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PRACTICE PAPER 05 (2024-25)

CHAPTER 09 FORCE AND LAWS OF MOTION

(ANSWERS)

SUBJECT: SCIENCE **MAX. MARKS : 40**

CLASS : IX **DURATION : 1½ hrs**

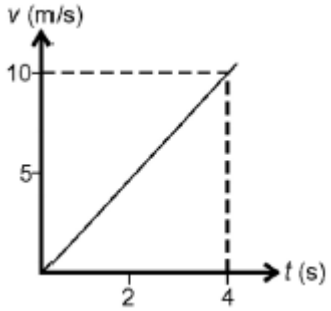
General Instructions:

(i). **All** questions are compulsory.
(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.
(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.
(iv). There is no overall choice.
(v). Use of Calculators is not permitted

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. The v – t graph of a body of 5 kg moving with the help of a force is shown. Then the force involved is



(a) 20 N (b) 125 N (c) 12.5 N (d) 2.0 N

Ans. (c) 12.5 N

a = slope of graph = $\frac{10-0}{4-0}$ = 2.5 m/s^2

F = ma = 5 × 2.5 = 12.5 N

2. When a 12 N force acts on 3 kg mass for a second, the change in velocity is (in m/s)

(a) 36 (b) 4 (c) 2 (d) 18

Ans. (b) 4

$$F = \frac{\Delta p}{E} = \frac{m\Delta v}{t}$$

$$\Delta v = \frac{12 \times 1}{3} = 4 \text{ m/s}$$

3. Rahul tosses the coin in a moving car and it falls behind him. The motion of car is:

(a) non-uniform motion (b) along a straight line
(c) acceleration (d) retardation

Ans. (c) acceleration

When a car accelerates, its speed changes (increases), yet the coin continues to move at the same speed as before. When the coin is tossed, the car will have moved ahead, by the time the coin reaches the back and the coin will land behind the point where it was tossed.

4. What would happen if the smaller ball were rolling with a velocity of 5 m/s and struck the bigger ball at rest?
(a) The two balls would continue to roll in the direction of the strike.
(b) The smaller ball would rebound and the bigger ball would roll forward.
(c) The two balls would roll in the direction opposite to the strike.
(d) The smaller ball would stop rolling and the bigger ball would start rolling.
Ans. (b) The smaller ball would rebound and the bigger ball would roll forward.
The momentum and velocity of the small ball will get transferred to the big ball but will not be able to move it far.

5. When the woman rowed a boat, she pushed the water backward with oars and the backward water exerts an equal and opposite push on the boat which makes the boat to move forward. Which principle is followed in this case?
(a) Inertia of motion (b) Newton's second law of motion
(c) Newton's first law of motion (d) Newton's third law of motion
Ans. (d) Newton's third law of motion
According to Newton's third law of motion, "To every action, there is an equal and opposite reaction." When a woman rode the boat, she intended to move forward in water and that's why she pushed the water backwards. The woman exerted the force on water in the backward direction and in turn, the reaction force exerted by water propelled the boat in forward direction.

6. A body of mass 9 kg is lying on a surface of table. Calculate the net force acting on it.
(a) 9 (b) 0 (c) 3 (d) 18
Ans. (b) 0
Net force acting on the body is zero as it is at rest.

7. Kajal was cycling and the cycle comes to stop after some time as she stopped pedalling. She got confused as the situation does not follow Newton's first law of motion. What makes the cycle stop?
(I) Frictional force
(II) Gravitational force
(III) Inertia
(IV) Heat
(V) Air resistance
Options:
(a) (I) and (III) (b) (I) and (V) (c) (I), (II) and (III) (d) (I), (III) and (V)
Ans. (b) (I) and (V)
The external force of air resistance and friction has forced the bicycle to change its state of motion to state of rest in this situation. If there was no air resistance or friction to resist the bicycle's motion, the bicycle would continue to move continuously, according to the first law of motion.

8. An object of mass 2 kg is sliding with a constant velocity of 4 ms^{-1} on a frictionless horizontal table. The force required to keep the object moving with the same velocity is:
(a) 32 N (b) 0 N (c) 2 N (d) 8 N
Ans. (b) 0 N
Newton's first law states that a body at rest or in uniform motion will remain at rest or in uniform motion until and unless it is subjected to a net external force.
Mass, m = 2 kg,
Velocity, v = 4 m/s
The acceleration of the object is zero because it is travelling at a constant velocity of 4 m/s.
Force = mass × acceleration
F = 2 × 0 = 0 N

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.

