Q. No. 2 (i) **Reason:-** It is because of the relative nature of velocity.

Explanation:- Consider two trains moving with different velocities in the same direction. The observer (you) is present in the faster train. When faster train having the observer passes the slower train, the slower train appears moving backward, this is because:

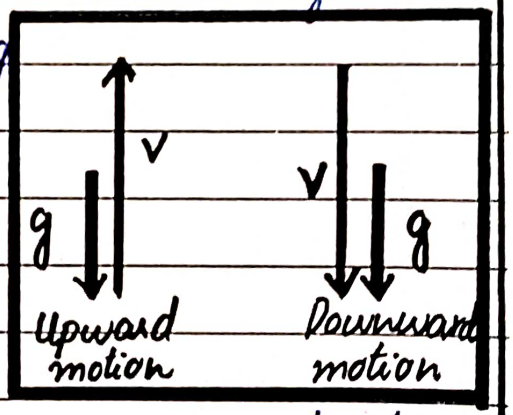
- The faster train is going ahead.
- The slower train is lagging behind.

If the other train gains equal speed it will appear at rest.

Conclusion:- It is due to relative motion between the trains.

Q. No. 2 (ii) **Reason:-** Yes it is possible under vertical motion in action of gravity.

Justification:- ★ When a body is thrown in vertically upward, its velocity goes on decreasing due to gravity and becomes zero at the maximum height.

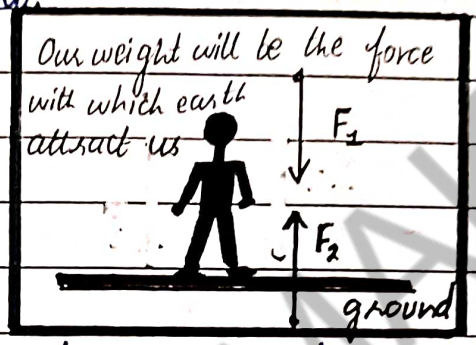


★ After attaining maximum height it will move in downward direction and reverse its direction of velocity.

★ But the magnitude of acceleration remains constant (i.e $9.8 m/s^2$) throughout its flight.

Conclusion:- Thus direction of the velocity reverse but the when acceleration is constant.

Q. No. 2 (iii) **Reason:-** When we stand on the ground then we exert force on ground equal to our weight.



Mathematically:-

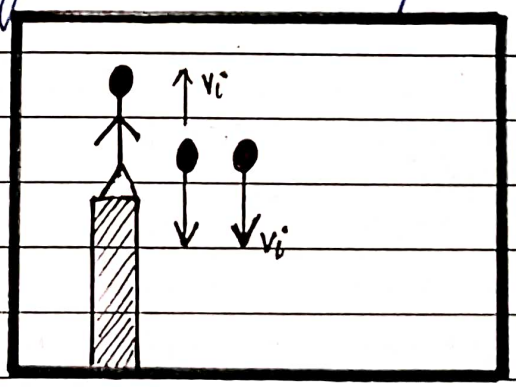
$$F = W = mg$$

Explanation
- The force acts as action on ground.
- According to Newton's 3rd law of motion ground exerts equal force but opposite in direction.
- This reaction is just sufficient to keep us standing on ground.
- This force of reaction can't make us to rise in air.

Conclusion:- For that purpose upward force must be greater than our weight which is acting downward.

Q. No. 2 (iv) **Reason:-** Both balls hit the ground with same speed.

Explanation:- The ball which is thrown vertically up with v_i will have same velocity v_i when it reaches back to the top of the tower.



Mathematically:-

$$v_f^2 = v_i^2 + 2gh$$
$$v_f = \sqrt{v_i^2 + 2gh}$$

Conclusion:- Since two balls have same downward velocity at the to top of tower. So both balls will hit the ground with same final velocity.

Q. No. 2 (v) **Reason:-** Follow through is advised to increase the momentum and hence increases velocity of the ball to travel a greater distance.

