



4. A particle of mass m moving in the x direction with speed $2v$ is hit by another particle of mass $2m$ moving in the y direction with speed v . If the collision is perfectly inelastic, the percentage loss in the energy during the collision is close to:

- (1) 44% (2) 50% (3) 56% (4) 62%

Answer:

In elastic collision momentum before and after will remain same as it is conserved

$$m2v\vec{i} + 2mv\vec{j} = 3m\vec{v}$$

$$\text{or } \vec{v} = \frac{m2v\vec{i} + 2mv\vec{j}}{3m} = \frac{2v(\vec{i} + \vec{j})}{3}$$

$$\text{therefore magnitude of final velocity} = v = \sqrt{\left(\frac{2v}{3}\right)^2 + \left(\frac{2v}{3}\right)^2} = \frac{v}{3} 2\sqrt{2}$$

Kinetic energy before and after collision remains same

$$\frac{1}{2} 2mv^2 + \frac{1}{2} m(2v)^2 = 3mv^2$$

$$\text{Kinetic energy after collision} = \frac{1}{2} 3m\left(\frac{2\sqrt{2}v}{3}\right)^2 = \frac{4}{3} mv^2$$

$$\text{Percentage Loss} = \frac{3mv^2 - \frac{4}{3}mv^2}{3mv^2} \times 100 = \frac{5}{9} \times 100 = 55.55\% \approx 56\%$$

Correct answer is option (3) 56%