III. Short Answer Type Questions
Question 1. State the difference in balanced and unbalanced force.
Answer:

Balanced force	Unbalanced force
1. Forces acting on a body from the opposite directions are same. 2. It does not change the state of rest or of motion of an object.	1. Forces acting on a body from two opposite directions are not same. 2. It do change the state of rest or of motion of an object.

Question 2. What change will force bring in a body?
Answer: Force can bring following changes in the body:

1. It can change the speed of a body.
2. It can change the direction of motion of a body,
3. It can change the shape of the body.

Question 3. When a motorcar makes a sharp turn at a high speed, we tend to get thrown to one side. Explain why?
Answer: It is due to law of inertia. When we are sitting in car moving in straight line, we tend to continue in our straight-line motion. But when an unbalanced force is applied by the engine to change the direction of motion of the motorcar. We slip to one side of the seat due to the inertia of our body.

Question 4. Explain why it is dangerous to jump out of a moving bus.
Answer: While moving in a bus our body is in motion. On jumping out of a moving bus our feet touches the ground and come to rest. While the upper part of our body stays in motion and moves forward due to inertia of motion and hence we can fall in forward direction.
Hence, to avoid this we need to run forward in the direction of bus.

Question 5. Why do fielders pull their hand gradually with the moving ball while holding a catch?
Answer: While catching a. fast moving cricket ball, a fielder on the ground gradually pulls his hands backwards with the moving ball. This is done so that the fielder increases the time during which the high velocity of the moving ball decreases to zero. Thus, the acceleration of the ball is decreased and therefore the impact of catching the fast moving ball is reduced.

Question 6. In a high jump athletic event, why are athletes made to fall either on a cushioned bed or on a sand bed?
Answer: In a high jump athletic event, athletes are made to fall either on a cushioned bed or on a sand bed so as to increase the time of the athlete's fall to stop after making the jump. This decreases the rate of change of momentum and hence the force.

Question 7. How does a karate player breaks a slab of ice with a single blow?
Answer: A karate player applied the blow with large velocity in a very short interval of time on the ice slab which therefore exerts large amount of force on it and suddenly breaks the ice slab.

Question 8. What is law of conservation of momentum?
Answer: Momentum of two bodies before collision is equal to the momentum after collision.

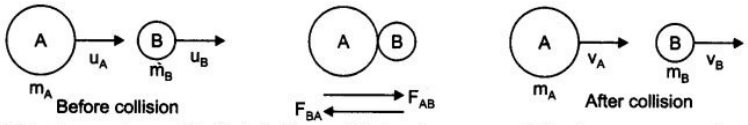
In an isolated system, the total momentum remain conserved.

Question 9. Why are roads on mountains inclined inwards at turns?
Answer: A vehicle moving on mountains is in the inertia of motion. At a sudden turn there is a tendency of vehicle to fall off the road due to sudden change in the line of motion hence the roads are inclined inwards so that the vehicle does not fall down the mountain.

Question 10. For an athletic races why do athletes have a special posture with their right foot resting on a solid supporter?
Answer: Athletes have to run the heats and they rest their foot on a solid supports before start so that during the start of the race the athlete pushes the support with lot of force and this support gives him equal and opposite push to start the race and get a good start to compete for the race.

Question 11.Why do you think it is necessary to fasten your seat belts while travelling in your vehicle?
Or
How are safety belts helpful in preventing any accidents?
Answer: While we are travelling in a moving car, our body remains in the state of rest with respect to the seat. But when driver applies sudden breaks or stops the car our body tends to continue in the same state of motion because of its inertia. Therefore, this sudden break may cause injury to us by impact or collision. Hence, safety belt exerts a force on our body to make the forward motion slower.

Question 12. Explain how momentum gets conserved in collision of two bodies.
Answer: Consider two bodies i.e., balls A and B, the mass and initial velocities are $m_A u_A$ and $m_B u_B$ respectively before collision. The two bodies collide and force is exerted by each body. There is change in their velocities due to collision.



The momentum of ball A before collision is $m_A u_A$ and final momentum is $m_A v_A$.
The rate of change of momentum, during the collision for 'A' will be $m_A \frac{(v_A - u_A)}{t}$.
Initial momentum of B is $m_B u_B$ and final momentum is $m_B v_B$.
Rate of change of momentum of B will be $m_B \frac{(v_B - u_B)}{t}$.
According to the third law of motion, the force F_{AB} exerted by ball A on ball B and the force F_{BA} exerted by the ball B on ball A must be equal and opposite to each other. Therefore

$$F_{AB} = F_{BA}$$

or $$m_A \frac{(v_A - u_A)}{t} = m_B \frac{(v_B - u_B)}{t}$$

$\therefore$ $$m_A u_A + m_B u_B = m_A v_A + m_B v_B$$

$\therefore$ $(m_A u_A + m_B u_B)$ is the total momentum of the two balls A and B before collision and $(m_A v_A + m_B v_B)$ is their total momentum after collision.

