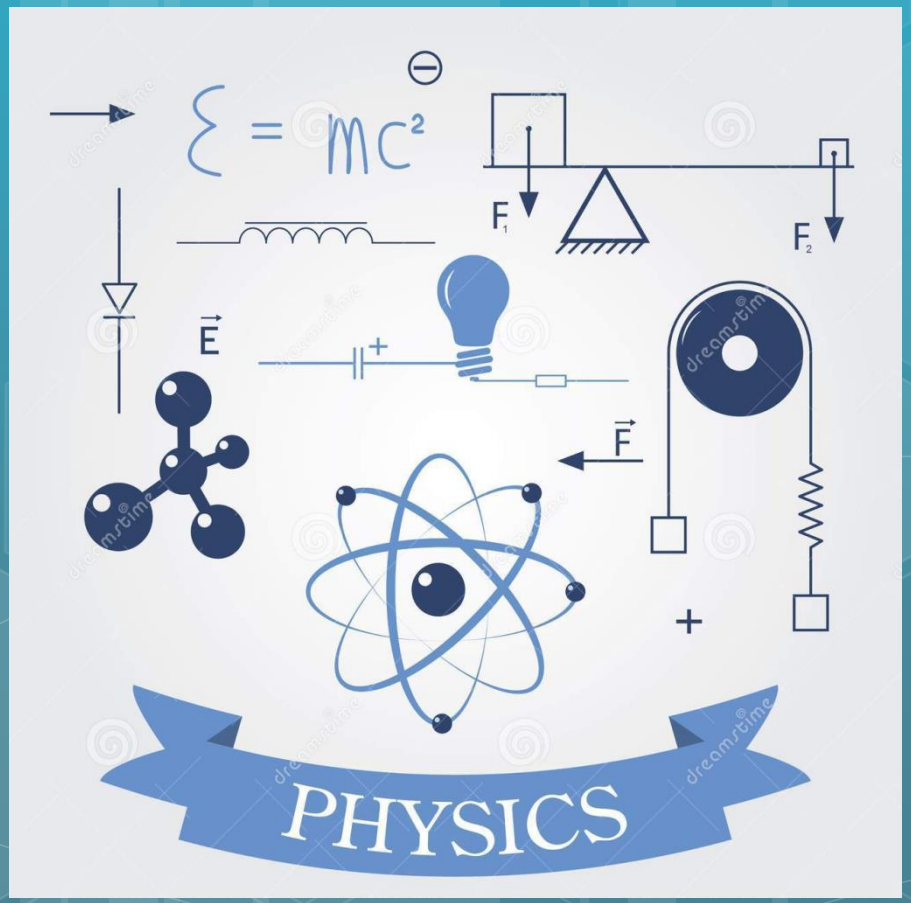



# PHYSICS

## Technical English

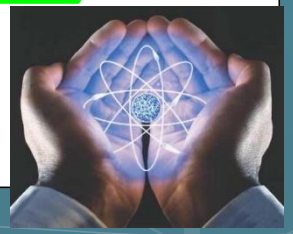
# Basic Concepts

**Physics** is the science of natural phenomena, the relationship between space and time, based on their properties. It is divided into several branches:

- **Kinematics**: Examines the consequences of the motion of bodies in space and time.
- **Dynamics**: Examines the causes of the motion of bodies in relation to space and time.
- **Geometric Optics**: Studies all the phenomena of light by means of analytical geometry.
- **Electromagnetic Optics**: Studies all the phenomena of light by means of their frequencies.

# Basic Concepts

- **Acoustic**: Studies all phenomena linked to mechanical waves and electromagnetism.
- **Thermodynamics**: Studies all phenomena related to the temperature (not just with the heat, as many believe).
- **Electricity**: Studies all phenomena related to electricity. This is sometimes subdivided into: *Static* which studies everything related to electrical energy stored in objects and *Dynamic which* Studies everything related to the movement of electrons.
- **Electromagnetism**: Studies everything about the causes and effects of magnetic fields.



# Applications

The most known application areas are:

- **Low temperatures:** These laboratories research on superconductivity and highly correlated electronic systems. Also in the manufacture of nanostructured materials.
- **Atomic collisions:** Research groups in this area carry out experimental and theoretical research on the interactions of atomic particles (charged and neutral) with solid or gaseous phase matter
- **Physics of metals:** Here research is directed to the thermodynamic and mechanical properties of metal alloys and materials in general.

