	INDIAN SCHOOL AL WADI AL KABIR	
Class: IX	**Department: SCIENCE (2026– 27)** **SUBJECT: SCIENCE (PHYSICS)**	**Date: 01/09/2026**
Worksheet: 02	**CHAPTER / UNIT: HOW FORCES AFFECT MOTION**	**Note:** **A4 FILE FORMAT**
CLASS & SEC:	**NAME OF THE STUDENT:**	**ROLL NO.**

I.OBJECTIVE TYPE OF QUESTIONS (1 MARK):

1) A cricket player pulls his hands backwards while catching a fast-moving ball. By doing this, the player:

   a) Increases the force exerted by the ball on his hands

   b) Decreases the time taken to stop the ball to increase momentum

   c) Increases the time of contact to reduce the rate of change of momentum

   d) Reduces the mass of the ball to make the catch easier

2) During a rocket launch, the hot gases are expelled downwards at high velocity, which pushes the rocket upwards. Which law of motion best explains this phenomenon?

   a) Newton's First Law of Motion

   b) Newton's Second Law of Motion

   c) Newton's Third Law of Motion

   d) Law of Inertia

3) Which of the following is the correct relation between force (F), mass (m), and acceleration (a)?

   a) F = a/m

   b) F = ma

   c) F = m + a

   d) F = m/a

4) A bullet of mass 10 g is fired from a gun of mass 6 kg with a velocity of 300 m/s. The recoil velocity of the gun is:

   a) 5 m/s

   b) 0.5 m/s

   c) 0.05 m/s

   d) 50 m/s

5) A fielder stops a moving ball of mass 150 g moving at 20 m/s in 0.1 seconds. The force applied by the fielder is:

a) 3 N

b) 30 N

c) 300 N

d) 0.3 N

6) When a hanging carpet is beaten with a stick, dust particles start coming out of it. This is a practical application of:

a) Newton's Second Law

b) Newton's Third Law

c) Inertia of rest

d) Conservation of momentum

7) A goalkeeper in a game of football pulls his hands backwards after holding the ball shot at the goal. This enables the goalkeeper to:

a) Exert larger force on the ball

b) Reduce the force exerted by the ball on hands

c) Increase the rate of change of momentum

d) Keep the ball steady in his hands

8) When a net force F acts on an object of mass m, it produces an acceleration a. If the force is doubled and the mass is halved, the new acceleration will be:

a) 4a

b) 2a

c) a/2

d) a

9) An object of mass 2 kg is sliding with a constant velocity of 4 m/s 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

10) The action and reaction forces mentioned in Newton's third law:

a) Act on different bodies

b) Act in the same direction

c) Are not equal in magnitude

d) Act on the same body

ASSERTION AND REASONING TYPE OF QUESTIONS :

DIRECTION: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

a) Both A and R are true, and R is the correct explanation of A.

b) Both A and R are true, and R is not the correct explanation of A.

c) A is true, but R is false.

d) Both A and R are false.

11) **Assertion (A):** A larger force is required to accelerate a heavier cricket ball than a tennis ball to the same velocity in the same amount of time.

Reason (R): According to Newton's Second Law, the force applied is equal to the product of mass and acceleration ($F = ma$).

12) **Assertion (A):** When a person jumps out of a rowing boat, the boat moves backward.

Reason (R): Action and reaction forces are equal in magnitude and opposite in direction, and they always act on the same body, resulting in a net force of zero.

13) **Assertion (A):** A football rolling on the floor eventually comes to rest.

Reason (R): According to Newton's First Law, an object in motion will continue to move with constant velocity unless acted upon by an external unbalanced force, which in this case is the force of friction.

II. VERY SHORT ANSWER TYPE OF QUESTIONS: (2 MARKS)

14) Define the SI unit of force. How is the magnitude of a force measured in a laboratory setting?

15) Using Newton's Third Law of Motion, explain why a canoe moves forward when the canoeist pushes the water backward with a paddle.

16) A box is kept at rest on a floor. You apply a small force, but the box does not move. Identify the force that opposes the force that you applied and explain why the box remains stationary.

17) Why does a bicycle gradually slow down and come to a stop when you stop pedalling? Relate this to the net force acting on the bicycle.

