

The Gravity Packed World of Physics (Part 1)

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I. Introduction to Physics

- A. Using Scientific Notation
 1. Multiplying Exponents
 2. Converting Numbers into Scientific Notation
- B. Using Numbers and Units in Physics
 1. Basic Units
 2. Conversion and Cancellation of Units

II. Scalars and Vectors

- A. What are Scalars and Vectors?
 1. Magnitude
 2. Direction
- B. Adding Vectors
 1. Head-to-Tail Method
 2. Component Method
- C. Multiplying Vectors
 1. Dot or Scalar Product
 2. Cross or Vector Product

III. One-Dimensional Kinematics

- A. Basic One-Dimensional Quantities
 1. Displacement
 2. Velocity
 3. Acceleration
- B. One-Dimensional Kinematic Equations
 1. Instantaneous Velocity
 2. Displacement
 3. Final Velocity

IV. Two-Dimensional Kinematics

- A. Projectile Motion
 1. First Projectile Motion Equation
 2. Second Projectile Motion Equation
 3. Third Projectile Motion Equation
 4. Fourth Projectile Motion Equation
- B. Uniform Circular Motion
 1. Centripetal Force
 2. Centripetal Acceleration
 3. Period

C. Accelerated Circular Motion

1. Tangential Acceleration
2. Total Acceleration

D. Rotational Motion

1. Rotating Through an Angle
2. Radians
3. Angular Velocity
4. Linear Speed

V. Linear Momentum and Newton's Laws of Motion

- A. Linear Momentum
- B. The Principle of Conservation of Linear Momentum
 1. Collisions
 2. Final Momentum = Initial Momentum
- C. The First Law of Motion
 1. Object in Motion → Stays in Motion
 2. Object at Rest → Stays at Rest
 3. Law of Inertia
- D. Newton's Second Law of Motion
 1. Force
 2. $F = ma$
 3. Weight
 4. Equilibrium
 5. Tension
- E. Newton's Third Law of Motion
 1. Equal But Opposite Force
 2. Momentum and Newton's Third Law

IV. Friction

- A. What is Friction?
- B. Kinetic and Static Friction
 1. Kinetic Friction → Acts Opposite Motion
 2. Normal Force
 3. Static Friction → Tries to Prevent Motion
 4. Coefficient of Friction

Metric System Prefixes:

10^{12}	tera	one trillion
10^9	giga	one billion
10^6	mega	one million
10^3	kilo	one thousand
10^{-2}	centi	one hundredth
10^{-3}	milli	one thousandth
10^{-6}	micro	one millionth
10^{-9}	nano	one billionth
10^{-12}	pico	one trillionth

Units:

time (s)	velocity (m/s)
mass (kg)	acceleration (m/s ²)
length (m)	force (N)

Equations

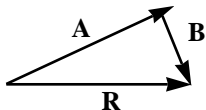
Breaking Vectors into Components:

$$A_x = A \cos \theta \quad B_x = B \cos \phi$$

$$A_y = A \sin \theta \quad B_y = B \sin \phi$$

Adding Vectors:

Head-to-Tail Method



Component Method

$$A_x + B_x = R_x$$

$$A_y + B_y = R_y$$

Multiplying Vectors:

Dot or Scalar Product

$$\mathbf{A} \cdot \mathbf{B} = AB \cos \theta = A_x B_x + A_y B_y$$

Cross or Vector Product

$$|\mathbf{A} \times \mathbf{B}| = AB \sin \theta = A_x B_y - A_y B_x$$

Pythagorean Theorem:

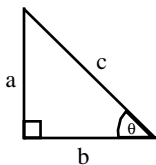
$$a^2 + b^2 = c^2$$

Trigonometric Functions:

$$\sin \theta = \frac{a}{c}$$

$$\cos \theta = \frac{b}{c}$$

$$\tan \theta = \frac{a}{b}$$



One-Dimensional Kinematic Equations:

$$v_f = v_i + at$$

$$x = v_i t + \frac{1}{2} at^2$$

$$v_f^2 = v_i^2 + 2ax$$

Projectile Motion:

1. Components of a Projected Object

$$v_{ix} = v_i \cos \theta$$

$$v_{iy} = v_i \sin \theta$$

2. Equations

$$v_y = v_{iy} - gt$$

$$v_x = v_{ix}$$

$$x_f = x_i + v_{ix} t$$

$$y_f = y_i + v_{iy} t - \frac{1}{2} gt^2$$

Acceleration Due to Gravity:

$$g = 9.8 \text{ m/s}^2$$

Uniform Circular Motion:

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

$$v = \frac{2\pi r}{T}$$

Accelerated Circular Motion:

$$\mathbf{a} = \mathbf{a}_t + \mathbf{a}_c$$

$$a^2 = a_t^2 + a_c^2$$

Rotational Motion:

$$\theta = \frac{s}{r}$$

$$\omega = \frac{\theta}{t}$$

$$v = \omega r$$

Linear Momentum:

$$\mathbf{p} = m\mathbf{v}$$

Conservation of Momentum:

$$\Delta \mathbf{p}_2 = -\Delta \mathbf{p}_1$$

Newton's Second Law of Motion:

$$\mathbf{F} = m\mathbf{a}$$

Weight:

$$\mathbf{w} = m\mathbf{g}$$

Friction:

$$F_f = \mu_k F_n$$

$$F_f \leq \mu_s F_n$$