# Applications

- **Statistical Physics:** These research groups apply statistics techniques - physical in origin - to biological, social and economic systems with emphasis on issues of epidemiology, neurosciences, ecology and cultural evolution.
- **Forensic physics:** They develop new techniques useful in the judicial forum. Expert advice is also provided to the judiciary using electronic microscopy scanning, analysis by neutron activation or innovative methodologies.
- **Nuclear fusion and physics of Plasmas:** Groups working on this area perform studies on balance, stability, transport, sustaining the flow and heating in plasmas

# Applications

- **Optical properties:** These laboratories characterize materials by optical means. They also study light and ultra-fast vibration at the nanoscale, and ultra-sensitive detection of molecules and pollutants.
- **Magnetic resonance:** Here, researchers perform characterization and measurement of magnetic, thermodynamic, elastic properties and transportation of new magnetic materials in both nanostructured and massive systems
- **Particles and field theory:** These groups carry out research in the areas of Physics of high energies, astroparticle, mathematical Physics, field theory and strings.

# Vectors and Scalars

- ***Scalars*** are completely specified by a single value with an appropriate unit and have no direction.
- *A* ***Vector*** is a quantity that has both magnitude and direction. *Displacement, velocity, acceleration, and force* are the vector quantities.
- There are examples of vectors that are directed in two dimensions - upward and rightward, northward and westward, eastward and southward, etc.

# MECHANICS

## Technical English

# Definition

- Mechanics is defined as the science that describes and predicts the conditions of rest or motion of bodies under the action of forces. It is divided into three parts: Mechanics of Rigid Bodies, Mechanics of Deformable Bodies and Mechanics of Fluids.
- The Mechanics of Rigid Bodies is subdivided into Statics, dealing with bodies at rest, and Dynamics, that attends bodies in motion.

# Definition

- Mechanics is a physical science, since it is closely related with the study of physical phenomena. Mechanics is the foundation of most engineering sciences and is an indispensable prerequisite to their study.
- The purpose of mechanics is to explain and predict physical phenomena and thus to lay the foundations for engineering applications.

# Fundamental Concepts

- The basic concepts used in Mechanics are: space, time, mass, and force.
- The **concept of space** is associated with the notion of the position of a point P. Three lengths measured from a certain reference plane having a common point, called origin, in three given directions may define the position of P. These lengths are known as the coordinates of P. The space is assumed to be uniform.

# Fundamental Concepts

- To define an event, it's not sufficient to indicate its position in space. **The time** of event should also be given.

- **The concept of mass** is used to characterize and compare bodies on the basis of certain fundamental mechanical experiments. Two bodies of the same mass, for example, will be attracted by the Earth in the same manner; they will also offer the same resistance to a change in translational motion.

# Fundamental Concepts

- **A force** represents the action of one body in another. It may be exerted by direct contact or at a distance, as in the case of gravitational forces and magnetic forces. A force is characterized by its point of application, its magnitude, and its direction; a force is represented by a vector.

- The conditions of rest or motion of particles and rigid bodies must be studied in terms of the four basic concepts we have introduced. By **particles** we mean a very small amount of matter, which may be assumed to occupy a single point in space. A **rigid body** is a combination of a large number of particles occupying fixed positions with respect to each other.

# Fundamental Concepts

- The study of the **Mechanics of Particles** is obviously a prerequisite to that of rigid bodies. Besides, the results obtained for a particle may be used directly in a large number of problems dealing with the conditions of rest or motion of actual bodies.

- The study of Elementary Mechanics rests on four fundamental principles based on experimental evidence:

## Principles of Elementary Mechanics

- **1. The parallelogram law for the addition of forces:** This states that two forces acting on a particle may be replaced by a single force, called their resultant, obtained by drawing the diagonal of the parallelogram, which has sides equal to the given forces.
- **2. The principle of transmissibility:** This states that the conditions of equilibrium or motion of a rigid body will remain unchanged if a force acting at a given point of the rigid body is replaced by a force of the same magnitude and the same direction, but acting at a different point, provided that the two forces have the same line of action.

## 3. Newton's three fundamental laws

- **I.** If the resultant force acting on a particle is zero, the particle will remain at rest (if originally at rest) or will move with constant speed in a straight line (if originally in motion).

- **II.** If the resultant force acting on a particle is not zero, the particle will have an acceleration proportional to the magnitude of the resultant and in the direction of this resultant force.

## 3. Newton's three fundamental laws

- **III.** The forces of action and reaction between bodies in contact have the same magnitude, same line of action, and opposite sense.
- **4. Newton's law of gravitation:** This states that two particles of mass "M" and "m" are mutually attracted with equal and opposite forces "F" and "-F" of magnitude "F" given by the formula in which "r" is the distance between the two particles, and "G" is the universal constant called the constant of gravitation

# International System of Units (SI) and Derived Units

- In this system, used worldwide, the base units are:
  - **Meter (m)** for measuring a length (L) property
  - **Second (s)** for measuring time (t) flow
  - **Kilogram (kg)** for measuring the mass (M) of a body
- The three base units are independent of the location where measurements are made.

# International System of Units (SI) and Derived Units

- In Physics, as well as in Engineering Sciences, there is a need to use secondary dimensional quantities. The units of these quantities are referred to as **derived units**.
- For example, the unit of force is a derived unit Newton (N), defined as the force which gives an acceleration of 1 m/s2 to a mass of 1 kg.