

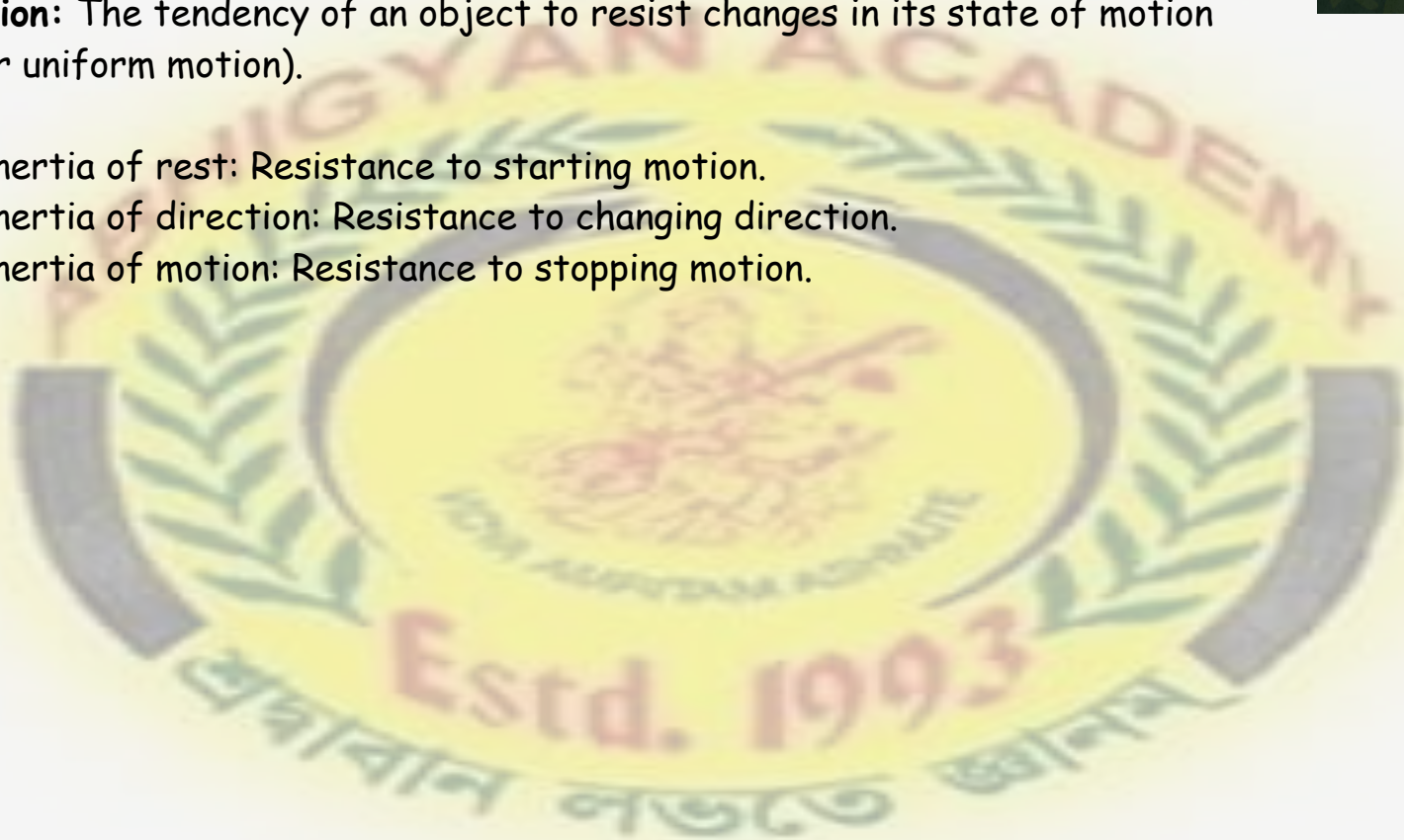
Force

- **Definition:** A push or pull that can change an object's velocity (speed and direction).
- **Characteristics:**
 - Has both magnitude (strength) and direction.
 - Can change an object's motion or shape.
 - Forces in the same direction add up, while forces in opposite directions subtract.
 - Balanced forces result in no change in motion, while unbalanced forces cause a change in motion.
- **Gravity:** The force that pulls objects towards the Earth.
- **Pressure:** Force per unit area.
- **Equilibrium:** When the net force on an object is zero, it's either at rest or moving at a constant velocity.
- **Nuclear Force:** The strongest force in nature.