(a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.

(b) Both the Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.

(c) Assertion is true but the Reason is false.

(d) Assertion is false but the Reason is true.

9. Assertion (A): Group of children are sitting on park bench. Their body weight is acting downwards and bench exerts an equal force upwards otherwise the bench will break.
Reason (R): According to Newton's third law of motion, "To every action, there is an equal and opposite reaction".
Ans. (b) Both A and R are true and R is not the correct explanation of A.
Children exert force on the bench by pressing it down and the bench exerts an equal opposite force on the children. The reaction force by the bench is the normal force exerted by children; both are equal in magnitude but opposite in direction. The normal force's magnitude describes how hard the two objects press against each other.

10. Assertion (A): In a long jump, an athlete is provided with a heap of sand on ground to prevent him/her from being hurt.
Reason (R): The heap of sand increases the momentum of the athlete.
Ans. (c) A is true but R is false.
Athletes who land on a smooth landing surface, such as a pile of sand after a long jump, take longer time to stop. Thus, reducing the momentum due to which less force acts on the athlete. Hence, an athlete does not hurt himself.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. (a) Why is Newton's first law of motion also called law of inertia?
(b) What should be the value of F in the following, to balance the effect of F_1 and F_2?

Ans. (a) Newton's first law of motion is also called law of inertia because inertia also opposes any change in state in state of rest or motion of the body.
(b) If forces are balanced, then $F = F_1 + F_2$.

12. A stone released from the top of a tower of height 19.6 m. Calculate its final velocity just before touching the ground. (Take g = 9.8 m/s^2)
Ans. Initial velocity, u = 0
Height of fall, h = 19.6 m
g = 9.8 ms^{-2}
Final velocity, v = $\sqrt{u^2 + 2gh} = \sqrt{0 + 2 \times 9.8 \times 19.6}$ = 19.6 m/s

13. Water sprinkler used for grass lawns begins to rotate as soon as the water is supplied. Explain the principle on which it works.
Ans. When one body exerts a force on another, According to Newton's third law of motion the first body receives a force equal in size in the opposite direction of the force exerted. The rotation of water sprinklers on grass lawns can be explained using Newton's third law of motion. When water sprays from a sprinkler, it causes the sprayer to rotate by exerting an equal and opposite force.

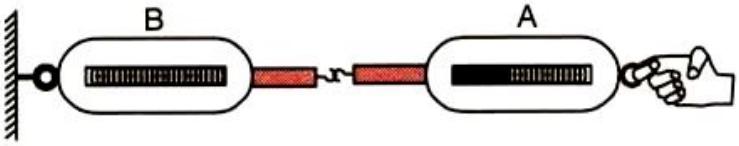
14. Two friends on roller skates are standing apart facing each other. One of them throws a ball towards the other, who catches it, how will this activity affect the position of the two? Explain your answer.

Ans. The distance between them will increase. Both of them have zero momentum initially since they are at rest. The person who throws the ball would go backwards to conserve momentum. After catching the ball, the second will experience a net force and will consequently travel backwards in the direction of the force.

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Look at the diagram and answer the following questions:



(a) When a force is applied through the free end of the spring balance A, the reading on the spring balance A is 15 g wt. What will be the reading of spring balance B?

(b) Write reasons for your answer.

(c) Name the force which balance A exerts on balance B and the force of balance B on balance A.

Ans. (a) 15 g wt

(b) Every action has equal and opposite reaction.

(c) Action force and reaction force.

16. Explain the following briefly:

(a) A cricket ball causes much severe injury than a tennis ball on hitting a spectator.

(b) An applied unbalanced force causes a change in momentum.

(c) A greater force is required to impart greater velocity to an object.

Ans. (a) A cricket ball has a greater mass than a tennis ball. So, its momentum is higher than a Tennis ball moving at same velocity. Thus it causes a greater impact upon the person who is hit.

(b) Force is required to accelerate an object. This causes a change in its velocity which means a change in momentum of the object.

