give the same value for h (7.5), *t* = 5.43 and *t* = 0.28, so required time 0.56 (s)		
		(5)	
7b alt	Use $7\sqrt{17}$ to form an equation in *t* only	M1	
	$\Rightarrow 7\sqrt{17} = \sqrt{(14-gt)^2+28^2}$	A1	Or equivalent
	Solve to find the required time Check their logic. Have they found the time speed is $< 7\sqrt{17}$ or the time the speed is $> 7\sqrt{17}$?	DM1	Dependent on the first M mark. Complete method to obtain the required time, condone sign errors
	$147 = 2gt - g^2t^2 \quad \Rightarrow t = \frac{5}{7}, t = \frac{15}{7}$	A1	Obtain at least one relevant value for *t*
	Total time $= \frac{20}{7} - \left(\frac{15}{7} - \frac{5}{7}\right) =$ 1.4 or 1.43(s)	A1	For the required time to 2 sf or 3 sf A0 for $\frac{10}{7}$; follows the use of an approximate value for *g*
		(5)	
		(11)	

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