Elastic and Inelastic Collision

1. (a)

2. (a)

3. (c) According to law of conservation of linear momentum both pieces should possess equal momentum after explosion. As their masses are equal therefore they will possess equal speed in opposite direction.

4. (a)

5. (c)

Initial linear momentum of system = $m_A\vec{v}_A + m_B\vec{v}_B$

= 0.2 × 0.3 + 0.4 × v_B

Finally both balls come to rest

∴ final linear momentum = 0

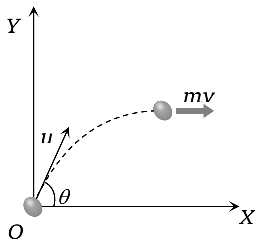
By the law of conservation of linear momenum

0.2 × 0.3 + 0.4 × v_B = 0

∴ $$v_B = -\frac{0.2\times0.3}{0.4} = -0.15\ m/s$$

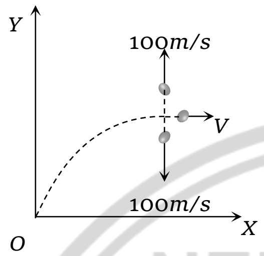
6. (c) For a collision between two identical perfectly elastic particles of equal mass, velocities after collision get interchanged.

7. (b)



Momentum of ball (mass *m*) before explosion at the highest point $= mv\hat{\imath} = mu\cos 60°\hat{\imath}$

$= m \times 200 \times \frac{1}{2}\hat{\imath} = 100\ m\hat{\imath}\ kgms^{-1}$



Let the velocity of third part after explosion is *V*

After explosion momentum of system = $\vec{P}_1 + \vec{P}_2 + \vec{P}_3$

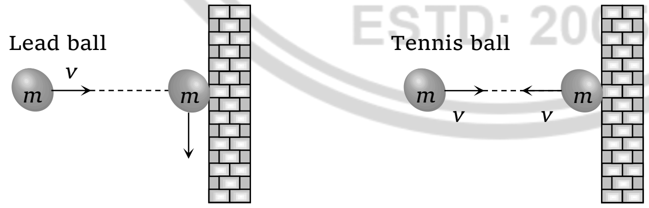
$= \frac{m}{3} \times 100\hat{\jmath} - \frac{m}{3} \times 100\hat{\jmath} + \frac{m}{3} \times V\hat{\imath}$

By comparing momentum of system before and after the explosion

$\frac{m}{3} \times 100\hat{\jmath} - \frac{m}{3} \times 100\hat{\jmath} + \frac{m}{3}V\hat{\imath} = 100m\hat{\imath} \Rightarrow V = 300m \rightleftarrows / \rightleftarrows s$

8. (c) Change in the momentum

= Final momentum – initial momentum



For lead ball $\Delta\vec{P}_{\text{lead}} = 0 - m\vec{v} = -m\vec{v}$

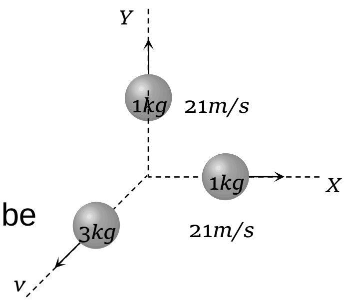
For tennis ball $\Delta\vec{P}_{\text{tennis}} = -m\vec{v} - m\vec{v} = -2m\vec{v}$

i.e. tennis ball suffers a greater change in momentum.

9. (c)

10. (d)

11. (d)



$P_x = m \times v_x = 1 \times 21 = 21\ kg\ m \rightleftarrows/\rightleftarrows s$

$P_y = m \times v_y = 1 \times 21 = 21\ kg\ m \rightleftarrows/\rightleftarrows s$

$\therefore$ Resultant $=\sqrt{P_x^2 + P_y^2} = 21\sqrt{2}kg\ m/s$

The momentum of heavier fragment should be numerically equal to resultant of $\vec{P}_x$ and $\vec{P}_y$.

$3 \times v = \sqrt{P_x^2 + P_y^2} = 21\sqrt{2} \therefore\ v = 7\sqrt{2} = 9.89\ m/s$

12. (b) We know that when heavier body strikes elastically with a lighter body then after collision lighter body will move with double velocity that of heavier body.

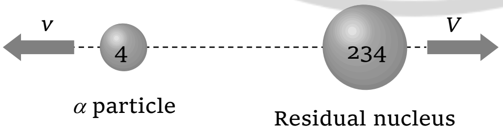
i.e. the ping pong ball move with speed of $2 \times 2 = 4\ m \rightleftarrows/\rightleftarrows s$

13. (d) Change in momentum= $m\vec{v}_2 - m\vec{v}_1 = -mv - mv = -2mv$

14. (c) $m_G = \frac{m_B v_B}{v_G}$ $\frac{50\times10^{-3}\times30}{1} = 1.5\ kg$

15. (d)

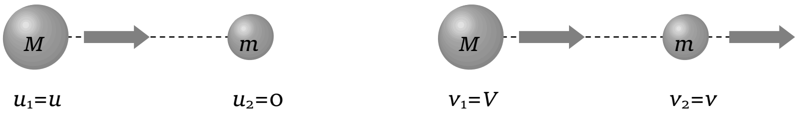
16. (a) Initially ^{238}U nucleus was at rest and after decay its part moves in opposite direction.



According to conservation of momentum

$4v + 234V = 238 \times 0 \Rightarrow V = -\frac{4v}{234}$

17. (c)



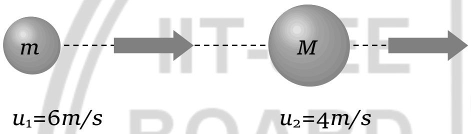
Before collision　　After collision

$$v_2 = \left(\frac{m_2-m_1}{m_1+m_2}\right) u_2 + \frac{2m_1u_1}{m_1+m_2} = \frac{2Mu}{M+m} = \frac{2u}{1+\frac{m}{M}}$$

18. (c) Velocity exchange takes place when the masses of bodies are equal

19. (d) In perfectly elastic head on collision of equal masses velocities gets interchanged

20. (a)



$$v_1 = \left(\frac{m_1-m_2}{m_1+m_2}\right) u_1 + \frac{2m_2u_2}{m_1+m_2}$$

Substituting $m_1 = 0$, $v_1 = -u_1 + 2u_2$

$\Rightarrow v_1 = -6 + 2(4) = 2m/s$

i.e. the lighter particle will move in original direction with the speed of 2 *m*/*s*.