(c) Force produces an acceleration in an object on which it acts. If larger change in velocity is required, then more force needs to be applied.

17. (a) State the law of conservation of momentum.

(b) A body of mass 2 kg, initially moving with a velocity of 10 m/s, collides with another body of mass 5 kg at rest. After collision velocity of first body becomes 1 m/s. Find the velocity of second body.

Ans. (a) The total momentum of a system remains constant when no external force acts on it.

(*b*) $m_1 = 2$ kg, $u_1 = 10$ m/s, $v_1 = 1$ m/s

$m_2 = 5$ kg, $u_2 = 0$, $v_2 = ?$

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$\Rightarrow \quad 2 \times 10 + 0 = 2 \times 1 + 5 \times v_2$$

$$\Rightarrow \quad v_2 = \frac{20-2}{5} = 3.6 \text{ m/s}$$

OR

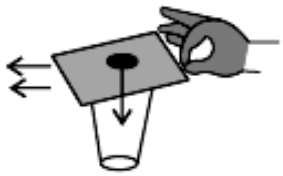
Shahid and Arun travelled to Mumbai by car. Midway, their car broke down. However, they are able to push the car with uniform velocity on a flat road. The mass of the car is 1500 kg. To accelerate the car, they take the help of a third person and when all three of them push the car, an acceleration of 0.5 m/s^2 is produced. What is the force with which each person pushes the car? (Assume that everyone pushing the car is exerting the same muscular effort.)

Ans. According to Newton's Second Law of Motion, the object having mass 'm' is accelerated by magnitude 'a'. Then the net force acting on the object is given by F = ma
When three people push the car forward, it accelerates by 0.5 m/s^2. We know that two people can push the car and keep it moving at a steady speed. As a result, the acceleration of the car is solely due to the force of a third person.
Using the formula, F = ma
$\Rightarrow$ F = 1500 kg × 0.5 m/s^2
$\Rightarrow$ F = 750 N

SECTION – D

Questions 18 carry 5 marks each.

18. (a) Define 'inertia'.
(b) A shopkeeper shows three toys to a child made up of aluminium, steel and wood of same shape and volume. Which one of them would have highest inertia? Why?
(c) Describe in brief an activity to illustrate the property of inertia of rest.
Ans. (a) The property of a body due to which it opposes a change in its state of rest or motion is inertia.
(b) Aluminium, as it has the greatest mass.
(c) Aim: To demonstrate inertia of rest of a coin.
Materials Required: A 5 or 10 rupee coin, a light weight piece of cardboard, a glass tumbler.



Method:
(i) Place the cardboard on the glass tumbler and keep the arrangement on a plane surface.
(ii) Put the coin at the centre of the cardboard.
(iii) Gently flick the cardboard away.
(iv) Observe what happens to the coin.
Conclusion: The coin possesses inertia of rest. As the card is flicked, it flies off but coin tends to be in a state of rest and falls into the glass.

OR

(a) State Newton's second law of motion and show that the first law of motion can be mathematically stated from the mathematical expression for the second law of motion.
(b) A stone dropped from a window reaches the ground in 0.5 seconds (given g = 10 ms^{-2}).
(i) Calculate the speed just before it hits the ground.
(ii) What is the average speed at t = 0.5 s?
(iii) Calculate the height of window from the ground.
Ans. (a) Force acting on a body is directly proportional to rate of change of its momentum.
F = ma
In uniform velocity, F = 0 (as a = 0)
When body is at rest, F = 0 (as a = 0)
This derives first law of motion.

