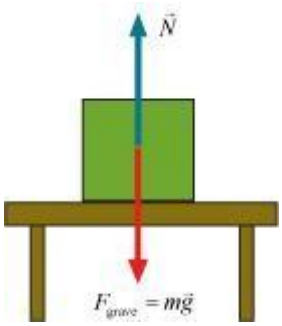
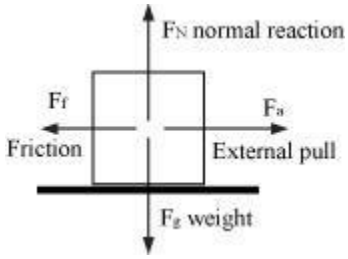
Force and Laws of Motion

- **Balanced force:** If the total force acting on a body cancels out such that there is no change in state of motion or of rest. The forces are said to be balanced.

	The normal reaction N balances the force due to gravity, hence no movement of the block on the table.

- **Unbalanced force:** A net force acts on the body. This is the reason of change in state of motion or of rest.

	The normal reaction N balances the weight, so there is no movement in vertical direction, but there will be movement along the horizontal (towards right) if the external pull F_a exceeds the friction F_f.

First law of motion

- A body at rest remains at rest and a body in uniform motion continues its uniform motion unless an external force is applied.

- **Inertia:**

- It is the tendency of a body to resist any change in its state of rest or of uniform motion along a straight line.

- Mass of an object is the measure of its inertia, more is the mass more is the inertia.

- Types of inertia: Inertia of rest and motion

- Momentum is the product of the mass of the body and its velocity. It is a vector quantity.
- Momentum = Mass × Velocity
- SI unit of the momentum is kg m/s.
- **Second law of motion**
  - The second law of motion says, when a force *F* is subjected to a body of mass *m*, an acceleration *a* is gained by the body in the direction of the force and the magnitude of acceleration is directly proportional to the *F* and inversely proportional to the *m*.
  - Rate of change of momentum ∝ Applied unbalanced force
  - Direction of change in momentum is the same as the direction of unbalanced force
    $F = ma$
    Unit of force is Newton
    $1\ N = 1\ kg \times 1\ m / s^2$
- **Third law of motion**
  - For every action force there is an equal and opposite reaction force.
  - The horse and the cart: From the third law of motion the pull by the horse in the forward direction is equal to the pull by the cart in the backward direction. The sum of these forces is therefore zero. Why should then the cart accelerate forward? Apart from the pulls of the horse and the cart there is frictional force and the reaction of the ground on the horse and the cart is also present. The resultant force of this normal reaction and the friction together helps the horse to move the cart in the forward direction.

Conservation of momentum

- Momentum of a system is always conserved when there is no net external force on the system.
- Momentum before collision = Momentum after collision

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