

Second collision between P and Q

	Before	(Mass)	After
P :	$2u$	4	r
Q :	$-5eu$	8	0

$$4(2u) + 8[-5eu] = 4r$$

$$\Rightarrow r = 2u - 10eu$$

$$\frac{r - 0}{2u + 5eu} = -\frac{1}{4}$$

$$\Rightarrow 4r = -2u - 5eu$$

$$\Rightarrow 4(2u - 10eu) = -2u - 5eu$$

$$\Rightarrow 8 - 40e = -2 - 5e$$

$$\Rightarrow 35e = 10$$

$$\Rightarrow e = \frac{2}{7}$$

(ii) $r = 2u - 10eu$

$$\Rightarrow r = 2u - 10\left(\frac{2}{7}\right)u$$

$$\Rightarrow r = 2u - \frac{20}{7}u$$

$$\Rightarrow r = -\frac{6}{7}u \quad \dots \text{ final speed of } P$$

(iii) $\text{K.E.}_{\text{before}} = \frac{1}{2}(4)(12u)^2$

$$= 288u^2 \text{ J}$$

$$\text{K.E.}_{\text{after}} = \frac{1}{2}(4)\left(\frac{6}{7}u\right)^2$$

$$= \frac{72}{49}u^2 \text{ J}$$

$$\text{Loss} = 288u^2 - \frac{72}{49}u^2$$

$$= 286.53u^2 \text{ J}$$

Exercise 7D

Q. 1.

Before	(Mass)	After
$u \cos A \vec{i} + u \sin A \vec{j}$	M	$v \cos B \vec{i} + v \sin B \vec{j}$
$0\vec{i} + 0\vec{j}$	M	$q\vec{i} + 0\vec{j}$

$$u \sin A = v \sin B \quad \dots \text{ Equation 1}$$

$$M(u \cos A) + M(0) = M(v \cos B) + Mq$$

$$\Rightarrow q = u \cos A - v \cos B \quad \dots \text{ Equation 2}$$

$$\frac{v \cos B - q}{u \cos A - 0} = -\frac{1}{4}$$

$$\Rightarrow 4v \cos B - 4q = -u \cos A \quad \dots \text{ Equation 3}$$

$$\text{But } q = u \cos A - v \cos B$$

\therefore 3 reads:

$$4v \cos B - 4u \cos A + 4v \cos B = -u \cos A$$

$$\Rightarrow 3u \cos A = 8v \cos B \quad \dots \text{ Equation 4}$$

Dividing equation 1 by equation 4, we get:

$$\frac{u \sin A}{3u \cos A} = \frac{v \sin B}{8v \cos B}$$

$$\Rightarrow 8 \tan A = 3 \tan B \quad \text{QED}$$