

**Q. 17.** (i) **Before**      **(Mass)**      **After**

$$u \quad 4m \quad p$$

$$0 \quad 2m \quad q$$

$$4m(u) + 2m(0) = 4m(p) + 2m(q) \quad \dots \text{divide by } 2m$$

$$\Rightarrow 2p + q = 2u \quad \dots \text{Equation 1}$$

$$\frac{p - q}{u - 0} = -e$$

$$\Rightarrow p - q = -eu \quad \dots \text{Equation 2}$$

Adding equations 1 and 2 we get

$$3p = u(2 - e)$$

$$\Rightarrow p = \frac{u}{3}(2 - e) \quad \dots \text{speed of } 4m \text{ sphere after impact.}$$

$$q = p + eu \quad \dots \text{from Equation 1}$$

$$\Rightarrow q = \frac{u}{3}(2 - e) + eu$$

$$\Rightarrow q = \frac{2u}{3} - \frac{eu}{3} + eu$$

$$\Rightarrow q = \frac{2u - eu + 3eu}{3}$$

$$\Rightarrow q = \frac{2u + 2eu}{3}$$

$$\Rightarrow q = \frac{2u}{3}(1 + e)$$

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

$$= 2mu^2$$

$$\text{K.E.}_{\text{after}} = \frac{1}{2}(4m)(p)^2 + \frac{1}{2}(2m)(q)^2$$

$$= 2m\left[\frac{u^2}{9}(2 - e)^2\right] + m\left[\frac{4u^2}{9}(1 + e)^2\right]$$

$$= \frac{2mu^2}{9}[4 - 4e + e^2 + 2(1 + 2e + e^2)]$$

$$= \frac{2mu^2}{9}[3e^2 + 6]$$

$$= \frac{2mu^2}{3}(e^2 + 2)$$

$$\text{Loss} = 2mu^2 - \frac{2mu^2}{3}(e^2 + 2)$$

$$= \frac{2mu^2}{3}(3 - e^2 - 2)$$

$$= \frac{2mu^2}{3}(1 - e^2)$$

**Q. 18.** (i) **Before**      **(Mass)**      **After**

$$2u \quad m \quad p$$

$$0 \quad m \quad q$$

$$m(2u) + m(0) = m(p) + m(q) \quad \dots \text{divide by } m$$

$$\Rightarrow p + q = 2u \quad \dots \text{Equation 1}$$

$$\frac{p - q}{2u - 0} = -e$$

$$\Rightarrow p - q = -2eu \quad \dots \text{Equation 2}$$

Adding equations 1 and 2 we get

$$2p = 2u(1 - e)$$

$$\Rightarrow p = u(1 - e) \quad \dots \text{speed of 1st sphere after impact}$$

$$q = p + 2eu \quad \dots \text{from Equation 1}$$

$$\Rightarrow q = u(1 - e) + 2eu$$

$$\Rightarrow q = u - eu + 2eu$$

$$\Rightarrow q = u + eu$$

$$\Rightarrow q = u(1 + e) \quad \dots \text{speed of second sphere after impact}$$