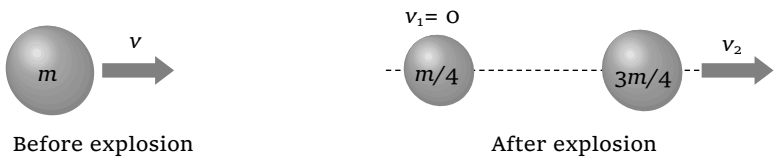
## Elastic and Inelastic Collision

**21.** (d)




According to conservation of momentum

$$mv = \left(\frac{m}{4}\right) v_1 + \left(\frac{3m}{4}\right) v_2 \Rightarrow v_2 = \frac{4}{3}v$$

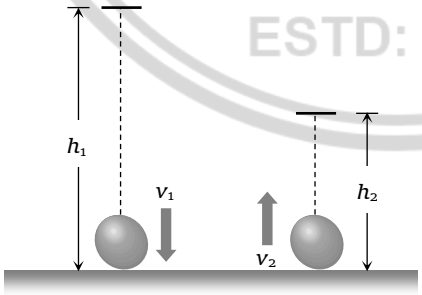
**22.** (d)


As $m_1 = m_2$ therefore after elastic collision velocities of masses get interchanged

*i.e.* velocity of mass $m_1 = -5\ m \rightleftarrows/\rightleftarrows\ s$

and velocity of mass $m_2 = +3\ m \rightleftarrows\rightleftarrows/\rightleftarrows\ s$

**23.** (b) If ball falls from height $h_1$ and bounces back up to height $h_2$ then $e = \sqrt{\frac{h_2}{h_1}}$




Similarly if the velocity of ball before and after collision are $v_1$ and $v_2$ respectively

then $e = \frac{v_2}{v_1}$

So $\frac{v_2}{v_1} = \sqrt{\frac{h_2}{h_1}} = \sqrt{\frac{1.8}{5}} = \sqrt{\frac{9}{25}} = \frac{3}{5}$

*i.e.* fractional loss in velocity $= 1 - \frac{v_2}{v_1} = 1 - \frac{3}{5} = \frac{2}{5}$

**24.** (a) $h_n = he^{2n} = 32\left(\frac{1}{2}\right)^4 = \frac{32}{16} = 2m$(here $n = 2$, $e = 1/2$)

**25.** (c) As the body at rest explodes into two equal parts, they acquire equal velocities in opposite directions according to conservation of momentum.

When the angle between the radius vectors connecting the point of explosion to the fragments is 90°, each radius vector makes an angle 45° with the vertical.

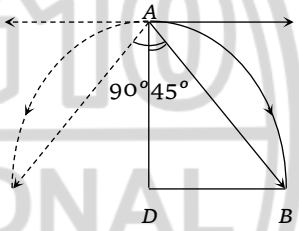
To satisfy this condition, the distance of free fall *AD* should be equal to the horizontal range in same interval of time.

$AD = DB$

$AD = 0 + \frac{1}{2} \times 10t^2 = 5t^2$

$DB = ut = 10t$

$\therefore 5t^2 = 10t \Rightarrow t = 2sec$




**26.** (a) $v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) u_1 + \left(\frac{2m_2}{m_1 + m_2}\right) u_2$ and

$$v_2 = \left(\frac{2m_1}{m_1 + m_2}\right) u_1 + \left(\frac{m_1 - m_2}{m_1 + m_2}\right) u_2$$

on putting the values $v_1 = 6m/s$ and $v_2 = 12m/s$

**27.** (b) $F = \frac{dp}{dt} = m\frac{dv}{dt} = \frac{m \times 2v}{1 \rightleftarrows / \rightleftarrows 50} = \frac{2 \times 2 \times 100}{1 \rightleftarrows / \rightleftarrows 50} = 2 \times 10^4 N$

