Chapter 9 Force and Laws of Motion

Page 118

Question 1. Which of the following has more inertia:
(a) a rubber ball and a stone of the same size?
(b) a bicycle and a train?
(c) a five-rupees coin and a one-rupee coin?
Answer:
(a) A stone of the same size
(b) a train
(c) a five-rupees coin
As the mass of an object is a measure of its inertia, objects with more mass have more inertia.

Question 2. In the following example, try to identify the number of times the velocity of the ball changes.
"A football player kicks a football to another player of his team who kicks the football towards the goal The goalkeeper of the opposite team collects the football and kicks it towards a player of his own team".
Also identify the agent supplying the force in each case.
Answer:

Agent supplying the force	*Change in velocity of ball*
1. First player kicks a football.	→ Velocity from '0' changes to '*u*'
2. Second player kicks the football towards the goal.	→ Velocity changes again
3. The goalkeeper collects the football.	→ Velocity becomes 0
4. Goalkeeper kicks it towards a player of his team.	→ Change in velocity takes place

The velocity of football changed four times.

Question 3. Explain why some of the leaves may get detached from a tree if we vigorously shake its branch.
Answer: When the tree's branch is shaken vigorously the branch attain motion but the leaves stay at rest. Due to the inertia of rest, the leaves tend to remain in its position and hence detaches from the tree to fall down.

Question 4. Why do you fall in the forward direction when a moving bus brakes to a stop and fall backwards when it accelerates from rest?
Answer: When a moving bus brakes-to a stop: When the bus is moving, our body is also in motion, but due to sudden brakes, the lower part of our body comes to rest as soon as the

bus stops. But the upper part of our body continues to be in motion and hence we fall in forward direction due to inertia of motion.
When the bus accelerates from rest we fall backwards: When the bus' is stationary our body is at rest but when the bus accelerates, the lower part of our body being in contact with the floor of the bus comes in motion, but the upper part of our body remains at rest due to inertia of rest. Hence we fall in backward direction.

Textbook – Page 126-127
Question 1. If action is always equal to the reaction, explain how a horse can pud a cart?
Answer: The third law of motion states that action is always equal to the reaction but they act on two different bodies.
In this case the horse exerts a force on the ground with its feet while walking, the ground exerts an equal and opposite force on the feet of the horse, which enables the horse to move forward and the cart is pulled by the horse.

Question 2. Explain, why is it difficult for a fireman to hold a hose, which ejects a large amount of water at a high velocity.
Answer: The water that is ejected out from the hose in the forward direction comes out with a large momentum and equal amount of momentum is developed in the hose in the opposite direction and hence the hose is pushed backward. It becomes difficult for a fireman to hold a hose which experiences this large momentum.

Question 3. From a rifle of mass 4 kg, a bullet of mass 50 g is fired with an initial velocity of 35 m/s. Calculate the initial recoil velocity of the rifle.
Answer:

(m_1) Mass of rifle = 4 kg
(m_2) Mass of bullet = 50 g = 0.05 kg
(v_2) Velocity of bullet = 35 m/s
(v_1) Recoil velocity of rifle = ?

According to the law of conservation of momentum

$$\text{Momentum of rifle} = \text{momentum of bullet}$$

$$m_1 v_1 = m_2 v_2$$

$$4\ \text{kg} \times v_1 = 0.05 \times 35\ \text{m/s}$$

$$\therefore \quad v_1 = \frac{0.05 \times 35}{4} = \frac{1.75}{4}$$

$$v_1 = 0.4375\ \text{m/s}$$

$$\therefore \quad \text{Recoil velocity of rifle} = 0.4375\ \text{m/s}$$

Question 4. Two objects of masses 100 g and 200 g are moving along the same line and direction with velocities of 2 m/s and 1 m/s respectively.
They collide and after the collision the first object moves at a velocity of 1.67 m./s.

Determine the velocity of the second object.
Answer:

$m_1 = 100\ g = 0.1\ kg$

$m_2 = 200\ g = 0.2\ kg$

$u_1 = 2\ m/s$

$u_2 = 1\ m/s$

After collision

$v_1 = 1.67\ m/s$

$v_2 = ?$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$(0.1 \times 2) + (0.2 \times 1) = (0.1 \times 1.67) + (0.2 \times v_2)$

$\therefore \quad 0.2 + 0.2 = 0.167 + 0.2v_2$

$0.4 - 0.167 = 0.2v_2$

$\frac{0.4 - 0.167}{0.2} = v_2$

$\therefore \quad \frac{0.233}{0.2} = 1.165\ m/s$

$\therefore$ The velocity of the second object is 1.165 m/s.