Explanation:- The follow-through technique with the shot increases the time of impulse when the ball is leaving the bat, as a result more impulsive force will act on it.

Mathematically:-

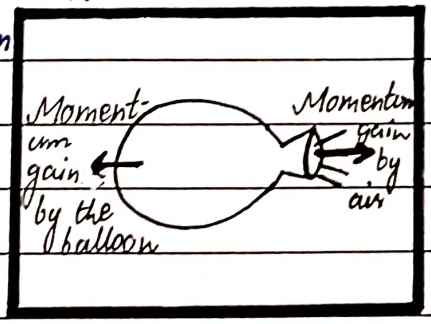
$$\vec{J} = \Delta P = \vec{F} \times \Delta t$$

Conclusion:- Thus the main purpose of the following through is to extend the amount of time for which the bat and ball are in contact.

Q. No. 2 (vi) **Reason:-** When you release an inflated but untied balloon, it flies across the room to conserve momentum.

Explanation:- → In an inflated balloon, air is at higher pressure then atmospheric pressure.

→ When it is released, air escapes from the balloon that carries momentum.



→ To observe the momentum, the balloon acquires momentum which is exactly opposite to the momentum of escaping air under the effect of reaction force.

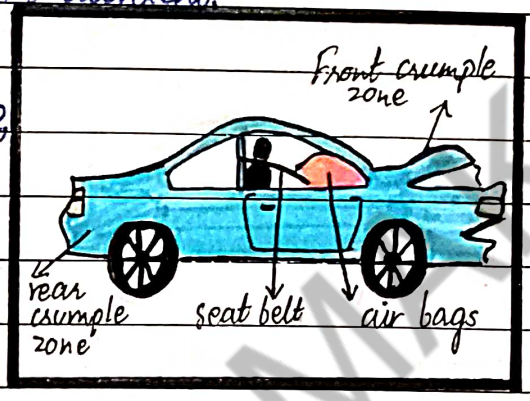
Mathematically:-

$$P_{gases} = P_{balloon}$$

Conclusion:- The balloon flies across the room to conserve momentum.

Q. No. 2 (vii) **Reason:-** Crumple zones like bumpers are made in cars to reduce the force during an accident.

Explanation:- During an accident, crumple zones like bumpers collapse, that will increase the collision time (Δt) and hence reduce the impact force.



Mathematically:-

$$F = \frac{J}{\Delta t}$$

Advantages:- ★ This will make passengers safer.
★ They absorb energy during head-on collisions, passenger will feel lesser jerk and remain safe.

Conclusion:- Thus, they are made to reduce the effectiveness of force.

Q. No. 2 (viii) **Reason:-** In cricket match, the time of collision between ball and bat decrease which increase the striking force. As a result, a ball goes longer distance.

Mathematically:-

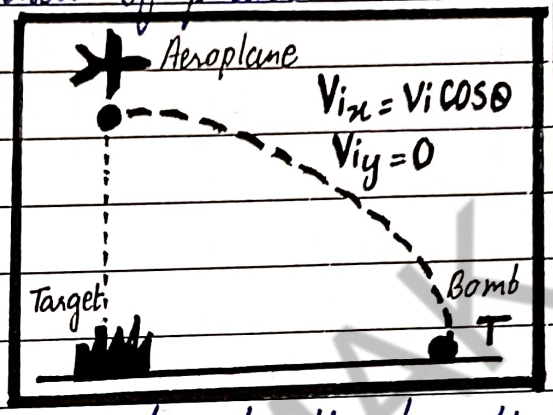
$$F = \frac{J}{\Delta t}$$

Explanation:- → When batman hit pitched ball, Δt is small so force will be greater. The change in momentum will be greater and ball will cover greater distance.
→ The motion of the ball when hit for six is like a projectile motion. A projectile has maxi. range when its hit at $\angle 45°$ with the ground and is possible to archieve.
→ It is difficult to archieve $\angle 45°$ when we toss the ball for ourselves.
→ If we toss the ball for ourselves change in momentum is smaller and cover small distance.

