

4A Direct Collisions & Newton's Law of Restitution

1. In these questions the diagrams show the speeds of two particles A and B just before and just after a collision. The particles are moving on a smooth horizontal plane.

Find the coefficient of restitution in each case.

a)

Before impact	After impact
$\xrightarrow{8}$ A	At rest
At rest	At rest
B	B
	$\xrightarrow{2}$

b)

Before impact	After impact
$\begin{array}{c} 6 \\ \longrightarrow \\ \textcircled{A} \end{array}$ $\begin{array}{c} 3 \\ \longrightarrow \\ \textcircled{B} \end{array}$	$\begin{array}{c} 4 \\ \longrightarrow \\ \textcircled{A} \end{array}$ $\begin{array}{c} 5 \\ \longrightarrow \\ \textcircled{B} \end{array}$

c)

Before impact	After impact
$\begin{array}{c} 11 \\ \longrightarrow \\ \textcircled{A} \end{array}$ $\begin{array}{c} 7 \\ \longleftarrow \\ \textcircled{B} \end{array}$	$\begin{array}{c} 6 \\ \longleftarrow \\ \textcircled{A} \end{array}$ $\begin{array}{c} 3 \\ \longrightarrow \\ \textcircled{B} \end{array}$

2. Find the value of v in the situation shown, given that $e = \frac{1}{3}$

Before impact	After impact
$\begin{array}{c} 4 \\ \longrightarrow \\ \textcircled{A} \end{array}$ $\begin{array}{c} 3 \\ \longrightarrow \\ \textcircled{B} \end{array}$	$\begin{array}{c} 2 \\ \longrightarrow \\ \textcircled{A} \end{array}$ $\begin{array}{c} v \\ \longrightarrow \\ \textcircled{B} \end{array}$

3. Calculate the values of v_1 and v_2 , given that the coefficient of restitution is $\frac{1}{2}$

Before impact		After impact	
$\xrightarrow{5}$ (A) 200g	$\xleftarrow{4}$ (B) 400g	$\xrightarrow{v_1}$ (A) 200g	$\xrightarrow{v_2}$ (B) 400g

4. Two small spheres have mass $3m$ and $4m$ respectively. They are moving towards each other in opposite directions on a smooth horizontal plane. P has speed $3u$ and Q has speed $2u$ just before the impact. The coefficient of restitution between P and Q is e .
- a) Show that the speed of Q after the collisions is given by $\frac{u}{7}(15e + 1)$

b) Given that the direction of motion of P is unchanged, find the range of possible values for e

c) Given that the magnitude of the impulse of P on Q is $\frac{80mu}{9}$, find the value of e