Inertia

- **Definition:** The tendency of an object to resist changes in its state of motion (rest or uniform motion).
- **Types:**
 - Inertia of rest: Resistance to starting motion.
 - Inertia of direction: Resistance to changing direction.
 - Inertia of motion: Resistance to stopping motion.

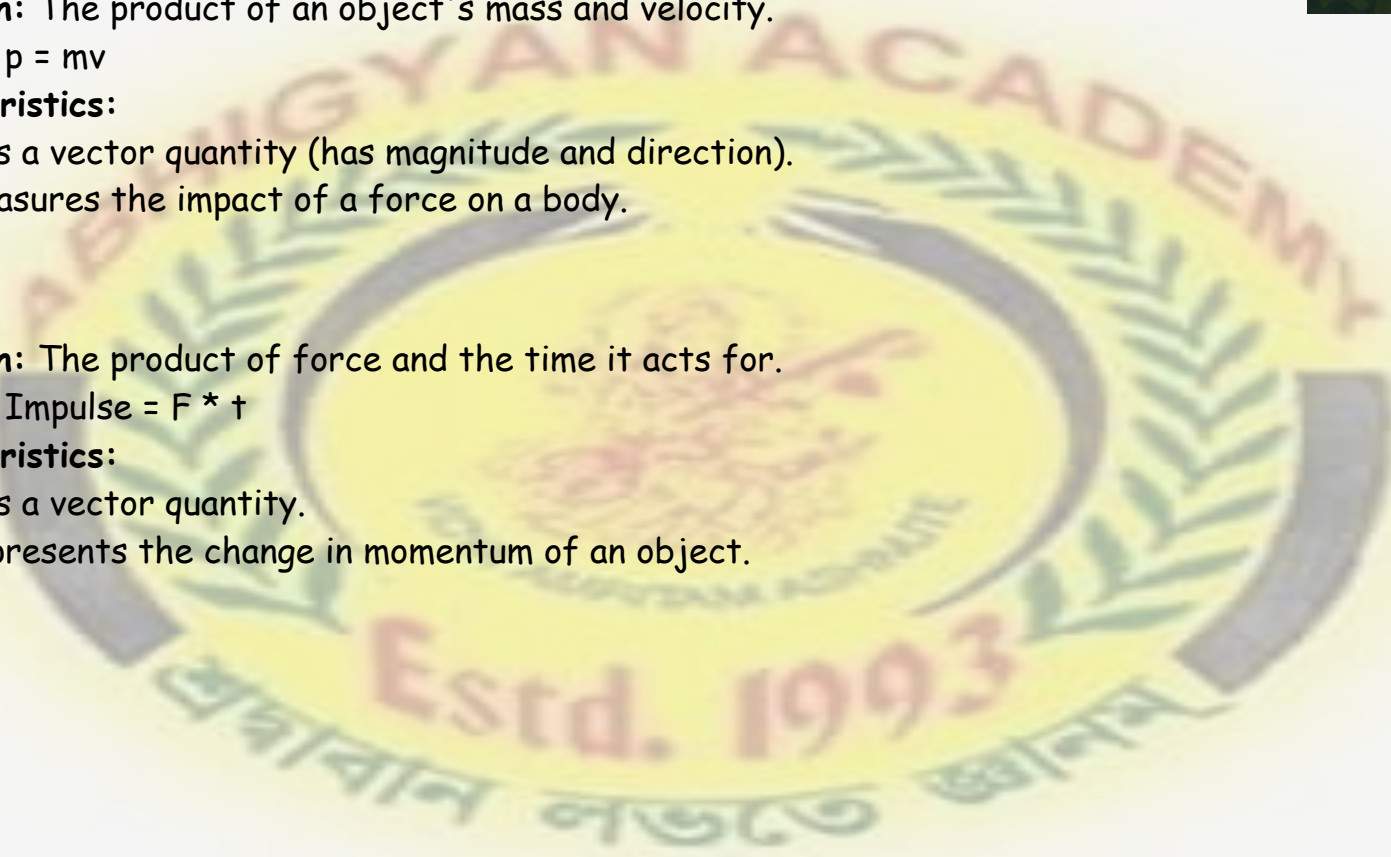


Linear Momentum

- **Definition:** The product of an object's mass and velocity.
- **Formula:** $p = mv$
- **Characteristics:**
 - It's a vector quantity (has magnitude and direction).
 - Measures the impact of a force on a body.

