

Fazal Academy

Unit # 3 Dynamics

Conceptual Questions

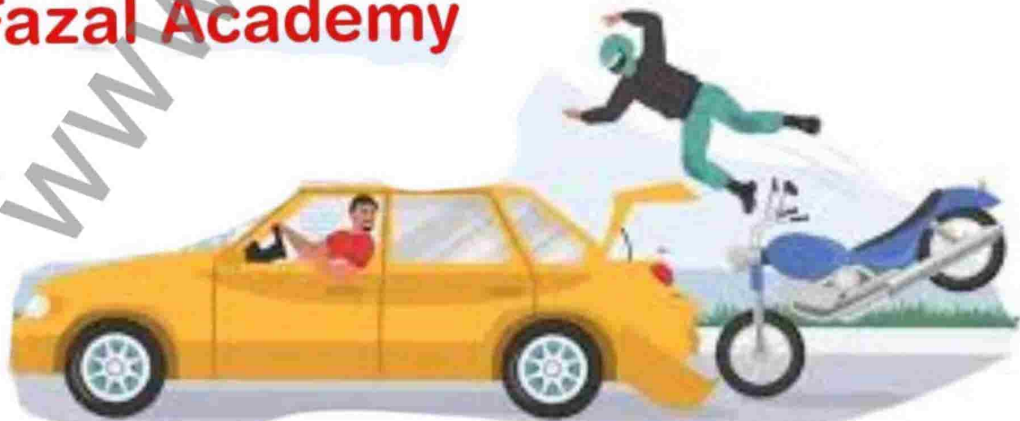
Uploaded by www.FazalAcademy.com

1. When a motor cyclist hits 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 (neck) of the driver wants to stay at rest due to inertia, but his lower part moves with the car with a force produced by collision. So the driver in the car feels backward jerk at his neck and may get neck injury.

Fazal Academy



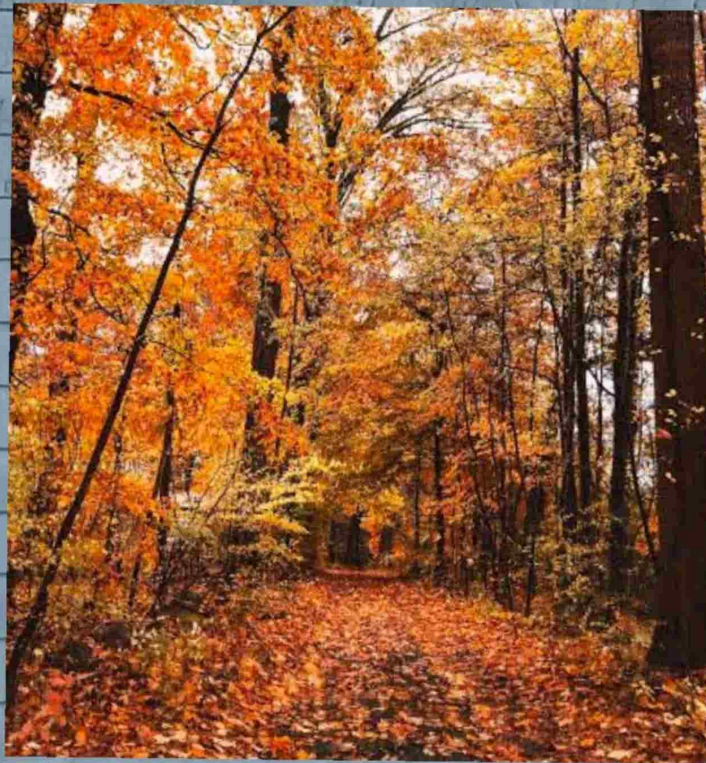
Fazal Academy

2. In autumn, when you shake a branch, the leaves get detached. Why does this happen?

It is due to inertia.

Explanation:

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 try to keep their state of rest due to inertia. As a result, leaves get separated from the branches of the tree and hence fall down.



3. When a Car takes a turn, the passengers experience a force acting on them away from the Center of Curve, why?

→ When a Car takes a turn then Centripetal force is produced which keeps the Car to move in a Circle. But according to Newton third law of motion, in reaction of this force Centrifugal force is also produced. Due to which passengers experience a force acting on them away from the Centre of Curve.

→ Secondly when a Car takes a turn, the passengers fall in the outward direction. It is due to inertia that they want to continue their motion in a straight line, that's why they are directed away from the center of the Curve instead of going towards it.

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

It is not safe because when the brakes are applied on the front wheel, the front tyre may get locked and stop but the body and bicycle want to continue their motion then our weight is being shifted towards the front wheel, so then the body and bicycle may topple over due to inertia which may cause an accident.

→ It is advised to apply brakes (front and back all at once).

5. Deduce Newton's first law of motion from Newton's Second law of motion.

OR

Newton's first law can be derived from Second law of motion. Explain.

