Chapter#3 **Dynamics-I**

Exercise short questions/answers

Q: 1 When a motor cyclist hit a stationary car, he may fly off the motor cycle and driver in the car may get neck injury. Explain

When a motor cyclist hits a stationary car then he cannot stop himself due to inertia and continue his state of motion so he may fly off the motor cycle. While the driver in the car is at rest. When the motor cyclist hits the car then the upper part of the driver wants to stay at rest due to inertia, but his lower part moves with the car with a force produced of collision. So the driver in the car may get neck injury

Q: 2. In autumn, when you shake a branch, the leaves are detached. Why?

In autumn, when we shake a branch, the leaves get detached. Because when a tree is forcefully shaken, the branches of the tree come in motion but the leaves tend to continue in their state of rest due to inertia. As a result of this, leaves get separated from the branches of the tree and hence fall down.

Q: 3. Why it is not safe to apply brakes only on the front wheel of a bicycle?

If we apply brakes only on the front wheel of a bicycle then the bike lifts the rear wheel which may cause an accident. It is due to inertia that the rear wheel wants to continue its motion but when we brake; our weight is being shifted towards the front wheel. The inertia coupled with gravity puts our weight and that of the bike onto the front wheel. More weight means more friction/grip with the ground. So the front wheel stops immediately, but the rear wheel lifts up which may cause an accident and rider will get injured.

Q: 4. Deduce Newton's first law of motion farm Newton's second law of motion.

According to Newton's 2nd law

$$\boldsymbol{F} = m\boldsymbol{a}$$

$$\boldsymbol{F} = m\left(\frac{\boldsymbol{v_f} - \boldsymbol{v_i}}{\mathrm{t}}\right)$$

If **F = 0** then a= 0 so, $\boldsymbol{v}_i = \boldsymbol{v}_f$ the object continues uniform velocity or the object will stay at rest.

According to Newton's 1st law of motion, an object at rest or uniform motion tends to remain at rest or in uninform motion unless an external applied on it.

Q: 5. Action and reaction are equal but opposite in direction, these forces always act in pair. Do they balance each other? Can bodies move under action reaction pair?

Since balanced forces are equal and opposite forces that act on the same object. That's why they cancel out but action and reaction forces are equal and opposite acting on different objects, so they don't cancel out (balanced each other).

Yes, a body can move under an action-reaction pair. For example when a rocket expels gases downward (action) and the gasses exerts an equal and opposite upward force on the rocket (reaction). This reaction force propels the rocket upward, allowing it to move.

Q: 6. A man steps on the oily floor, he wants to move out of this area. He is alone. He throws his bag to move out of this slippery area. Why is it so?

When a man slips on the oily floor then he has minimum friction between floor and his feet. He throws his bag to move out of this slippery area. When he throws a bag in one direction then this is an action, according to third law of motion as a reaction he will move in opposite direction due to less friction. This act helps him to move out from the oily floor.

Q: 7. How would you use Newton's 3rd law of explain motion of rocket and law of conservation of momentum.

Newton's third law of motion states that to every action there is an equal and opposite reaction. Similarly, when a rocket moves, it exerts the action force on the gases to expel them backwards which in turn exert an equal and opposite reaction force to move the rocket forward. Rocket works on the principle of conservation of momentum. Rocket eject gases in backward direction which creates momentum of the gases backwards and thus by conservation of momentum, the rocket gets momentum in the forward direction making it move forward.

Q: 8. Why are cricket batter gloves padded with foam?

The batsman gloves are padded with foam in order to increase the impact time and thus decrease the influence of change in momentum on batman's hands. Because the rate of change of momentum is given by:

$$\boldsymbol{F} = \frac{\Delta p}{\Delta t} \qquad \rightarrow \boldsymbol{F} \propto \frac{1}{\Delta t}$$

For same change in momentum (Δp), if impact time (Δt) is greater force will be smaller. The foam of the gloves just increases time of impact (Δt) between handle of bat and batsman's hand which reduces acceleration and hence the force is reduced ($\boldsymbol{F} \propto \boldsymbol{a}$) . Batsman gloves are padded with foam for protection and it provides better friction between the gloves and the bat instead of using cotton.

Q: 9. Where will your weight be greater, near earth or near moon? What about mass?

Weight: We know that weight (W = mg) depends on the value of gravitational acceleration (g). As the value of g is greater on Earth then on Moon so the weight near Earth will be greater than Moon.

Mass: Mass is a quantity of matter that remains same everywhere. So the mass will be same on Earth and Moon.

Q: 10. When Ronaldo kicks the ball, at the highest point of ball both Earth and ball attract each other with the same magnitude of force. Why then the ball moves towards Earth and not the Earth?

When Ronaldo kicks the ball, at the highest point of ball both Earth and ball (according to third law they exert equal and opposite forces on each other) attract each other with the same magnitude of force. As per Newton's second law (F = ma). The accelerations they experience are inversely proportional to their masses. Since the Earth's mass is larger, its acceleration towards the ball is negligible.

On the other hand, the ball, with its much smaller mass, experiences a significant acceleration towards the Earth, which is why we see the ball move towards the Earth and not vice versa.