$\therefore$ The total momentum of the two balls remains unchanged or conserved provided no other external force acts.

Question 13. When you kick a football it flies away but when you kick a stone you get hurt why?
Answer: This is because stone is heavier than football and heavier objects offer larger inertia.
When we kick a football its mass is less and inertia is also less so force applied by our kick acts on it and hence it shows larger displacement but in case of stone, it has larger mass and offers larger inertia. When we kick (action) the stone it exerts an equal and opposite force (reaction) and hence it hurts the foot.

Question 14. If a person jumps from a height on a concrete surface he gets hurt. Explain.
Answer: When a person jumps from a height he is in state of inertia of motion. When he suddenly touches the ground he comes to rest in a very short time and hence the force exerted by the hard concrete surface on his body is very high, and the person gets hurt.

Question 15. What is the relation between Newton's three laws of motion?
Answer: Newton's first law explains about the unbalanced force required to bring change in the position of the body.
Second law states/explains about the amount of force required to produce a given acceleration.
And Newton's third law explains how these forces acting on a body are interrelated.

Question 16. Give any three examples in daily life which are based on Newton's third law of motion.
Answer: Three examples based on Newton's third law are :

1. Swimming: We push the water backward to move forward.
   action - water is pushed behind
   reaction - water pushes the swimmer ahead
2. Firing gun: A bullet fired from a gun and the gun recoils.
   action - gun exerts force on the bullet
   reaction - bullet exerts an equal and opposite force on the gun
3. Launching of rocket
   action - hot gases from the rocket are released reaction - the gases exert upward push to the rocket

Question 17. A bullet of m.ass 20 g is horizontally fired with a velocity 150 m/s from a pistol of mass 2 kg. What is the recoil velocity of the pistol?
Answer:

Bullet	**Pistol**
m_1 mass = 20 g = 0.02 kg	m_2 = 2 kg
u_1 = 0	u_2 = 0
v_1 = + 150 m/s	v_2 = ?

Total momentum of the pistol and bullet before firing, when the gun is at rest

$$= m_1u_1 + m_2u_2$$
$$= (0.02 \times 0) + (2 \times 0)$$
$$= 0 \text{ kg m/s}$$

Total momentum of the pistol and bullet after it is fired

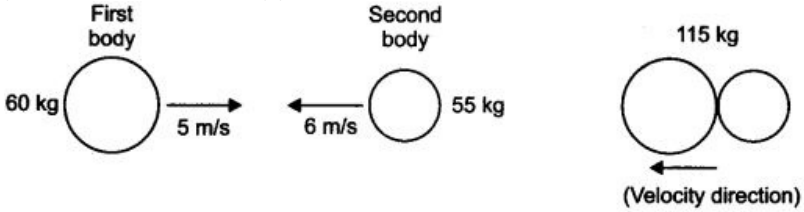
$$= m_1v_1 + m_2v_2$$
$$= (0.02 \text{ kg} \times 150) + (2 \text{ kg} \times v)$$
$$= 3 + 2v$$

$\therefore$ **Total momentum after firing = Total momentum before firing**

$$3 + 2v = 0$$

$$\therefore \quad v = \frac{-3}{2} = -1.5 \text{ m/s}$$

Question 18. Negative sign indicates that the direction in which the pistol would recoil is opposite to that of bullet.



Two bodies as shown in the figure collide with each other and join thereafter. With what velocity will they move after combining together?
Answer:

m_1 = 60 kg $\quad$ m_2 = 55 kg

u_1 = + 5 m/s positive direction $\quad$ u_2 = – 6 m/s negative direction

v =? $\quad$ v = ?

Total momentum of two bodies before collision

$$= m_1u_1 + m_2u_2$$
$$= 60 \times 5 + 55 \times -6$$
$$= -30 \text{ kg m/s}$$

If v is the velocity of two joined bodies. After collision, the total momentum will be

$$= m_1v_1 + m_2v_2 \quad (\therefore v_1 = v_2)$$
$$= (m_1 + m_2)\, v$$
$$= (60 + 55) \text{ kg} \times v \text{ m/s}$$
$$= 115\, v$$

$\therefore$ According to law of conservation of momentum

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$
$$-30 \text{ kg m/s} = 115\, v$$

$$\therefore \quad v = \frac{-30}{115} = -0.26 \text{ m/s}$$

$\therefore$ Two bodies will move with velocity 0.26 m/s in the direction of the second body.

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