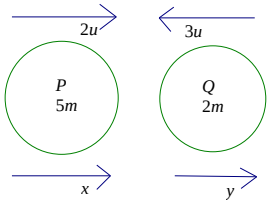
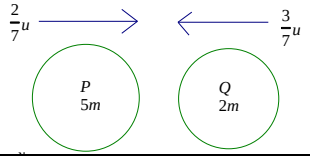
Question	Scheme	Marks
		
7(a)	CLM	M1
	$10mu-6mu=5mx+2my$ $\left(4u=5x+2y\right)$	A1
	Impact law	M1
	$y-x=5ue$	A1
	$4u=5x+2x+10ue\left(=7x+10ue\right)$	DM1
	$(x>0\Rightarrow)\ 10ue<4u$	DM1
	$\Rightarrow 0\text{ ,, }\ e<\frac{2}{5}$ o.e.	A1
		(7)
7(b)	Impulse momentum equation	M1
	$\frac{60}{7}mu=2m\left(3u-\left(-y\right)\right)$ or $-\frac{60}{7}mu=5m\left(x-2u\right)$	A1
	Solve to find a correct expression for either x or y $\left(y=\frac{9}{7}u\ ,\ x=\frac{2}{7}u\text{ but may not be seen explicitly}\right)$	DM1
	Use both impulse equations and impact law with their x **and** y to form an equation in e (and u). $5ue=\frac{9}{7}u-\frac{2}{7}u$ Using CLM and impact law from part (a) to form an equation in e (and u). For example $\frac{2u}{7}=\frac{4u-10eu}{7}$	M1
	$e=\frac{1}{5u}\left(\frac{9}{7}u-\frac{2}{7}u\right)=\frac{1}{5}$ *	A1*
		(5)
7(c)		
	Speed of $Q=\frac{1}{3}\times\frac{9}{7}u\ \left(=\frac{3}{7}u\right)$	B1ft
	Magnitude of impulse = $\frac{1}{7}\times\frac{60}{7}mu$	M1
	$=\frac{60}{49}mu$	A1

		(3)
		(15)
	Notes	
7(a)		
M1	Form CLM equation. All terms required. Mass and velocity correctly paired. Dimensionally consistent, condone consistent additional g in each term. Condone sign errors.	
A1	Correct equation or equivalent. Condone consistent additional g in each term. Condone $\pm y$.	
M1	Use Impact Law. Dimensionally correct. Used the right way round (separation and approach must not be interchanged). Condone sign errors.	
A1	Correct equation or equivalent. Directions of P and Q after impact must be consistent with CLM.	
DM1	Dependent on the preceding M marks. Eliminate velocity of Q to form an equation in x, e and u only. $\left(x = \frac{4u - 10eu}{7}\right)$	
DM1	Dependent on all preceding M marks. May be implied by $e < 0.4$ Use direction of P to form an inequality in e (and u). Use correct inequality for their diagram: if they had P changing direction should now be using $x < 0$	
A1	Both ends required 0 „ $e < 0.4$ but condone $0 < e < 0.4$	
7(b)		
M1	Impulse-momentum equation. Dimensionally correct, using the correct mass and velocity pair for a single particle. Must be subtracting momenta but allow incorrect order. May use working in terms of e from (a) $x = \frac{4u - 10eu}{7}$ $y = \frac{25eu + 4u}{7}$	
A1	At least one correct unsimplified equation.	
DM1	Solve impulse-momentum equation to find either $y = \frac{9}{7}u$ or $x = \frac{2}{7}u$	
M1	Complete method to form an equation in e (and u) only with the usual rules for CLM and Impact Law.	
A1*	Obtain given answer from complete and correct working. A0 for 0.2	
7(c)		
B1	Follow $\frac{1}{3} \times$ their y from part (b). If y is given in terms of e then $e = \frac{1}{5}$ must be substituted at some point. Seen or implied. May appear on diagram. Accept $\pm$.	

M1	Complete method using (a) and (b) and working from first principles to find the impulse in the second collision between *P* and *Q*. Must see: • Usual rules for CLM and Impact Law to **find** V_p or V_q after second collision. CLM $\frac{10mu}{7}-\frac{6mu}{7}=5mV_p+2mV_q$ Impact Law $\frac{1}{5}\times\left(\frac{2u}{7}+\frac{3u}{7}\right)=V_q-V_p$ • **Then** use of Impulse – momentum equation with usual rules to find magnitude of impulse. Impulse – momentum Either $I=2m\left(\frac{9u}{49}--\frac{3u}{7}\right)$ or $I=5m\left(\frac{2u}{49}-\frac{2u}{7}\right)$	
A1	1.2*mu* or better (1.2244897…)	

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