

CBSE Test Paper 01
Chapter 09 Forces and Laws of Motion

1. On a 3 kg mass, 5 newton of force acts for 0.1 second. The impulse imparted to the mass is (in kg m/s) **(1)**
 - a. 0.16
 - b. 1.0
 - c. 1.5
 - d. 0.5

2. A force of 5 N applied on m_1 produces an acceleration of 8 m/s^2 and when applied on m_2 produces an acceleration of 24 m/s^2 . When they are tied together, the acceleration will be **(1)**
 - a. 3 m/s^2
 - b. 16 m/s^2
 - c. 6 m/s^2
 - d. 8 m/s^2

3. Which of the following is not used to reduce friction **(1)**
 - a. using ball bearing
 - b. using grease between contact surfaces
 - c. using oil between contact surfaces
 - d. making scratches on the contact surfaces

4. Water drops sticking to the wheel come out along the tangential line due to **(1)**
 - a. inertia
 - b. acceleration
 - c. momentum
 - d. force

5. "Internal forces are forces which bodies exert on each other when the bodies are part of the system" is **(1)**
 - a. false
 - b. partially false

- c. partially true
 - d. true
6. What is the total momentum of a bullet and a gun before firing? **(1)**
 7. State Newton's first law of motion. **(1)**
 8. What do you mean by a resultant force? **(1)**
 9. What do balanced forces usually do to a body? **(1)**
 10. State the meaning of recoil velocity of a gun? **(1)**
 11. A certain particle has a weight of 30 N at a place where the acceleration due to gravity is 9.8 m/s^2 **(3)**
 - a. What are its mass and weight at a place where acceleration due to gravity is 3.5 m/s^2 .
 - b. What will be its mass & weight at a place where acceleration due to gravity is zero.
 12. A bullet of mass 0.02 kg is fired from a gun weighing 7.5 kg. If the initial velocity of the bullet is 200 m/s, calculate the speed with which the gun recoils. **(3)**
 13. Explain, why is it difficult for a fireman to hold a hose, which ejects large amounts of water at a high speed. **(3)**
 14. A body of mass 2 Kg is at rest at the origin of a frame of reference. A force of 5 N acts on it at $t = 0$. The force acts for 4 s and then stops. **(5)**
 - i. What is the acceleration produced by the force on the body?
 - ii. What is the velocity at $t = 4 \text{ s}$
 - iii. Draw the vt graph for the period $t = 0$ to $t = 6 \text{ S}$.
 - iv. Find the distance travelled in 6 s.
 15. A 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 frictional force of 5000 N, then calculate: **(5)**
 - a. the net accelerating force;
 - b. the acceleration of the train; and
 - c. the force of wagon 1 on wagon 2.

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Answers

1. d. 0.5

Explanation: Impulse can also be expressed as rate of change of momentum.

And Momentum = force \times time = 5×0.1

= 0.5 kg m/s

2. c. 6 m/s^2

Explanation: For the first body,

$$F = m_1 a_1$$

$$\text{So, } 5 = m_1 \times 8$$

$$\text{So, } m_1 = 5/8 \text{ kg}$$

For second body,

$$F = m_2 a_2$$

$$\text{So, } 5 = m_2 \times 24$$

$$\text{So, } m_2 = 5/24 \text{ kg}$$

Combined mass of both bodies, $m_1 + m_2$

$$= 5/8 + 5/24 = 20/24 \text{ kg}$$

$$\text{Now, } m = 20/24 \text{ kg}$$

$$F = 5 \text{ N}$$

$$a = ?$$

$$F = ma$$

$$\text{So, } 5 = 20/24 \times a$$

$$\text{So, } a = 5 \times 24 / 20$$

$$\text{So, } a = 6 \text{ m/s}^2$$

3. d. making scratches on the contact surfaces

Explanation: To reduce the friction, oiling between contact surfaces can be done, besides we can use ball bearing or grease between contact surfaces.

Making scratches between contact surfaces will make the surface rough and so,

will increase the friction.

4. a. inertia

Explanation: Inertia is the resistance of any physical object to any change in its state of motion. This includes changes to the object's speed, direction, or state of rest.

5. d. true

Explanation: Internal forces are those forces which are exerted on each other when the bodies are part of the system. The forces acting between the atoms of molecules that keep them together are example of internal force.

6. Zero. Before firing, both the gun and the bullet are at rest and therefore the total initial momentum is zero.

7. Newton's first law of motion states that, 'Everybody continues to be in its state of rest or of uniform motion in a straight line unless it is compelled by some external applied force to change that state.'

8. When two or more forces act on a body simultaneously, then the single force which produces the same effect as produced by all the forces acting together is known as the resultant force.

9. Balanced forces usually change the shape of the body but not the direction of the moving body. They do not change the state of motion of the body, nor they produce any acceleration.