According to Newton's 2nd law of motion

$$F = ma$$

$$\text{if } F = 0$$

$$0 = ma$$

$$\Rightarrow ma = 0$$

As $m \neq 0$ therefore $a = 0$

i.e., In the absence of external force ($F = 0$), a body at rest remains at rest ($a = 0$), a body in motion, continue its motion in a straight line with constant velocity ($a = 0$).

6. 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?

→ Balanced forces are equal and opposite forces that act on the same object. That's why they cancel out. Action and reaction forces are equal and opposite forces that act on different objects, so they do not balance each other because they act on two different objects.

Action-Reaction Pairs



Describe how we walk... in terms of the 3rd law.

→ Yes, bodies can move under action-reaction pair.

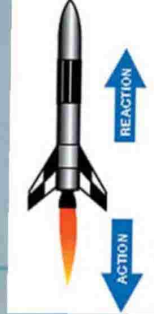
Example:

A bad boy pushes the ground in the backward direction, it is action and the ground pushes the bad boy in the forward direction, it is reaction, so the boy moves, so we can say bodies can move under action-reaction pair.

7. A man slips 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. How can this act help him?

A man slips on the oily floor because of less friction. So he cannot move. In order to get out of this area, he throws the bag in one direction, this is action and as a reaction he gets equal and opposite force due to which he moves in opposite direction and gets out of this slippery area, so this act helps him to move out from this slippery area.





8. How would you use Newton's 3rd law of motion and law of Conservation of momentum to explain motion of rocket?

Newton's 3rd law and motion of rocket:

Newton's 3rd law of motion states that to every action there is an equal and opposite reaction. Similarly, In a rocket, when its fuel burns, hot gases escape out from its tail with very high speed, it is action. In the reaction of these gases rocket moves in upward direction.

Law of Conservation of momentum and Motion of rocket:

Rocket works on the principle of Conservation of momentum. Rocket eject gases in backward direction which creates momentum of the gases backwards. As a result rocket gain an equal and opposite momentum due to which it move in forward direction with very high speed.

9. Why are batsman gloves padded with foam?

→ Batsman gloves are padded with foam for protection.

→ Batsman gloves are padded with foam to increase the impulse time and reduce the risk of injury.

$$\text{As } F = \frac{\Delta P}{t} \Rightarrow F \propto \frac{1}{t}$$



If the impact time is short, the force is large. So due to foam impact time increases which decrease the force and batsman save from injury.

10. While walking on ice, one should take small steps to avoid slipping. Why?

$f_k = \mu_k N \Rightarrow f_k \propto N$
As force of friction is directly proportional to Normal force (N) or weight i.e. ($N = W$)

So smaller steps will give large normal force and more the normal force will give more friction and the chances of slipping are decreased.

Just for understanding:

Smaller Step \rightarrow Normal force \rightarrow Force of friction
(N) ^{weight} _{OR}

\downarrow
Chances of slipping decreased.





11. "Slippery when wet", it is precaution displayed on motorways. Why is it dangerous to drive on wet roads?

It is dangerous to drive on a wet road because when a road is wet, the pits and bumps of road and tyres are filled with water, so the two surfaces become smooth. In this way the friction between the road and tyres become very small and the chances of slipping are more. So it is dangerous to drive on a wet roads.

12. Why tyres of vehicles are wrapped with chains during snow in Murree hill areas?

Tyres of vehicles are wrapped with chains during snow in Murree hill areas because

- Snow chains provide more friction and
- By increasing the friction between the road and tyre makes driving much safer as it reduce the chances of skidding on icy surfaces.



13. Centripetal force acting on the car moving at a round about is 200N. If velocity of the car is doubled then what will be centripetal force acting on the car?

$$\text{Centripetal force} = F_c = \frac{mv^2}{r} = 200\text{N}$$

When velocity is doubled ($2v$), then

new centripetal force = $F_c' = ?$

$$F_c' = \frac{m(2v)^2}{r}$$

$$= \frac{m(4v^2)}{r}$$

$$= 4 \frac{mv^2}{r}$$

$$= 4 \left(\frac{mv^2}{r} \right)$$

$$F_c' = 4 F_c$$

$$\because F_c = \frac{mv^2}{r}$$

So $F_c' = 4(200)$

$$F_c = 200\text{N}$$

$$F_c' = 800\text{N}$$

Result:

If the velocity of the car is doubled then centripetal force increase by 4 times.

14. Your Car is stuck in mud track, two men sit on the bonnet of your Car. This helps you to take your Car out of mud. How sitting of men on Car's bonnet did help you?

When the Car stuck in mud track, the friction between the tyres and mud becomes zero due to which Car cannot move.

So to increase friction, we need to increase the pressing force

As

$f_s \propto N$

So when two men sit on the bonnet, the pressing force increased due to increase in weight and friction also increase which will help to take the Car out of the mud track.