Impulse

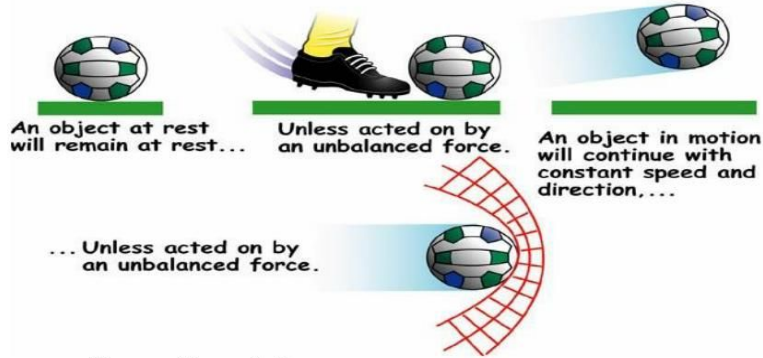
- **Definition:** The product of force and the time it acts for.
- **Formula:** $\text{Impulse} = F * t$
- **Characteristics:**
 - It's a vector quantity.
 - Represents the change in momentum of an object.



Newton's Laws of Motion

- **First Law (Law of Inertia):** An object at rest stays at rest, and an object in motion stays in motion with the same speed and direction unless acted upon by an unbalanced force.

Newton's First Law of Motion



– "Law of Inertia"



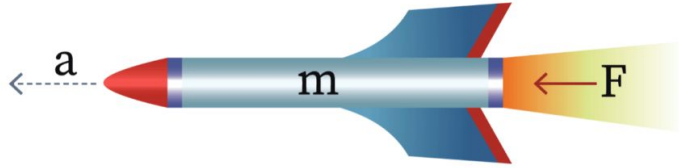
• Inertia

- tendency of an object to resist any change in its motion
- increases as mass increases



- **Second Law:** The rate of change of momentum of an object is proportional to the applied unbalanced force in the direction of the force. ($F = ma$)

NEWTON'S SECOND LAW OF MOTION



$$F = ma$$

Where F - force
m - mass of the body
a - acceleration of the body

- **Third Law:** For every action, there is an equal and opposite reaction.