III. SHORT ANSWER TYPE OF QUESTIONS (3 MARKS):

18) In a game of tug-of-war, two teams are pulling a rope.

a) Describe the state of the rope if both teams apply equal force in opposite directions.

b) What happens to the rope if Team A suddenly applies a force of larger magnitude than Team B?

c) In which direction will the net force act in scenario (b)?

19) A constant force acts on an object of mass 5 kg for a duration of 2 seconds. It increases the object's velocity from 3 m/s to 7 m/s.

a) Calculate the acceleration of the object.

b) Find the magnitude of the applied force.

c) If the same force is applied to an object with double the mass, how will the acceleration change?

20) Consider two identical canoes, one empty and one carrying a heavy passenger.

a) If the same force is applied to both canoes, which one will achieve a higher velocity in the same amount of time?

b) Relate your answer to Newton's Second Law of Motion.

21) A cricket ball of mass 150 g moving with a velocity of 12 m/s is hit by a bat so that it turns back and moves with a velocity of 20 m/s. The force of the blow acts for 0.01 seconds.

a) Calculate the magnitude of the force exerted by the bat on the ball.

b) What is the direction of the force exerted by the bat?

IV. LONG ANSWER TYPE OF QUESTIONS (5 MARKS):

22) A truck of mass 5000 kg is moving at a speed of 18 km/h. The driver sees a child standing in the middle of the road 25 meters ahead. He immediately applies the brakes and brings the truck to rest just in time to save the child.

a) Calculate the acceleration of the truck and the force applied by the brakes.

b) Explain which law of motion describes why the driver and passengers are thrown forward when the brakes are applied.

c) If the truck was carrying a heavy unsecured crate in the back, describe what happens to the crate during this sudden stop using Newton's First Law of Motion.

23) State Newton's third law of motion. Explain with four different examples from daily life how this law operates. Also explain why the Earth does not appear to move when a fruit falls towards it, even though the fruit exerts an equal and opposite force on the Earth.

24) A sports car of mass 1500 kg is moving towards the east. Its velocity-time graph shows: velocity increases uniformly from 0 m/s to 10 m/s in the first 5 s, remains constant at 10 m/s from 5 s to 10 s, and then decreases uniformly to 0 m/s from 10 s to 15 s. Calculate the force acting on the car during each time interval.

V. CASE STUDY TYPE OF QUESTIONS (4 MARKS):

25) In a vehicle safety research facility, engineers conduct crash tests to understand how different forces affect passengers during a collision. A test car of mass 1500 kg is driven at a constant velocity toward a barrier. Upon impact, the car's velocity changes rapidly. The engineers recorded the following data for a specific test in which the car was brought to rest by a safety barrier.

Parameter	Value
Mass of the car (m)	1500 kg
Initial Velocity (u)	20 m/s
Final Velocity (v)	0 m/s
Time of Impact (t)	0.1 seconds

Questions:

i) Determine the magnitude of the average net force exerted by the barrier on the car during the collision.

ii) Modern cars are designed with 'crumple zones' that increase the time of impact during a crash. Based on Newton's Second Law, explain how increasing the time of impact from 0.1 s to 0.5 s would affect the force experienced by the passengers.

iii) If the car were carrying a heavy load, increasing its total mass to 2000 kg while maintaining the same initial velocity and impact time, how would the force exerted by the barrier change? Show your calculation.

26) A small research rocket is launched vertically from a platform. The rocket works on the principle of ejecting exhaust gases at high speeds in the opposite direction of its desired motion. The following table describes the forces acting on the rocket at the moment of ignition and during the first few seconds of flight.

Force Component	**Magnitude (Newtons)**
Upward Thrust (Force from gases)	25,000 N
Weight of Rocket (Gravitational Force)	10,000 N
Air Resistance (at 2 seconds)	2,000 N

Questions:

i) Identify the action-reaction pair involved in the rocket's propulsion according to Newton's Third Law.

ii) Calculate the net force acting on the rocket at the 2-second mark, considering thrust, weight, and air resistance. Is the motion balanced or unbalanced?

iii) As the rocket travels higher, it consumes fuel, causing its total mass to decrease. If the thrust remains constant at 25,000 N, explain what will happen to the rocket's acceleration over time. Justify your answer using Newton's Second Law (F = ma).

