LAWS OF MOTION – IX

1. Compare the momentum possessed by each of the following bodies, a 1 g body moving at 1000 m/s and a 1 kg body moving at 1m/s.

2. Force act on an object of mass 4 kg and changes its velocity from 10 m/s to 20 m/s in 5 s. Find the magnitude of force.

3. A force of 50 N acts on a stationary body of mass 10 kg for 2 s. Find the acceleration produced in the body and velocity attained by it.

4. A force of 5N gives a mass m_1 an acceleration of 10 m/s^2 and a mass m_2, an acceleration of 20 m/s^2. What acceleration would it give if both the masses are tied together?

5. A 500 kg vehicle moving with a speed of 10 m/s is brought to rest at a distance of 50 m. Find the acceleration and time. Also, find the unbalanced force acting on it.

6. A bullet train is moving with a velocity of 180 km/h and it takes 5 s to stop after the brakes are applied. Find the force exerted by the brakes on the wheel of train if its mass with the wagon is 2000 kg.

7. A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of 400 m in 20s. Find the force acting on it if its mass is 7 metric tonnes.

8. A hockey ball of mass 200 g travelling at 10 ms^{-1} is struck by a hockey stick so as to return it along its original path with a velocity of 5 ms^{-1}. Calculate the change in momentum occurred in the motion of the ball by the force applied by hockey stick.

9. How much momentum will the dumb-bell of mass 10 kg transfer to the floor if it falls from a height of 80 cm? Take g = 10 ms^{-2}.

10. An 8000 kg engine pulls a train of 5 wagons, each of 2000 kg along a horizontal track. If the engine exerts a force of 40000 N and the track offers a friction force of 5000 N, then calculate (i) the net accelerating force (ii) the acceleration of the train and (iii) the force of wagon 1 on wagon 2.

11. A bullet of mass 10 g is travelling horizontally with a velocity of 150 ms^{-1} strikes a stationary wooden block and comes to rest in 0.03 s. Calculate the distance of penetration of the bullet into the block. Also calculate the magnitude of the force exerted by the wooden block on the bullet.

12. Two persons manage to push a motor car of mass 1200 kg at a uniform velocity along a level road. The same motor car can be pushed by three persons to produce an acceleration of 0.2 ms^{-2}. With what force does each person push the motor car. (Assume that all the three persons push car with equal force)

13. Why does a boatman tie his boat to a pillar before allowing the passengers to step on his boat?

14. Two bodies of masses 60 kg and 55 kg are moving at 5 m/s and 6 m/s respectively towards each other. They collided and stick together after collision. With what velocity they would move together after collision?

15. Why does a gun recoil?

16. A tennis ball of mass 0.11 kg travelling at 40 m/s hits a wall head on and bounces off, returning along the same path at 30 m/s. Calculate the change in velocity of the ball. Also, calculate the change in momentum of the ball.

17. A student measured minimum force to slide a wooden block by pulling it successively by a spring balance towards left, right, and front. Find a relation between the three forces.

18. An athlete always runs some distance before taking a jump. Why?

19. Why should we wear seat belts in a car?

20. Athletes in pole jump events fall on cushioned surface and not on the floor. Why?

21. A water tanker filled upto 2/3 of its height is moving with a uniform speed. On sudden application of the brakes, in which direction the water in the tanker would flow?

22. Two similar vehicles are moving with the same velocity on the roads such that one of them is loaded and the other is empty. Which of the vehicles will require larger force to stop it. Why?

23. A passenger in a moving train tosses coin which falls behind him. From this incident, what can you predict about the motion of the train?

24. What is the net momentum of the gun and bullet system after firing?

25. Two balls of the same size but of different materials, rubber and iron, are kept on a smooth floor of a moving train. The brakes are applied suddenly to stop the train. Will the balls start rolling? If so, in which direction? Will they move with the same speed? Give reasons.

26. A man throws a ball weighing 500 g vertically upwards with a speed of 20 m/s. What will be its initial momentum? What would be its momentum at the highest point of its flight?

27. A bullet fired against a glass window pane makes a hole in it and the glass pane is not cracked. But on the other hand, when a stone strikes the same glass pane, it gets smashed. Why is it so?

28. A heavy and a light object have same momentum. Which of these is travelling faster?

29. State and prove law of conservation of momentum for two colliding bodies.

30. How are action and reaction forces related to magnitude and direction?

31. Two identical bullets are fired one by one by a light rifle and another by a heavy rifle with the same force, which rifle will hurt the shoulder more and why?

32. A bullet of mass 20 g is fired from a pistol of mass 2 kg with a horizontal velocity of 150 m/s. Calculate the recoil velocity of the pistol.

33. Glass wares are wrapped in straw during their transportation. Justify giving reason.

34. Force of 10N applied to a mass m_1 produces an acceleration of 5 ms^{-2} and when applied to mass m_2, produces an acceleration of 15 ms^{-2} in the mass. How much acceleration will the same force produce if the two masses are tied together?

35. Water drops are removed from wet clothes by giving tight jerk to the cloth. Give reasons.

36. Explain why is it difficult to walk on sand?

37. A cracker of mass 100 g explodes into two pieces of equal mass. Show that these two pieces of the cracker fly in opposite direction.

38. A rifle of mass 3 kg fires a bullet of mass 0.03 kg. The bullet leaves the barrel of the rifle at a velocity of 100 m/s. If the bullet takes 0.03 s to move through its barrel, calculate the force experienced by the rifle due to its recoil.

39. If the engine of a car provides an acceleration of 2 ms^{-2} to start it from rest, assuming the mass to be roughly 1000 kg. Calculate (i) force provided by the engine (ii) momentum after 10 s (iii) time after which the car comes to rest if the engine is turned off after 15 s. (Frictional force = 15 N).

40. A bullet of mass 20 g is horizontally fired with a horizontal velocity 150 ms^{-1} from a pistol of mass 2 kg. What is the recoil velocity of the pistol?