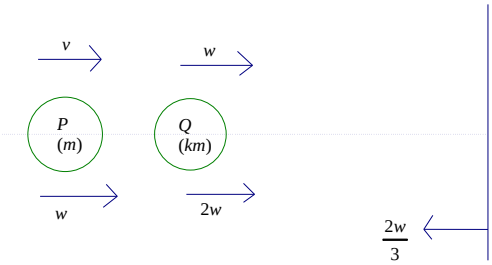
Question Number	Scheme	Marks
6a		
	CLM: $mv+kmw=mw+2kmw$ Impact law: $2w-w=\frac{2}{3}(v-w)$ $\left(\frac{2}{3}v=\frac{5}{3}w\right)$ $v=\frac{5}{2}w \quad\Rightarrow\quad k=\frac{3}{2}$	M1A1 M1A1 M1A1 **(6)**
6b	Speed of Q at second impact $=\frac{2w}{3}$ Time for Q to reach wall $=\frac{d}{2w}$ Distance travelled by P plus Q after hitting wall to second impact $\Rightarrow wt+\frac{2}{3}w\left(t-\frac{d}{2w}\right)=d$ $\Rightarrow t=\frac{4d}{5w}$	B1 B1 M1A1 A1 **(5)**
Alt1	Speed of Q at second impact $=\frac{2w}{3}$ Time for Q to reach wall $=\frac{d}{2w}$ Time t from wall to second impact $\Rightarrow\frac{2w}{3}t+wt=\frac{d}{2}$ $\left(t=\frac{3d}{10w}\right)$ Total time $=\frac{d}{2w}+\frac{3d}{10w}=\frac{4d}{5w}$	B1 B1 M1A1 A1 **(5)**
Alt 2	Speed of Q at second impact $=\frac{2w}{3}$ Time for Q to reach wall $=\frac{d}{2w}$ Time from wall to second impact $=\frac{\text{distance apart}}{\text{speed of approach}}=\frac{d/2}{w+\frac{2w}{3}}$ Total time $=\frac{d}{2w}+\frac{3d}{10w}=\frac{4d}{5w}$	(B1) (B1) (M1A1) (A1)

Alt 3	Speed of Q at second impact $= \frac{2w}{3}$	(B1)
	Time for Q to reach wall $= \frac{d}{2w}$	(B1)
	$AB = x \Rightarrow$ time for P to travel A to B $= \frac{x}{w}$	
	Time for Q to travel A to B $= \frac{d}{2w} + \frac{d-x}{2w/3} \left(= \frac{4d-3x}{2w} \right)$	(M1)
	$\frac{x}{w} = \frac{4d-3x}{2w} \Rightarrow x = \frac{4d}{5}$	(A1)
	$\Rightarrow t = \frac{4d}{5w}$	(A1)
		Total 11

Notes	
a	
M1	Conservation of momentum. Must have 4 terms. All terms must have m or none.
A1	Correct equation.
M1	Impact law. Must be the correct way up.
A1	Correct equation. Note, speeds and directions are defined in the question, so the signs must be correct.
M1	Solve equations to find k.
A1	$\frac{3}{2}$ (accept any equivalent)
b	
All methods – The M mark requires a complete method to find the total time, so the line of working with the first A mark attached might not be sufficient to earn the M mark.	
B1	Speed of Q at second impact $= \frac{2w}{3}$ seen in working. Must be seen, not implied. (i.e. $3v=2w$ scores B0).
B1	Time for Q to reach wall $= \frac{d}{2w}$. Must be seen, not implied. (i.e. $2wt=d$ scores B0).
M1	Complete method to find total time. If time from wall found, the method must be completed to earn this mark. Condone numerical slips if a clearly sound strategy is attempted
A1	Correct initial equation to find either for total time or time from wall to impact.
A1cao	total time $= \frac{4d}{5w}$