**28.** (d) $h_n = he^{2n} = 1 \times e^{2\times 1} = 1 \times (0.6)^2 = 0.36m$

**29.** (d) $h_n = he^{2n}$, if $n = 2$ then $h_n = he^4$

**30.** (b) Impulse = change in momentum

$mv_2 - mv_1 = 0.1 \times 40 - 0.1 \times (-30)$

**31.** (b) In elastic head on collision velocities gets interchanged.

**32.** (a) Impulse = change in momentum = 2 *mv*

$=2 \times 0.06 \times 4 = 0.48\ kg\ m/s$

**33.** (b) When ball falls vertically downward from height $h_1$ its velocity $\vec{v}_1 = \sqrt{2gh_1}$ and its velocity after collision $\vec{v}_2 = \sqrt{2gh_2}$

Change in momentum

$$\Delta\vec{P} = m(\vec{v}_2 - \vec{v}_1) = m(\sqrt{2gh_1} + \sqrt{2gh_2})$$

(because $\vec{v}_1$ and $\vec{v}_2$ are opposite in direction)

**34.** (a) Velocity of 50 *kg*. mass after 5 *sec* of projection $v = u - gt = 100 - 9.8 \times 5 = 51\ m \rightleftarrows s$

At this instant momentum of body is in upward direction

$$P_{\text{initial}} = 50 \times 51 = 2550\ kg - m \rightleftarrows s$$

After breaking 20 *kg* piece travels upwards with 150 *m/s* let the speed of 30 *kg* mass is *V*

$$P_{\text{final}} = 20 \times 150 + 30 \times V$$

By the law of conservation of momentum

$P_{\text{initial}} = P_{\text{final}}$

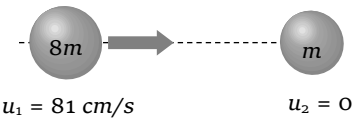
$\Rightarrow 2500 = 20 \times 150 + 30 \times V \Rightarrow V = -15\ m \rightleftarrows s$

*i.e.* it moves in downward direction.

**35.** (c) Ratio in radius of steel balls = 1/2

So, ratio in their masses= $\frac{1}{8}$ [As$M \propto V \propto r^3$]

Let $m_1 = 8m$ and $m_2 = m$




$$v_2 = \frac{2m_1u_1}{m_1+m_2} = \frac{2\times 8m\times 81}{8m+m} = 144cm \rightleftarrows s$$

**36.** (a) After explosion $m$ mass comes at rest and let Rest $(M-m)$ mass moves with velocity $v$.

By the law of conservation of momentum $MV = (M-m)v \Rightarrow v = \frac{MV}{(M-m)}$

**37.** (c) As the ball bounces back with same speed so change in momentum = 2 $mv$ and we know that force = rate of change of momentum

*i.e.* force will act on the ball so there is an acceleration.

**38.** (d) According to conservation of momentum

$$m_Bv_B + m_Gv_G = 0 \Rightarrow v_G = -\frac{m_Bv_B}{m_G}$$

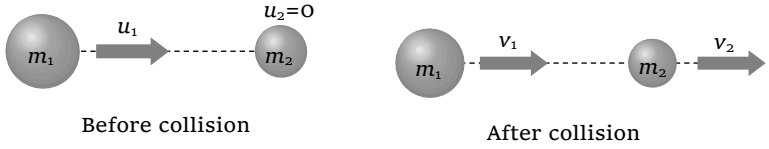
$$v_G = \frac{-50\times 10^{-3}\times 10^3}{5} = -10m/s$$

**39.** (a) As 20% energy lost in collision therfore

$$mgh_2 = 80\% \text{ of } mgh_1 \Rightarrow \frac{h_2}{h_1} = 0.8$$

but $e = \sqrt{\frac{h_2}{h_1}} = \sqrt{0.8} = 0.89$

**40.** (b)



If target is at rest then final velocity of bodies are

$v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) u_1$ …(i) and $v_2 = \frac{2m_1 u_1}{m_1 + m_2}$…(ii)

From (i) and (ii) $\frac{v_1}{v_2} = \frac{m_1 - m_2}{2m_1} = \frac{2}{5} \Rightarrow \frac{m_1}{m_2} = 5$