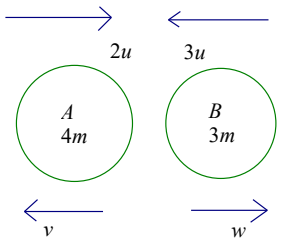
Question Number	Scheme	Marks
8		
	Change in KE $\frac{4m}{2}\left(4u^2-v^2\right)+\frac{3m}{2}\left(9u^2-w^2\right)=\frac{473}{24}mu^2$ $\left(48v^2+36w^2=43u^2\right)$	M1 A1
	Equation for CLM Need all terms. Dimensionally correct. Condone sign errors. $8mu-9mu=-4mv+3mw$ $\left(u=4v-3w\right)$	M1 A1
	Impact law $w+v=5eu$	M1 A1
	$48v^2+36\left(\frac{4v-u}{3}\right)^2=43u^2$ Or $48\left(\frac{u+3w}{4}\right)^2+36w^2=43u^2$ Or $\frac{48}{49}(1+15e)^2+\frac{36}{49}(20e-1)^2=43$	DM1
	$112v^2-32uv-39u^2=0$ $=(4v-3u)(28v+13u)$ Or $63w^2+18uw-40u^2=0$ $=(21w+20u)(3w-2u)$ Or $25200e^2=2023$	DM1

Notes

	The first 8 marks are available if they have ignored the information about the final directions Work with their directions. Ignore the diagram if that is to the candidate's advantage.
M1	Need all terms. Dimensionally correct. Accept ±
A1	Correct unsimplified equation in *v*, *w* or their *v*, *w*
M1	Need all terms. Dimensionally correct. Condone sign errors.
A1	Correct unsimplified equation with their correct signs
M1	Must be used the right way round
A1	Or equivalent in their *w*, *v*. Signs for *v*, *w* consistent with CLM eqn
DM1	Form equation for *v* or *w* or *e* Dependent on M marks scored for the equations used.
DM1	Solve for *v* or *w* or *e* . Dependent on the preceding M

Question Number	Scheme	Marks
8	$v = \frac{3u}{4}$ $w = \frac{2u}{3}$ $\frac{3u}{4} + \frac{2u}{3} = 5eu$, $e = \frac{17}{60}$ Use of $I = m(v-u)$ $4m\left(2u + \frac{3u}{4}\right) = 11mu$	A1 A1 DM1 A1 (12)
	Notes	**[12]**
A1	v or w correct	
A1	$\frac{3u}{4} + \frac{2u}{3} = 5eu$	
DM1	Must be attempting to subtract corresponding values for u and v Dependent on the first 4 M marks	
A1	Or $3m\left(3u + \frac{2u}{3}\right)$ from correct solution only	

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