For every action, there is an equal and opposite reaction

Reaction

Recoil force on the gun



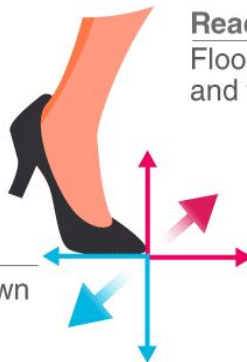
Action

Accelerating force of the bullet



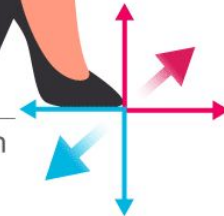
Reaction

Floor pushes up and forward



Action

Foot pushes down and back



Action

Boy's feet exert force on boat

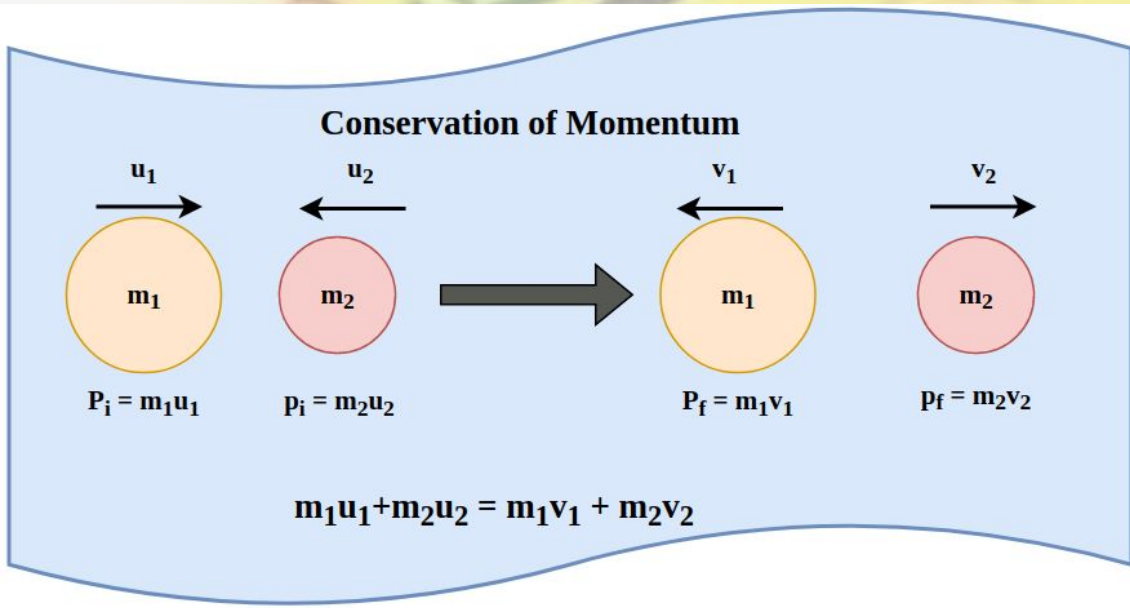
Reaction

Boat exerts force on feet



Conservation of Momentum

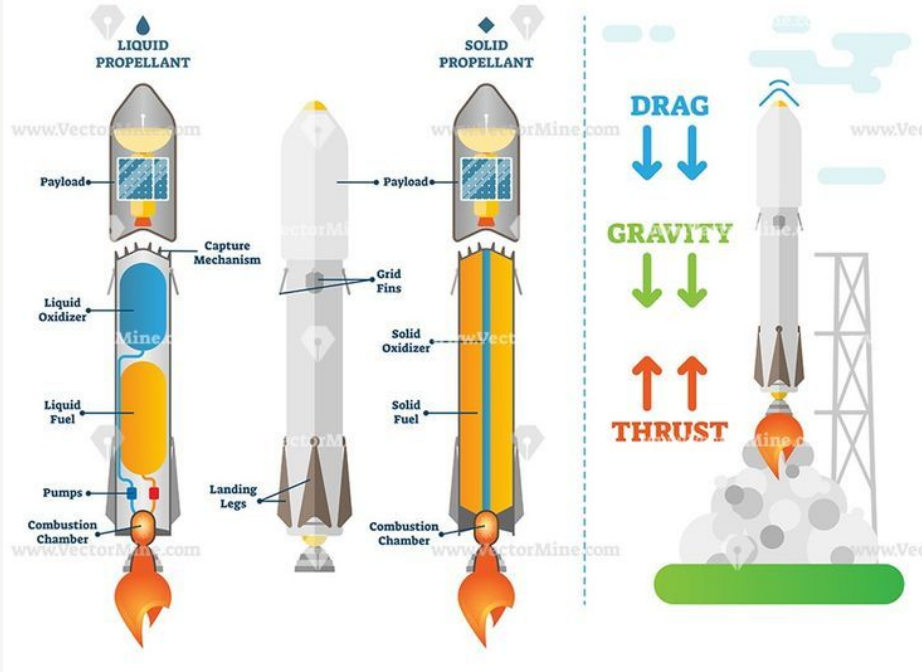
- The total momentum of a system remains constant if no external forces act on it.
- The total momentum of objects before and after a collision is the same.



Rocket Propulsion

- Based on the conservation of linear momentum and Newton's third law.
- Burning fuel creates hot gas expelled at high speed, producing momentum.
- An equal and opposite reaction force propels the rocket forward.

