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TOPIC : LAWS OF MOTION

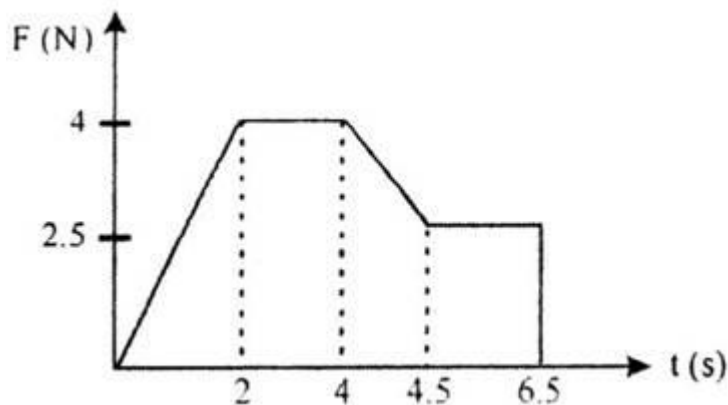
SECTION – A CONCEPTUAL AND APPLICATION TYPE QUESTIONS

1. If the net force acting on the body be zero, will the body remain necessarily in rest position? Explain your answer .
2. Why passengers are thrown forward from their seats when a speeding bus stops suddenly?
3. A cricket player lower his hands to catch the ball safely. Explain why?
4. It is easy to catch a table tennis ball than a cricket ball even both are moving with same velocity. why?
5. Can a bomb initially at rest explodes into three pieces which fly in mutually perpendicular directions?
6. While firing a bullet, the gun should be held tight to the shoulder .why?
7. Carts with rubber tyres are easier to ply than those with iron wheels .why?
8. Proper inflation of tyres of vehicles save fuel .why?
9. What is the angle between frictional force and instantaneous velocity of the body moving over a rough surface?
10. Does the angle of banking depend on the mass of vehicle?

SECTION – B NUMERICAL PROBLEMS

1. A pebble of mass 0.03 kg is thrown vertically upwards. Give the magnitude and direction of the net force acting on (a) during its upward motion (b) during its downward motion (c) at the highest point where it is momentarily at rest
2. A truck starts from rest and rolls down a hill with constant acceleration. It travels a distance of 400 m in 20 s . Calculate the acceleration of the truck and force acting on it , if its mass is 7 metric ton .
3. A constant force acting on a body of mass 3.0 kg changes its speed from 2.0 m s^{-1} to 3.5 m s^{-1} in 25 s. The direction of the motion of the body remains unchanged. What is the magnitude of the force?

4. A car of mass 1000 kg is moving with a velocity of 10 m/s and is acted upon by a forward force of 1000 N due to engine and retarding force of 500 N due to friction . What will be the velocity after 10 seconds?
5. A machine gun fires a bullet of mass 40 g with a speed of 1200 m/s . The person holding the gun can exert a maximum force of 144 N on it .Find the number of bullets that can be fired from the gun per second ?
6. A golf ball of mass 60 g at rest is hit with a striker. Find the impulse of the hit if the ball stops after travelling a horizontal distance of 50 m with a uniform retardation of 4 ms^{-2} .
7. A shell of mass 0.02 kg is fired by a gun of mass 10 kg. If the muzzle speed of the shell is 80 m/s, what is the recoil speed of the gun ?
8. Two billiard balls each of mass 50 g moving in opposite directions with a speed of 36 km/hr collide and rebound with the same velocity. What is the impulse imparted to each ball due to the other?
9. The initial speed of a body of mass 2 kg is 5 m/s . A force acts for 6.5 s in the direction of motion of the body. The force – time graph is as shown. Calculate the impulse of the force and the final speed of the body.



10. A bomb at rest explodes into three fragments of equal masses. Two fragments fly off at right angles to each other with velocities 9 m/s and 12 m/s respectively . Calculate the speed of the third fragment.
11. Two bodies of masses 4 kg and 3 kg respectively are connected by a light string passing over a smooth frictionless pulley. Calculate the acceleration of the masses and tension in the string.
12. A body of mass 10 kg is sliding down a rough inclined plane which makes an angle of 30° with the horizontal. If the coefficient of friction is 0.25, find the acceleration of the body ?
 $g = 10 \text{ m/s}^2$
13. A circular race track of radius 400 m is banked at an angle of 10° . If the coefficient of friction between the wheels of a race car and the road is 0.2 , what is the
 - (i) optimum speed of the car to avoid wear and tear on its tyres
 - (ii) maximum permissible speed to avoid slipping . $g = 9.8 \text{ m/s}^2$

14. An aircraft executes a horizontal loop at a speed of 720 km/hr with its wings banked at 15° . What is the radius of the loop? $g = 10 \text{ m/s}^2$
15. A box of mass 4 kg rests upon an inclined plane. The inclination of the plane to the horizontal gradually increased. It is found that when the slope of the plane is 1 in 3, the box starts sliding down the plane. Given $g = 9.8 \text{ m/s}^2$
- (i) Find the coefficient of friction between the box and the plane.
16. A train is moving along a horizontal track. A pendulum suspended from the roof makes an angle of 4° with the vertical. Obtain the acceleration of the train $g = 10 \text{ m/s}^2$
17. A stream of water flowing horizontally with a speed of 15 m s^{-1} gushes out of a tube of cross-sectional area 10^{-2} m^2 , and hits a vertical wall nearby. What is the force exerted on the wall by the impact of water, assuming it does not rebound?
18. Ten one-rupee coins are put on top of each other on a table. Each coin has a mass m . Give the magnitude and direction of
- a) the force on the 7th coin (counted from the bottom) due to all the coins on its top,
b) the force on the 7th coin by the eighth coin,
c) the reaction of the 6th coin on the 7th coin.
19. A monkey of mass 40 kg climbs on a rope which can stand a maximum tension of 600 N. In which of the following cases will the rope break: , the monkey
- a) climbs up with an acceleration of 6 m s^{-2}
b) climbs down with an acceleration of 4 m s^{-2}
c) climbs up with a uniform speed of 5 m/s
d) falls down the rope nearly freely under gravity?

(Ignore the mass of the rope).