$(b)\ u = 0,\ t = 0.5\ \text{s},\ g = 10\ \text{m/s}^2$

$(i)\ v = u + gt = 0 + 10 \times 0.5 = 5\ \text{m/s}$

$(ii)\ v_{avg} = \frac{u+v}{2} = \frac{0+5}{2} = \frac{5}{2} = 2.5\ \text{m/s}$

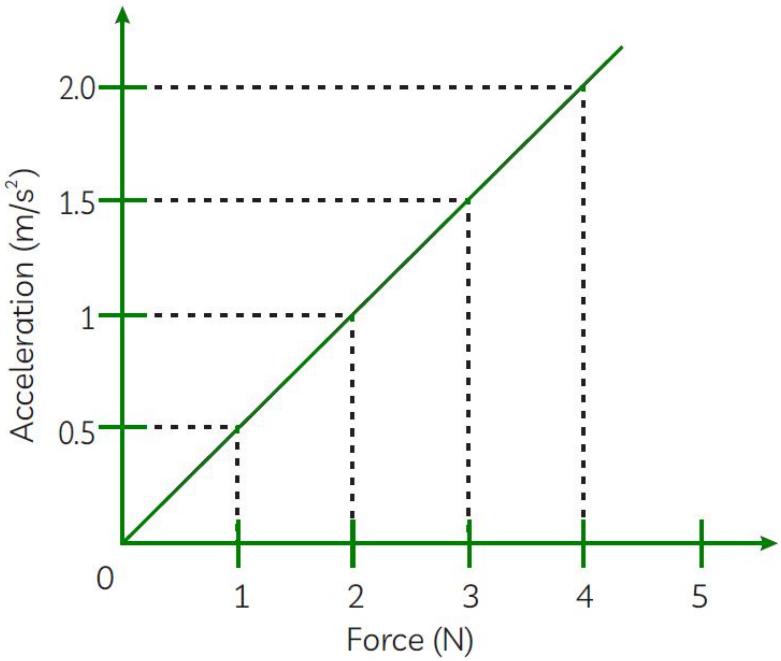
$(iii)\ h = ut + \frac{1}{2}gt^2 = 0 + \frac{1}{2} \times 10 \times (0 - 0.5)^2 = 1.25\ \text{m}$

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Read the following information and answer the questions based on information and related studied concepts.

Mahesh measures the acceleration of the Volvo using an apparatus. The result is obtained as shown in the Acceleration-Force graph. It is known that the more is force applied to an object, the more is its acceleration. Acceleration is proportional to force, as may be demonstrated experimentally. It may also be demonstrated that the greater the object's mass, the lower is its acceleration for the same force. The force must rise in proportion to the mass to obtain the same acceleration.



(a) Calculate the mass of Volvo from given graph if Yogesh takes the force applied is 1 N.

(b) If the force applied on the Volvo as doubled and acceleration is halved. What is the ratio of mass?

(c) Define momentum. What happens to the momentum of a body if its speed is doubled?

Ans. (a) From the given graph, F = 1 N and a = 0.5 m/s^2

F = ma

$\Rightarrow$ 1 = 0.5 m

$\Rightarrow$ m = 1/0.5 = 2 kg

Mass of the Volvo is 2 kg.

(b) As we know, Force = mass x acceleration

Initial mass: $m_1 = \frac{F}{a}$

Final mass: $m_2 = \dfrac{2F}{a/2}$

Ratio = $\dfrac{m_2}{m_1} = \dfrac{\frac{2F}{a/2}}{\frac{F}{a}} = \dfrac{4F/a}{F/a} = \dfrac{4}{1}$

Required ratio is 4 : 1

(c) The momentum of an object or body is defined as the product of mass and velocity and has the same direction as that of velocity. It is symbolised by 'p'.

Therefore, Momentum = mass x velocity.

$$p = m \times v$$

If the speed of an object is doubled, its momentum also gets doubled.

20. Read the given passage and answer the questions that follow based on the passage and related studied concepts.

While playing carrom, the coins on a carrom board are arranged vertically. Aditya observed that a fast moving striker strikes a pile of carrom coins and only the bottom coin gets removed and the vertical arrangements of the coins remain intact.

(a) Which law best describes the given situation?

(b) What's the reason that only the bottom coin is removed and the rest of the coins do not fall?

(c) What is the momentum of a body of mass 2m and velocity v/2?

Ans. (a) Newton's first law of motion states that unless a force acts on an object and changes its state of motion, it will continue to move at a constant velocity or remain at rest when observed from an inertial frame of reference. Inertia is the ability of an object to resist a change in its condition of rest/uniform motion.

(b) When the striker hits the lowest coin, it moves (i.e., changes its state of rest), but the remaining pile remains intact and takes the place of the previous pile due to inertia of rest.

(c) Given, Mass of body, m = 2m

Velocity, v = v/2

As we know, p = mv

$\Rightarrow$ p = 2m × v/2

$\Rightarrow$ p = mv