

Chapter - 1 Physical World

- The word Science originates from the Latin verb Scientia meaning 'to know'
- Science is a systematic attempt to understand natural phenomena in as much detail and depth as possible, and use the knowledge so gained to predict, modify and control phenomena.

THE STEPS IN SCIENTIFIC METHOD

- Systematic observations
- controlled experiments
- qualitative and quantitative reasoning
- mathematical modelling
- Prediction and verification or falsification of theories.

PHYSICS

- Physics is a basic discipline in the category of Natural Sciences.
- Physics as a study of the basic laws of nature and their manifestation in different natural phenomena.
- In Physics, we attempt to explain diverse physical phenomena in terms of a few concepts and laws.
- The two approaches of physics are unification and reductionism.
- Attempting to explain diverse physical phenomena with a few concepts and laws is unification.
- An attempt to explain a macroscopic system in terms of its microscopic constituents is reductionism.

SCOPE OF PHYSICS

Macroscopic domain

- The macroscopic domain includes phenomena at the laboratory, terrestrial and astronomical scales.
- Classical Physics deals mainly with macroscopic phenomena and includes subjects like Mechanics, Electrodynamics, Optics and Thermodynamics.
- Mechanics -founded on Newton's laws of motion



- Electrodynamics – deals with electric and magnetic phenomena associated with charged and magnetic bodies.
- Optics – deals with the phenomena involving light
- Thermodynamics. – it deals with systems in macroscopic equilibrium and is concerned with changes in internal energy, temperature, entropy, etc., of the system through external work and transfer of heat.

Microscopic domain

- The microscopic domain includes atomic, molecular and nuclear phenomena.
- Quantum Theory is currently accepted as the proper framework for explaining microscopic phenomena.

Link between technology and physics

| Technology | Scientific principle |
|---|--|
| Steam engine | Laws of thermodynamics |
| Nuclear reactor | Controlled nuclear fission |
| Radio and TV | Generation, propagation and detection of electromagnetic waves |
| Computers | Digital logic |
| Lasers | Light amplification by stimulated emission of radiation |
| Production of ultrahigh magnetic fields | Superconductivity |

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|-----------------------|--|
| Rocket propulsion | Newton's laws of motion |
| Electric generator | Faraday's laws of electromagnetic induction |
| hydroelectric power | Conversion of gravitational potential energy in to electrical energy |
| Aeroplane | Bernoulli's principle in fluid dynamics |
| Particle accelerators | Motion of charged particles in electromagnetic fields |
| Sonar | Reflection of ultrasonic waves |
| Optical fibres | Total internal reflection of light |
| Electron microscope | Wave nature of electrons |
| Photocell | Photoelectric effect |

FUNDAMENTAL FORCES IN NATURE

- Gravitational force
- Electromagnetic force
- Strong nuclear force
- Weak Nuclear force

Gravitational force



- Force of mutual attraction between two weak bodies due to their masses.
- It is a universal force.
- It is a non-contact force.
- Obeys inverse square law.
- Weakest force of all forces.
- Long range force.
- Independent of intervening medium.

Electromagnetic force

- The force between charged particles.
- May be repulsive or attractive.
- Depends on the intervening medium.
- Large compared to gravitational force.
- Acts over large distances.
- Electric force between two protons, for example, is 10^{36} times the gravitational force between them, for any fixed distance.
- The forces like 'tension', 'friction', 'normal force', 'spring force', etc. are electromagnetic.

Strong nuclear force

- The strong nuclear force binds protons and neutrons in a nucleus.
- Attractive in nature.
- Strongest force in nature-about 100 times the electromagnetic force in strength.
- It is charge-independent and acts equally between a proton and a proton, a neutron and a neutron, and a proton and a neutron.
- Short range force-about nuclear dimensions.

Weak nuclear force

- Appears only in certain nuclear processes such as the β -decay of a nucleus.
- In β -decay, the nucleus emits an electron and an uncharged particle called neutrino.
- The electron and neutrino interacts through weak force.
- not as weak as the gravitational force, but much weaker than the strong nuclear and electromagnetic forces.
- The range of weak nuclear force is exceedingly small, of the order of 10^{-16} m.

Ratio of strengths of forces

Strong force > electromagnetic > force > gravitational

The ratio of strengths is 1: 10⁻²: 10⁻¹³: 10⁻³⁹

