

KARACHI EDU COACHING CENTER • IX PHYSICS

Unit 3: Dynamics

Study of Motion and its Causes • Sindh Textbook Board

Dynamics & Force



Dynamics

Branch of mechanics that deals with the study of motion of an object and the **causes of its motion**.



Force (\$F\$)

A push or pull that moves, stops, or changes direction. Vector quantity. SI unit: **Newton (N)**.

Inertia and Mass

Inertia

Property of a body due to which it resists any change in its state of rest or uniform motion.

Mass as Measure of Inertia

Greater the mass of a body, greater is its inertia. Mass is a scalar quantity measured in kilograms (kg).

Newton's First Law of Motion

Law of Inertia

"A body continues in its state of rest or of uniform motion in a straight line, provided no net force acts on it."

Also known as the **Law of Inertia** because it relies on the inherent property of inertia in matter.

Newton's Second Law of Motion

Statement

When a net force acts on a body, it produces acceleration in the direction of force. Magnitude is directly proportional to force and inversely to mass.

Mathematical Form

$$\mathbf{\$F = ma\$}$$

$$1\text{ N} = 1\text{ kg} \times 1\text{ m/s}^2$$

Newton's Third Law of Motion

Action and Reaction

"To every action there is always an equal and opposite reaction."

$$\mathbf{\$F_A = -F_B\$}$$

Examples: Walking on the road, flight of rockets, and swimming.

Mass vs. Weight

Mass (m)

- Quantity of matter contained in a body.
- Scalar quantity.
- Constant everywhere.
- SI Unit: Kilogram (kg).

Weight (W)

- Gravitational force acting on a body ($W = mg$).
- Vector quantity.
- Varies with gravity (g).
- SI Unit: Newton (N).

Linear Momentum

Quantity of Motion

Momentum is the quantity of motion possessed by a body due to its mass and velocity.

$$\mathbf{P} = mv$$

Vector quantity. SI Unit: $\text{kg} \cdot \text{m/s}$ or $\text{N} \cdot \text{s}$.

Conservation of Momentum

Isolated System Principle

"The total momentum of an isolated system of two or more interacting bodies remains constant."

$$m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2$$

Friction and Its Types

Friction Definition

The force that opposes the relative motion between two surfaces in contact.

Static Friction

Friction that exists when a body tends to move from a state of rest.

Kinetic & Rolling

Kinetic friction opposes motion during sliding; rolling friction occurs when bodies roll.

Uniform Circular Motion

Centripetal Force

Force that keeps a body to move in a circular path, directed towards the center.

$$F_c = \frac{mv^2}{r}$$

Centripetal Acceleration

Acceleration produced in a body moving along a circular path.

$$a_c = \frac{v^2}{r}$$

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Unit 3 Completed

Mastering Dynamics, Newton's Laws, Momentum Conservation, and
Circular Motion.

Next: Unit 4 - Turning Effect of Forces
