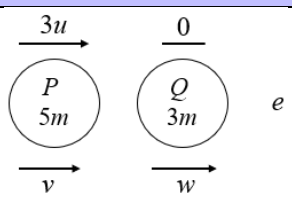
Question number	Scheme	Marks
6		
6(a)	Equation for CLM	M1
	$5m(3u) = 5mv + 3mw$ **or** $5m(3u) = -5mv + 3mw$	A1
	Use of impact law	M1
	$3ue = w - v$ **or** $3ue = w + v$	A1
	$\frac{15u}{8}(1+e)$ *	A1*
		(5)
6(b)	Velocity of P after collision, (to the right.) $v = \frac{3u}{8}(5-3e)$	M1
	$(5-3e) > 0 \quad \Rightarrow \quad \frac{3u}{8}(5-3e) > 0$	A1
	Uses $(0 <) e \leqslant 1$ to determine direction of P, compares with direction of Q and concludes correctly*	A1*
NB: Possible max scores for last two A marks in (b) • If $(0 <) e \leqslant 1$ seen followed by both positive, then A1A1 • If $(0 <) e < 1$ seen followed by both positive, then A1A0 • If $e_{\max} = 1$ seen followed by $v = \frac{3}{4}u > 0$, then A1A1 • If $e = 1$ only seen followed by both positive then, A1A0 • If $e = 1$ and $e = 0$ used, then A1A0 • If $e = 1$ and $e = 0$ used **and** $(0 <) e \leqslant 1$ seen, then A1A1 • If v_P and v_Q found then states $v_P > 0$, $v_Q > 0$ with no reference to e values, then A0A0		
		(3)
6(c)	Rebound speed of Q $\frac{15u}{16}(1+e)$	B1
	Use of impulse - momentum	M1
	$\frac{45mu}{4} = 3m\left(\frac{15u}{16}(1+e) - -\frac{15u}{8}(1+e)\right)$	A1ft
	$e = \frac{1}{3}$	A1
		(4)
		(12)

	Notes for question	
(a)		
M1	Equation for CLM. Dimensionally correct, all terms required. Condone sign errors. Mass and velocity paired correctly.	
A1	Correct unsimplified equation, accept $\pm v$	
M1	Use of impact law. Condone sign errors but must be used the right way round.	
A1	Correct unsimplified equation, sign of v consistent with CLM.	
A1*	Obtain given answer from correct working. Must be in factorised fraction form, allow equivalent factorised forms. Must be at least one line of working after equations with preferably an equation in w only	
(b)		
M1	Method to find the velocity of P after the collision.	
A1	Correct deduction without justification. Allow $(3e-5)<0$ followed by $e<\frac{5}{3}$ Use $e = 1$, or 'better' to show that $v_P > 0$	
A1*	Correct justification i.e. uses $(0<)e\leqslant 1$, compares with direction of Q and concludes correctly. Fully correct answer using either $e_{\max}=1$ or $e\leqslant 1$, to show that $v_P > 0$ [and $e > 0$ to show that $v_Q > 0$] A0 If uses (0 <) e < 1	
(c)		
B1	Correct rebound speed of Q after the collision with the wall, in terms of e and u allow $\pm$	
M1	Impulse-momentum equation using result from (a) and rebound speed of Q. May not replace w until later in working eg $\frac{45mu}{4}=3m\left(w--\frac{w}{2}\right)$ w must be substituted for this M mark. Candidates could solve for $w=\frac{5}{2}u$ and then equate this to w $\frac{5}{2}u=\frac{15u}{8}(1+e)$	
A1ft	Correct unsimplified equation in e (m and u). Follow their rebound speed of Q.	
A1	Correct answer. Allow 0.33 or better. Note that calculators can solve the equation so there may be little evidence of working out.	