ROCKET PROPULSION



Key Concepts

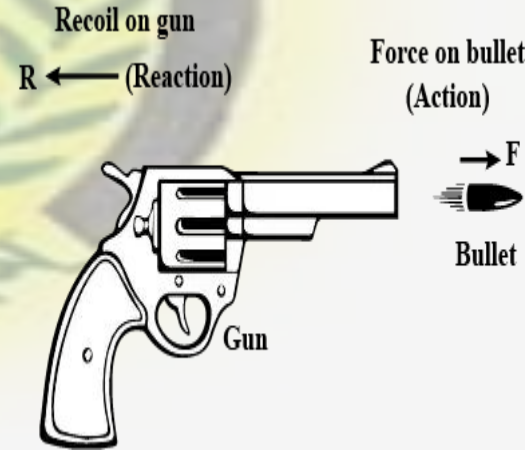
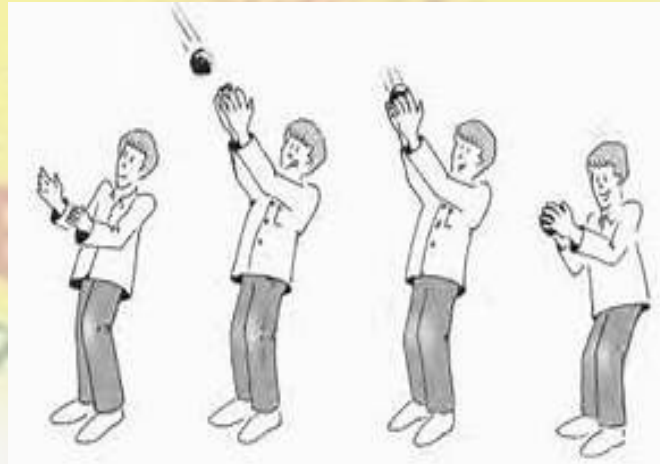
- **Inertia:** The tendency of an object to resist changes in its motion.
- **Momentum:** The product of an object's mass and velocity ($p = mv$).
- **Impulse:** The change in momentum, equal to force multiplied by time ($\text{Impulse} = F \times t$).

Real-life Examples

- **First Law:** Passengers in a suddenly starting/stopping bus experience a jerk due to inertia.
- **Second Law:** A fielder moves their hand backward while catching a ball to reduce the impact force.
- **Third Law:** The recoil of a gun when fired.

Riding the Bus

When a moving bus halts, you continue moving forward.





Pressure: The force acting perpendicularly on a unit area. It is calculated by dividing the thrust (or force) by the area. The SI unit of pressure is the pascal (Pa).

Factors Affecting Pressure: The pressure exerted by a force depends on the magnitude of the force and the area of contact. Increasing the thrust or decreasing the surface area increases the pressure.

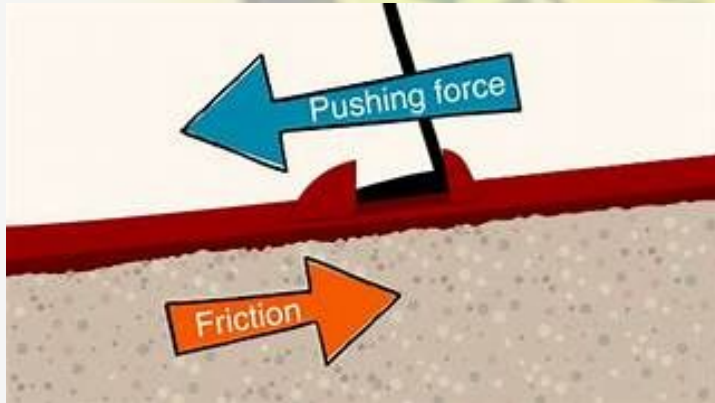
Atmospheric Pressure: The force exerted by the weight of the atmospheric air on a unit surface area of the Earth. It is measured using a barometer. Atmospheric pressure decreases as altitude increases.

Friction

- **Definition:** The force that opposes motion between two surfaces in contact.
- **Direction:** Always acts in the opposite direction of the moving body.
- **Cause:** Due to irregularities on the surfaces in contact.
- **Increase:** Friction can be increased by increasing the contact area between surfaces.

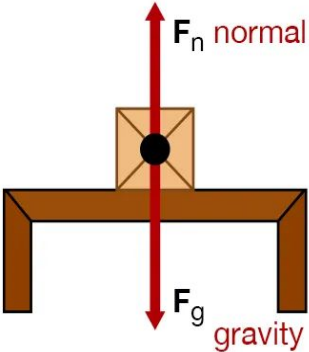
Effects of Friction

- Opposes motion.
- Causes wear and tear of surfaces.
- Produces heat.