10. The velocity with which a gun moves backward after firing a bullet is called the recoil velocity of a gun.

11. Weight of particle, $W = 30 \text{ N}$

Acceleration due to gravity, $g = 9.8 \text{ m/s}^2$

Let, m be the mass of particle

From the relation, $W = mg$

$$30 = m \times 9.8$$

$$\Rightarrow m = \frac{30 \times 10}{98}$$

$$\Rightarrow m = \frac{300}{98} \text{ Kg} = 3.06 \text{ kg}$$

a. $W = mg'$

$$g' = 3.5 \text{ m/s}^2$$

$$W = \frac{300}{98} \times \frac{35}{10}$$

$$= 10.71 \text{ N}$$

b. Mass at the place = 3.06 Kg (mass is always constant)

At a place where $g = 0$

$$W = m \times 0 = 0$$

But Mass = 3.06 Kg (mass is a constant quantity)

12. Here, the mass of the bullet, $m_1 = 0.02 \text{ kg}$

Mass of gun, $m_2 = 7.5 \text{ kg}$

Velocity of bullet, $v_1 = 200 \text{ m/s}$

and the speed of gun, $v_2 = ?$

According to law of conservation of momentum, we have

Total momentum of system before firing = Total momentum of system after firing

$$\text{i.e., } m_1 v_1 + m_2 v_2 = 0$$

(since initial velocities of gun and bullet before firing is zero.)

$$\Rightarrow 0.02 \times 200 + 7.5 \times v_2 = 0$$

$$\Rightarrow 7.5 \times v_2 = -0.02 \times 200$$

$$\Rightarrow v_2 = -\frac{4}{7.5} = -0.533$$

$$\Rightarrow v_2 = -0.53 \text{ m/s}$$

Here, negative sign indicates that the direction of the recoil force is in the opposite direction.

Therefore, recoil velocity of the gun is 0.53 ms^{-1}

13. It is based on the law of conservation of momentum. When water comes out of the hose, with certain momentum in the forward direction, the hose, in order to conserve momentum moves backward. This makes it difficult for the fireman to hold the hose.

14. Force, $F = 5 \text{ N}$

Mass, $m = 2 \text{ kg}$

i. $F = m \times a$

$$\Rightarrow 5 = 2 \times a$$

$$\Rightarrow a = 2.5 \text{ m/s}^2$$

Therefore, acceleration produced by the body is 2.5 ms^{-2}

ii. Final velocity, $v = 0$

Initial velocity, $u = 0$ (body starts from Rest)

Time, $t = 4 \text{ s}$

From the relation,

$$v = u + at$$

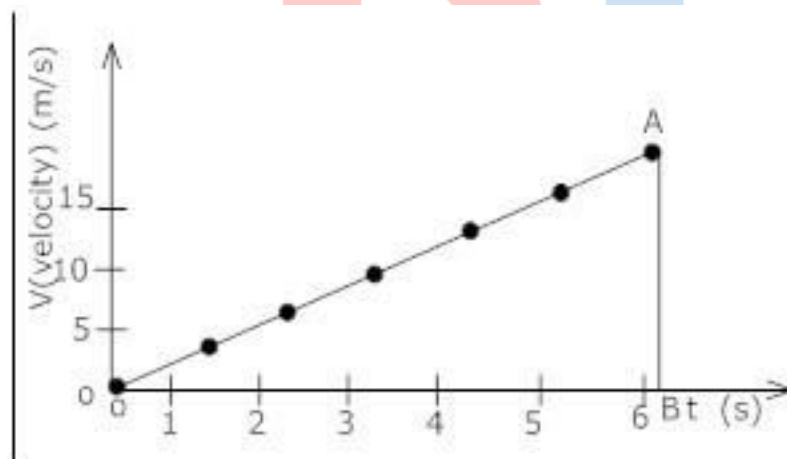
$$\Rightarrow v = 2.5 \times 4$$

$$\Rightarrow v = 10 \text{ m/s}$$

Therefore, the velocity at $t = 4 \text{ s}$ is 10 ms^{-1}

iii.

For $t = 0$	1	2	3	4	5	6
$V = 0$	2.5	5	7.5	10	12.5	15



iv. Distance Travelled = Area under v/t curve = Area of $\triangle AOB$

$$= \frac{1}{2} \times \text{Base} \times \text{Height}$$

$$= \frac{1}{2} \times OB \times AB$$

$$= \frac{1}{2} \times 6 \times 15$$

$$= 45 \text{ m}$$

Therefore, distance travelled in 6 s is 45 m.

15. Force exerted by the engine, $F' = 40,000 \text{ N}$

Frictional force offered by the track in the direction opposite of the motion, $F'' = -5,000$

N

- a. The net accelerating force, $F = F' + F'' = 40,000 \text{ N} + (-5,000 \text{ N}) = 35,000 \text{ N}$
b. Mass of each wagon of the train = 2000 kg

Number of wagons = 5

Therefore, Mass of the train, $m = 2,000 \text{ kg} \times 5 = 10,000 \text{ kg}$.

Net accelerating force acting on the train, $F = 35,000 \text{ N}$

From Newton's second law of motion, acceleration

$$a = \frac{F}{m} = \frac{35,000 \text{ N}}{10,000 \text{ kg}} = 3.5 \text{ ms}^{-2}$$

- c. Mass of 1 wagon = 2000 kg

acceleration of the train = 3.5 ms^{-2}

From the relation, $F = ma$, we get

$$F = 2000 \text{ kg} \times 3.5 \text{ ms}^{-2}$$

$$F = 7000 \text{ N}$$

Force exerted by wagon 1 on wagon 2

$$= \text{Net accelerating force} - \text{Force acting on wagon 1} = 35,000 \text{ N} - 7,000 \text{ N} = 28,000 \text{ N}$$

Therefore, the required answer is 28,000 N.

