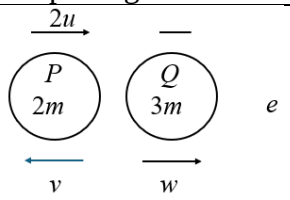
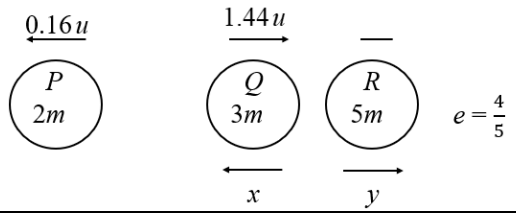
QUESTION NUMBER	SCHEME	MARKS
7	N.B. throughout this question refer to diagram for the direction of speeds and then apply to equations. N.B. Correct mass-speed pairings are needed for all M marks	
		
7(a)	CLM	M1
	$2m(2u) = 2m(-v) + 3m(w)$	A1
	Use of impact law	M1
	$e(2u) = w + v$	A1
	$w = \frac{4u}{5}(e+1)$ *	A1*
		(5)
7(b)	Find an expression involving v , e and u	M1
	Correct expression Eg $v = \frac{2u}{5}(3e-2)$	A1
	Use $v > 0$ to form an inequality in e, $\Rightarrow \quad \frac{2}{3} < e \leq 1$	A1
		(3)
7(c)	Use of Impulse-momentum	M1
	$\frac{108mu}{25} = 3m \times \frac{4u}{5}(e+1)$	A1
	$e = \frac{4}{5}$ *	A1*
		(3)
7(d)		
	$v = 0.16u$, 4/25u Allow +/-	B1
	Use of CLM with their v $3m(1.44u) = 3m(-x) + 5m(y)$ $3m\left(\frac{4u}{5}(e+1)\right) = 3m(-x) + 5m(y)$	M1

	Use of impact law with their v $0.8(1.44u) = x + y$ $e\left(\frac{4u}{5}(e+1)\right) = x + y$	M1
	Correct expression $x = 0.18u$ o.e.	A1
	Compare the speed of P after the first collision with the speed of Q after the second collision. ($v = 0.16u$ and $x = 0.18u$)	dM1
	Since $0.18u > 0.16u$ a third collision will occur (between P and Q)	A1
		(6)
		(17)
	Notes for question	
7(a)		
M1	Equation for CLM. Dimensionally correct, all terms required. Condone sign errors.	
A1	Correct unsimplified equation.	
M1	Use of impact law. Condone sign errors but must be used the right way round.	
A1	Correct unsimplified equation, signs consistent with CLM.	
A1*	Obtain given answer from correct working. Must be factorised with $(e+1)$ for this mark. Allow $(1+e)$	
7(b)		
M1	Find an expression involving their v_p after the first collision with u and e only for their direction	
A1	Correct unsimplified expression for v_p after the first collision with u and e for their direction.	
A1	Use the direction of P and their expression for v to form a correct inequality in e, both ends required.	
7(c)		
M1	Use of impulse-momentum equation. Dimensionally correct, condone sign errors.	
A1	Correct unsimplified equation.	
A1*	Obtain given answer from complete and correct working. At least one line of working form equation to answer as a 'Show that'	
7(d)		
B1	Correct expression seen for speed of Q after the first collision. Allow $-0.16u$,$-4/25u$	
M1	Form relevant CLM equation using given answer from (a). Dimensionally correct, all terms required. Condone sign errors. No need for e to be replaced.	
M1	Use of impact law with given answer from (a). Condone sign errors but must be used the right way round. No need for e to be replaced.	

A1	Correct expression from correct working for the speed and direction of Q after the second collision, e must be replaced. Allow +/- answer o.e	
dM1	Compare the speed of P after the first collision with the speed of Q after the second collision ($v = 0.16u$ and $x = 0.18u$) Dependent on two previous M marks. Velocities must have been found in terms of u prior awarding this mark	
A1	Cso. Since $0.18u > 0.16u$ a second collision could occur between P and Q	
	N.B. if all that is seen is '. ($v = 0.16u$ and $x = 0.18u$) and then so second collision'. This is M0A0 as no comparison has occurred.	

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