<u>ANSWER KEY</u>

1	c) Increases the time of contact to reduce the rate of change of momentum
2	c) Newton's Third Law of Motion
3	b) F = ma
4	b) 0.5 m/s
5	b) 30 N
6	c) Inertia of rest
7	b) Reduce the force exerted by the ball on the hands
8	a) 4a
9	b) 0 N
10	a) Act on different bodies
11	a) Both assertion and reason are correct, and reason is the correct explanation for assertion.
12	c) Assertion is true but reason is false.
13	a) Both assertion and reason are correct, and reason is the correct explanation for the assertion.
14	1 Newton (N): the force that produces an acceleration of 1 m/s^2 in an object of 1 kg mass. In a lab, it is measured using a spring balance.
15	The paddle pushes the water backward (Action). The water exerts an equal and opposite force on the paddle/canoe (Reaction), pushing it forward.
16	The friction between the box and the floor opposes the applied force. The box is stationary because the applied force is equal to or less than the static friction (Balanced forces).
17	When pedalling stops, the unbalanced force of friction (and air resistance) acts opposite to motion, causing negative acceleration (slowing down).
18	a) The rope remains stationary (Balanced forces). b) The rope moves toward Team A. c) The net force acts toward Team A.
19	a) $a = (v-u)/t = (7-3)/2 = 2\ m/s^2$ b) $F = ma = 5 \times 2 = 10$ N c) Acceleration will be halved ($a = 1\ m/s^2$)
20	a) The empty canoe (lower mass). b) $a = F/m$; a lower mass results in a higher acceleration for the same force.
21	a) $F = m(v-u)/t = 0.15 \times (-20-12)/0.01 = -480$ N b) Opposite to the initial direction of the ball.
22	a) u = 18 km/h = 5 m/s. Using $v^2-u^2 = 2as$: $0-25 = 2(a)(25) \Rightarrow a = -0.5\ m/s^2$; $F = 5000 \times (-0.5) = -2500$ N b) Inertia of Motion (Newton’s First Law). c) The crate continues moving forward due to inertia, potentially sliding into the front of the truck.
23	Newton's Third Law: whenever one object exerts a force on a second object, the second object simultaneously exerts an equal and opposite force on the first; these forces act on two different objects. Examples: 1) Walking – the foot pushes the ground backward; the ground pushes the foot forward. 2) Rowing a canoe – the paddle pushes water backwards; the water pushes the canoe forward. 3) Rocket propulsion – the engine expels gas downward; the gas pushes the rocket upward. 4) Kicking a ball – the foot pushes the ball, the ball pushes back on the foot. The Earth and the fruit exert equal and opposite gravitational forces on each other, but since $a = F/m$ and the Earth's mass is enormously larger than the fruit's, the Earth's

	acceleration is negligible – so the Earth does not appear to move.
24	0–5 s: $a = 2\ m/s^2$ (east); F = 1500 × 2 = 3000 N east. 5–10 s: velocity constant, a = 0; F = 0 N (no net force). 10–15 s: $a = -2\ m/s^2$; F = 1500 × (-2) = -3000 N (i.e. 3000 N towards the west, opposite to the motion).
25	i) F = m(v-u)/t = 1500(0-20)/0.1 = -300,000 N – magnitude 300,000 N, opposing the motion. ii) Increasing the impact time to 0.5 s (a 5× increase) reduces the force by 5× (since $F = \Delta p/t$), reducing the injury risk to passengers. iii) F = m(v-u)/t = 2000(0-20)/0.1 = -400,000 N – the force increases in magnitude to 400,000 N because of the greater mass.
26	i) Action: the rocket pushes the exhaust gases downward. Reaction: the gases push the rocket upward. ii) Net Force = 25,000 (up) − 10,000 (weight) − 2,000 (air resistance) = 13,000 N upward – this is an unbalanced force. iii) The acceleration will increase. Since a = F/m, as fuel is consumed, the mass decreases while the thrust (force) stays constant, so the acceleration increases over time.

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