Q. No. 2 (xii)

Reason:- When a bomb is dropped from the aeroplane it has the same velocity as that of plane.

Explanation:- → If the bomb is dropped when the aero-plane is vertically above the target, it will strike a point ahead of the target due to constant horizontal velocity component and interia.



→ The bomb misses the traget if its dropped vertical above the target because it moves like a projectile.

→ Because during making projectile due to resistance of air the curve path will be reduced.

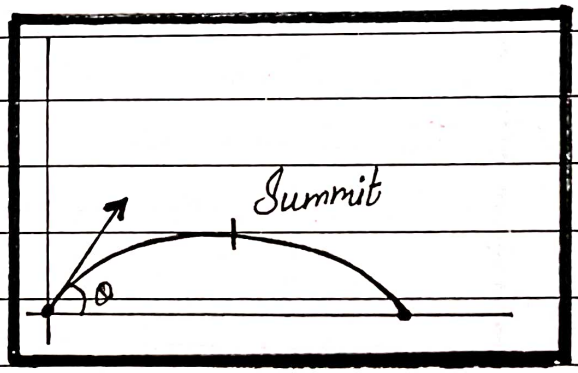
→ It will not hit the target but hit point T.

Conclusion:- The bomb strikes ahead because of horizontal component of velocity.

Q. No. 2 (viii)

Given condition:-

$$(K.E)_{summit} = \frac{1}{4}(K.E)_{initial} \rightarrow (A)$$



→ K.E at maximum point is written as

$$K.E = \frac{1}{2} m v_{ix}^2$$

$$K.E = \frac{1}{2} m (v_i \cos\theta)^2$$

$$K.E = \frac{1}{2} m v_i^2 \cos^2\theta \rightarrow (i)$$

→ K.E at initial point is written as

$$(K.E)_i = \frac{1}{2} m v_i^2 \rightarrow (ii)$$

Putting value of eq (i) and (ii) in eq (A)

$$\frac{1}{2} m v_i^2 \cos^2\theta = \frac{1}{4}\left(\frac{1}{2} m v_i^2\right)$$

$$\cos^2\theta = \frac{1}{4}$$

$$\sqrt{\cos^2\theta} = \sqrt{\frac{1}{4}} \Rightarrow \cos\theta = \frac{1}{2} \Rightarrow \theta = 60^\circ$$

Q. No. 2 (xi) Maximum range of projectile is at $\theta = 45°$

$$R_{max} = \frac{v_i^2}{g}$$

Height of projectile

$$H = \frac{1}{4} R_{max}$$

At angle of projection $\theta = 45°$

$$H = \frac{v_i^2 \sin^2(45)}{2g}$$

$$H = \frac{v_i^2}{2g}\left(\frac{1}{\sqrt{2}}\right)^2$$

$$H = \frac{v_i^2}{2g}\left(\frac{1}{2}\right)$$

$$H = \frac{v_i^2}{4g}$$

$$H = \frac{1}{4}\left(\frac{v_i^2}{g}\right)$$

$\therefore v_i^2/g = R_{max}$

$4H = R_{max}$

Conclusion:- The "R" of projectile for any velocity can't exceed from "4H."

Q. No. 2 (xii) **Given data:-**

Maximum height = horizontal range

To Find:-

Angle of projection $= \theta = ?$

Calculation:-

$H = R$

$$\frac{v_i^2 \sin^2\theta}{2g} = \frac{v_i^2 \sin 2\theta}{g}$$

$$\frac{\sin^2\theta}{2} = \frac{\sin 2\theta}{1}$$

$\therefore \sin 2\theta = 2\sin\theta\cos\theta$

$$\frac{\sin^2\theta}{2} = \frac{2\sin\theta\cos\theta}{1}$$

$$\frac{\sin\theta}{\cos\theta} = 4$$

$\tan\theta = 4$

$\theta = \tan^{-1}(4)$

$\theta = 76$

Conclusion:- The angle for which the maximum height and corresponding range are equal is 76°.