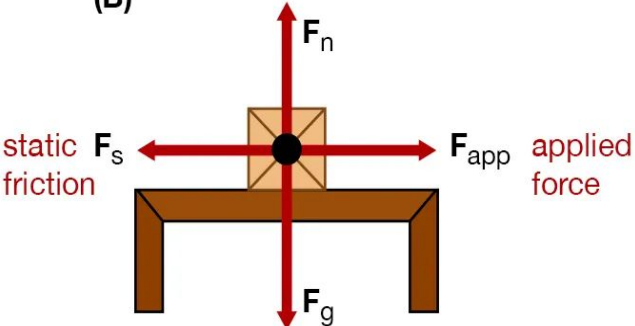


Friction forces

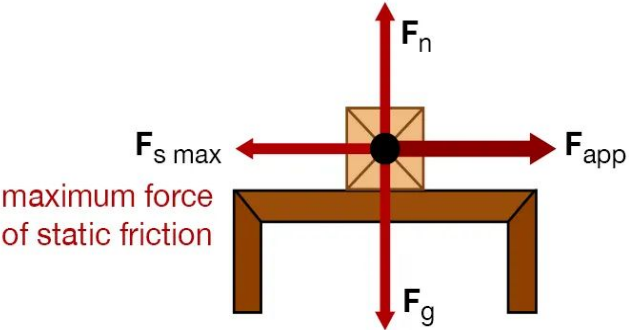
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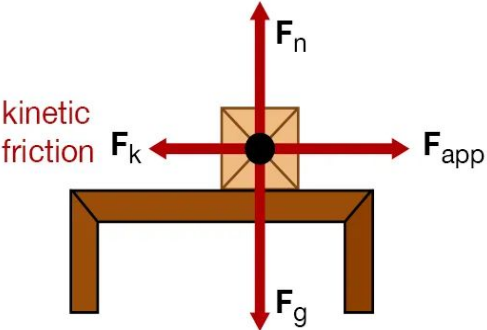
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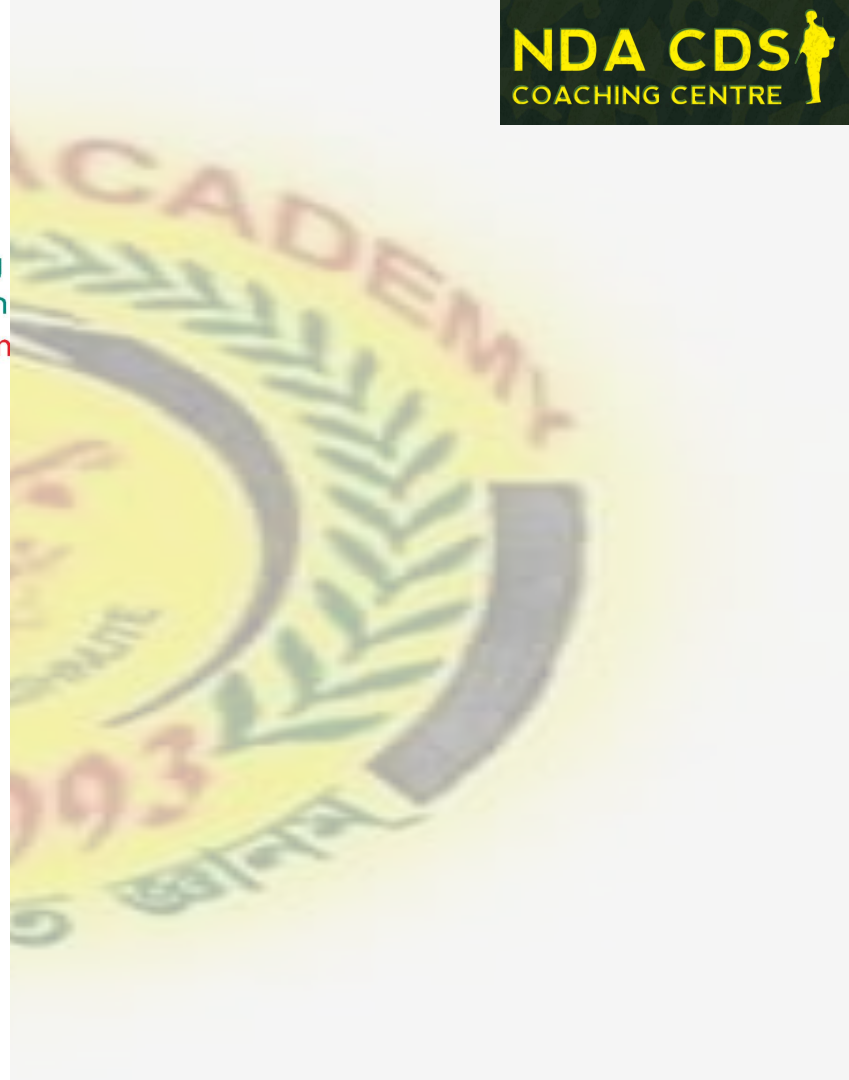
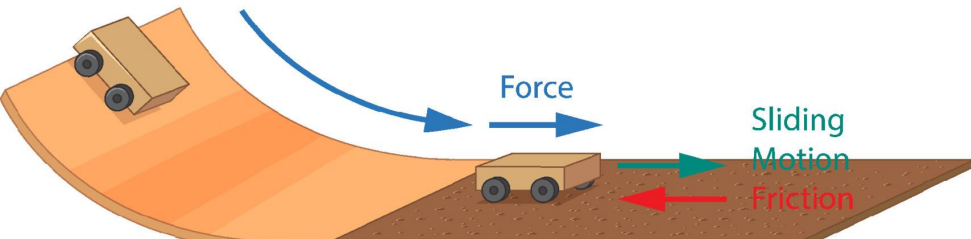
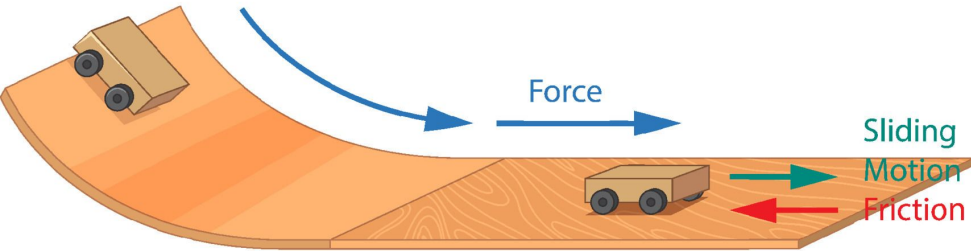
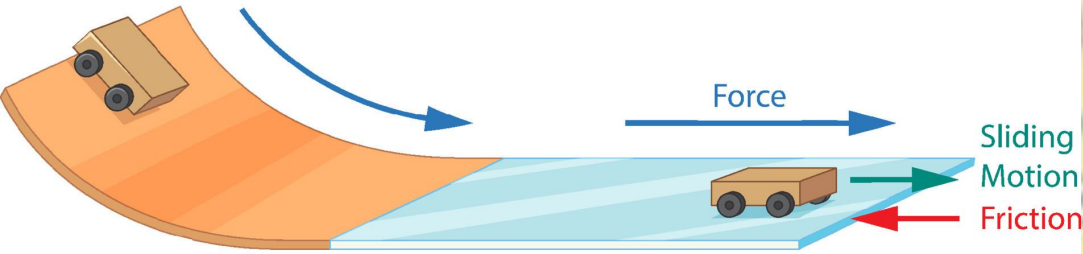


(D)





Friction



Reducing Friction

- **Lubricants:** Substances like oil, grease, or graphite reduce friction by creating a thin layer between surfaces.
- **Rolling:** Rolling motion experiences less friction than sliding motion.
- **Fluid Friction (Drag):** Friction in fluids depends on the object's speed, shape, and the nature of the fluid.
- **Streamlining:** Reduces fluid friction by giving objects suitable shapes.

Advantages of Friction

- Enables us to hold objects.
- Allows us to walk without slipping.
- Makes writing possible.
- Enables automobiles to move and brake safely.