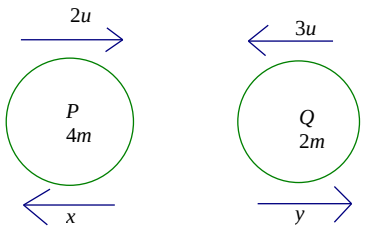
Question	Scheme	Mark	Notes
7a			
	Equation for CLM	M1	Dimensionally correct. All terms required. Condone sign errors.
	$8mu-6mu=2my-4mx$ $\left(u=y-2x\right)$	A1	Correct unsimplified equation
	Equation for kinetic energy $\left(\frac{1}{2}\text{ or 2 must be used}\right)$	M1	Dimensionally correct. Correct masses paired with correct velocities. All terms required. No sign errors. Condone 2 on the wrong side.
	$2mx^2+my^2=\frac{1}{2}\left(2m\times4u^2+m\times9u^2\right)$ $\left(17u^2=4x^2+2y^2\right)$	A1	Correct unsimplified equation
	Solve for y: $17u^2=2y^2+\left(y-u\right)^2$ $\Rightarrow 3y^2-2yu-16u^2=0$	DM1	Some working must be shown to obtain the quadratic in y (and u). Dependent on the preceding M marks $\left(\left(3y-8u\right)\left(y+2u\right)=0\right)$
	$\Rightarrow y=\frac{8}{3}u$ *	A1*	Obtain given answer from correct working
		[6]	
7b	Use of Impact Law: $x+y=e\times5u$	M1	Condone sign errors but must be used the right way round.
	$e=\dfrac{\frac{1}{2}\left(\frac{8}{3}u-u\right)+\frac{8}{3}u}{5u}$	A1	Correct unsimplified equation. $\left(x=\dfrac{5u}{6}\right)$
	$=\dfrac{7}{10}$	A1	Correct only
		[3]	
7c	Velocity of Q after impact $=f\times\dfrac{8}{3}u$	B1	Allow $\pm$
	No collision if $f\times\frac{8}{3}u\le\frac{5}{6}u$ i.e. speed of $P\ge$ speed of Q	M1	Correct inequality with their values Accept strict inequality. Dimensionally correct.
	$\Rightarrow 0<f\le\frac{5}{16}$	A1	Both ends required. $\left(0<f\le0.3125\right)$
		[3]	
7d	Use of $I=\pm2m\left(y-\left(-\dfrac{1}{4}y\right)\right)$	M1	Subtraction seen or implied with *their* $\frac{1}{4}y$ Requires correct mass Requires correct impact law
	$\left\|I\right\|=\dfrac{20}{3}mu$	A1	Or equivalent. Must be positive $6.7mu$ or better Condone $-\dfrac{20}{3}mu\rightarrow\dfrac{20}{3}mu$ with no explanation
		[2]	
		(14)	

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