Laws of Motion

CHAPTER 5

TRY YOURSELF ANSWERS

1. It happens due to inertia of motion.

2. Due to inertia of direction, when the bicycle wheel suddenly starts rotating, the mud particles tries to move along their original straight line path.

3. Since, mass of object *B* is higher, it has higher inertia.

4. A karate player strikes the pile of tiles with his hand very quickly. He raises his hand before striking the tiles to increase his final velocity. Thus, while striking, the high momentum of his hand is reduced to zero in a very short time thus producing a large force which is sufficient to break the tiles.

5. Momentum, $p = mv$. Since both the car and the bicycle are having same momentum, the bicycle should have higher velocity as car is having higher mass.

6. Given, mass, $m = 20\ g = 0.02\ kg$, $u = 150\ m/s$
and $s = 300\ cm = 3\ m$ and $v = 0$
$\because \quad v^2 - u^2 = 2as$
$-(150)^2 = 2 \times a \times 3 \implies a = -3750\ m/s^2$
Here, the negative sign indicates that the velocity of the bullet is decreasing.
From Newton's second Law of motion,
$F = m \times a = 0.02 \times (-3750) = -75\ N$
Hence, the magnitude of the force exerted by the wooden block on the bullet is 75 N.

7. When a person pushes against the ground, he receives an equal and opposite force from the ground. Harder the push, higher is the reaction force.

8. Given, total mass (man + rocket), $m = 1.0 \times 10^4\ kg$
If weight of the man sitting in the rocket increases by 5 times, the acceleration, $a = 5g$
Force applied by the rocket engine,
$F = ma = 1.0 \times 10^4 \times 5 \times 10 = 5 \times 10^5\ N$

9. Here, mass of the bullet, $m = 200\ g = 200 \times 10^{-3}\ kg$
Mass of the gun, $M = 1\ kg$
Speed of the bullet, $v = 5\ m/s$
Let V be the recoil velocity of the gun.
According to law of conservation of linear momentum,

$$0 = mv + MV \quad \text{or} \quad V = -\frac{mv}{M}$$

$$V = -\frac{(200 \times 10^{-3}\ kg)(5\ m/s)}{1 kg} = -1 m/s$$

Negative sign shows that the gun rebounds backward as the bullet moves forward.

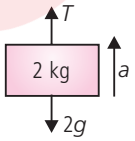
10. Given that, Tension $T = 72$ kg-wt, mass $m = 90$ kg
$mg - T = ma$

$$\text{or } a = \frac{mg - T}{m} = \frac{90 \times 9.8 - 72 \times 9.8}{90} = 1.96\ m/s^2$$

11. Let a be the common acceleration of the system and T be tension in the string.

$$\therefore \quad a = \frac{F - 4g - 2g}{4 + 2} = \frac{120 - 40 - 20}{6} = 10\ m\ s^{-2}$$

The free body diagram of 2 kg block is as shown in figure.



$$\therefore \quad T - 2g = 2a \quad \text{or} \quad T = 2(a + g) = 2(10 + 10) = 40\ N$$

12. Time taken by the ball to reach the floor of the lift is

$$t = \sqrt{\frac{2h}{a + g}}$$

Here, $h = 1.25\ m$, $g = 10\ m\ s^{-2}$, $a = 5\ m\ s^{-2}$

$$\therefore \quad t = \sqrt{\frac{2 \times 1.25\ m}{(5 + 10)\ m\ s^{-2}}} = 0.4\ s$$

13. We throw sand on the ground during a rainy day to increase friction.

14. Static friction is called as a self adjusting force because it increases with increase in the applied external force, thus balancing it.

15. Acceleration, $a = g\ (\sin\theta - \mu_k \cos\theta)$
$= 9.8(\sin 60° - 0.5 \cos 60°)$

$$= 9.8\left(\frac{\sqrt{3}}{2} - 0.5 \times \frac{1}{2}\right) = 9.8(0.616) = 6.04\ m/s^2$$

16. $$\mu = \frac{v^2}{rg} = \frac{169}{20 \times 9.8} = 0.86$$

17. The cyclist bends while taking a sharp turn in order to provide the necessary centripetal force.

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