CBSE Test Paper 04

Chapter 09 Forces and Laws of Motion

1. Which is incorrect statement about action and reaction referred to Newton's third law of motion? **(1)**

   A They are not equal

   B They are opposite

   C They act on same object

   D They act simultaneously

   a. (a) and (c)
   b. (a), (b) and (c)
   c. (b) and (c)
   d. All of these

2. Which has more inertia? **(1)**

   a. 1Rs coin
   b. All have same inertia.
   c. 5Rs note
   d. 5Rs coin

3. Impulse has the S.I. unit of_____**(1)**

   a. newton
   b. N-s
   c. joule
   d. m/s^2

4. If force, change in momentum and time are given by F, p and t respectively, then they are related by **(1)**

   a. F = pt
   b. $p = F^2t$
   c. $F = \frac{P}{t}$
   d. $Ft^2 = p$

5. If no external force acts on a system of particles then the_____of the system remains conserved. **(1)**

a. movement
b. inertia
c. momentum
d. motion

6. What did Galileo conclude on the basis of his experiments on the motion of objects? **(1)**

7. If the body is found to be accelerated, is the force acting on it balanced or unbalanced? **(1)**

8. Do action and reaction act on the same body? **(1)**

9. Does Newton's third law apply to a system where bodies do not actually touch each other? **(1)**

10. Define electrostatic force. **(1)**

11. A bullet of mass 5 g travelling at a speed of 120 ms^{-1} penetrates deeply into the fixed target and is brought to rest in 0.01 s. Calculate: (a) the distance of penetration in the target, (b) the average force exerted on the bullet. **(3)**

12. Explain, why is it difficult for a fireman to hold a hose, which ejects large amounts of water at a high velocity. **(3)**

13. Differentiate between mass and weight? **(3)**

14. A stone is dropped from a 100 m high tower. How long does it take to fall? **(5)**

a. the first 50 m and
b. the second 50 m.

15. Derive the law of conservation of linear momentum from Newton's third law? **(5)**

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Answers

1. a. (a) and (c)

   Explanation: Action and reaction are equal and opposite and act on two different bodies simultaneously.

2. d. 5Rs coin

   Explanation:

   Inertia of the body is proportional to the mass of the body. 5Rs coin is heavier than 5Rs note and 1Rs coins. So, inertia of 5Rs coin more than others.

3. b. N-s

   Explanation: If we multiply the force acting on an object by the time it is acting for this is called the impulse of a force. Impulse is a vector and its unit is the kilogram metre per second ($kgms^{-1}$) or the newton second (Ns).

4. c. $F = \frac{P}{t}$

   Explanation: $F = \frac{P}{t}$ because momentum can be given as the product of the force applied and time.

5. c. momentum

   Explanation: momentum changes with change in force, velocity or acceleration.If no resultant force is there, momentum remains conserved.

6. A body continues to move with the same velocity if no unbalanced force acts on it.It stays at rest or moves in a straight line with constant speed, i.e. it will remain unaccelerated.

7. Unbalanced force. Any body moving at constant speed gets accelerated or de-accelerated due to the action of unbalanced forces.

8. No,action and reaction forces act simultaneously but on different bodies.Action and reaction forces occur in pairs only.

9. Yes, whenever the bodies are in actual contact or even if there is an interaction between the bodies (e.g., attraction or repulsion between two magnets, charges, etc.), Newton's third law is applicable.

10. The force of attraction or repulsion of particles or objects because of their electric charge is known as electrostatic force.It is also known as Coulomb force or Coulomb interaction.

11. m = 5 g = 5 $\times$ 10^{-3} kg u = 120 ms^{-1}, v = 0, t = 0.01s

    a. From the relation v = u + at

    We have 0 = 120 + a $\times$ 0.01

    or a $= -\frac{120}{0.01}$ = -12000 ms^{-2} (the negative sign here shows retardation)

    Distance of penetration in the target

    S = ut + $\frac{1}{2}$ at^2 we have

    S = 120 $\times$ 0.01 + $\frac{1}{2}$ $\times$ (-12000)$\times$ $(0.01)^2$ = 0.6 m

    b. Average retarding force F = ma = (5 $\times 10^{-3}$) $\times$ (12000) = 60N

12. We can explain the above observation on the basis of law of conservation of momentum. When a system of the hose and water is not ejecting any water its momentum is zero. When the water issues out from the hose with a high velocity, it has momentum in the forward direction. Therefore, in order to conserve momentum the hose tends to move in the backward direction and hence is difficult to hold.

13.

	Mass	Weight
1.	It is the matter contained by a body	It is force which the earth exerts on the body.
2.	It remains the same	It changes from place to place.
3.	It is always positive.	It can be positive and zero.
4.	It is a scalar quantity	It is a vector quantity
5.	Its S.I. unit is Kg	Its S.I. unit is Newton(N)

14. Initial velocity, u=0

Total height, h = 100 m

a. Let, for the first 50 m the time taken by the stone be 't' sec.

S=-50 m (- ve sign shows the stone falls in downward direction)

g = -10 m/s^2

$h = s = ut + \frac{1}{2}gt_1^2$

$\Rightarrow -50 = 0 + \frac{1}{2}(-10)t_1^2$

$\Rightarrow -50 = -5t_1^2$

$\Rightarrow \frac{50}{5} = t_1^2$

$\Rightarrow t_1^2 = 10$

$\Rightarrow t_1 = \sqrt{10}$

$\therefore t_1 = 3.16sec$

b. For the entire journey,let the time taken be T

u = 0

S = -100 m

$a = -10m/s^2$

$S = ut + \frac{1}{2}aT^2$

$\Rightarrow -100 = 0 + \frac{1}{2} \times (-10)T^2 \Rightarrow T^2 = 20$

$\Rightarrow T = \sqrt{20}$

$\Rightarrow T = 4.47sec$

$\therefore$ Time taken to fall through the next 50m=T-t_1 = 4.47-3.16=1.31sec

15. According to Newton's third law of motion, 'To every action there is an equal and opposite reaction;action and reaction forces act on different bodies.'

From law of conservation of momentum, for an isolated system, the total initial momentum for an event is equal to total final momentum.

Let

Mass of body A = m_A

Mass of body B = m_B

Initial velocity of Body A = u_A

Initial velocity of Body B = u_B

Final velocity of Body A = v_A

Final velocity of Body B = v_B

momentum of body A=$m_A u_A$ and momentum of body B= $m_B u_B$

Therefore, initial momentum of the system =$m_A u_A + m_B u_B$

Now, let the body A collide with body B.

So, final momentum of the system =$m_A v_A + m_B v_B$

Body A exerts a force of action F_{AB} on body B.

Body B exerts a force of reaction F_{BA} on body A.

Let the collision lasts for t seconds,then

F_{AB}= Rate of change of momentum of body A = $\frac{m_A(v_A - u_A)}{t}$

F_{BA}= Rate of change of momentum of body B= $\frac{m_B(v_B - u_B)}{t}$

From Newton's third law,

F_{AB} = - F_{BA}

$\Rightarrow \frac{m_A(v_A - u_A)}{t} = -\frac{m_B(v_B - u_B)}{t}$

$\therefore\ m_A u_A + m_B u_B = m_A v_A + m_B v_B$

$\therefore$ Momentum of the system before collison=Momentum of the system after collsion.

This is the law of conservation of momentum.