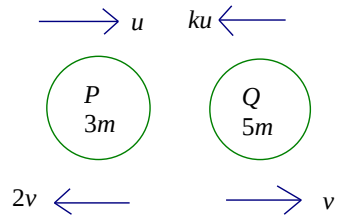
4a			
	Impulse-momentum equation for P:	M1	Correct use of $I = mv - mu$: Evidence of subtraction (can go straight to + you do not need to see $-(-)$) and dimensionally correct. Use of $3m$
	$15mv = 3m(2v-(-u))$	A1	Correct unsimplified equation
	$9mv = 3mu \Rightarrow u = 3v$ *	A1*	Obtain **given answer** from correct working
4a alt	Impulse-momentum equation for Q and CLM:	M1	CLM dimensionally consistent, all 4 terms, condone sign error(s). Correct use of $I = mv - mu$: Evidence of subtraction and dimensionally correct. Use of $5m$
	$15mv = 5m(v+ku)$, $k = 2\frac{v}{u}$ and substitute into CLM: $3mu - 5m\frac{2v}{u}u = 5mv - 6mv$	A1	Correct unsimplified equation in u and v
	$\Rightarrow u = 3v$ *	A1*	Obtain **given answer** from correct working
		(3)	
4b	Impulse-momentum equation for Q or use of CLM:	M1	Dimensionally consistent. All relevant terms.
	$15mv = 5m(v-(-ku))$ or $3mu - 5mku = 5mv - 6mv$	A1	Correct unsimplified equation
	$10v = 5ku = 15kv \Rightarrow k = \frac{2}{3}$	A1	Correct only. Accept 0.67 or better
		(3)	
4c	Use of impact law:	M1	Must be used the right way round. Condone sign error(s)
	$2v + v = e(u+ku)$ $\left(= e \times 3v \times \frac{5}{3}\right)$	A1ft	Correct unsimplified equation. Follow their k.
	$\Rightarrow e = \frac{3}{5}$	A1	Correct only
		(3)	

4d	Change in KE	M1	Allow for gain rather than loss. Dimensionally correct. Need to use all 4 terms and to be using the correct values for mass.
	$\frac{1}{2}\times 3m\left(u^2-(2v)^2\right)+\frac{1}{2}\times 5m\left((ku)^2-v^2\right)$	A1	Correct unsimplified equation. Allow for gain rather than loss. A0 if an error occurs before they form a single expression
	$\left(\frac{1}{2}\times 3m\left(5v^2\right)+\frac{1}{2}\times 5m\left(3v^2\right)=15mv^2\right)$		NB: $15mv^2=\frac{5}{3}mu^2$
	$\lambda=15$	A1	Correct only. Accept $15mv^2$
		(3)	