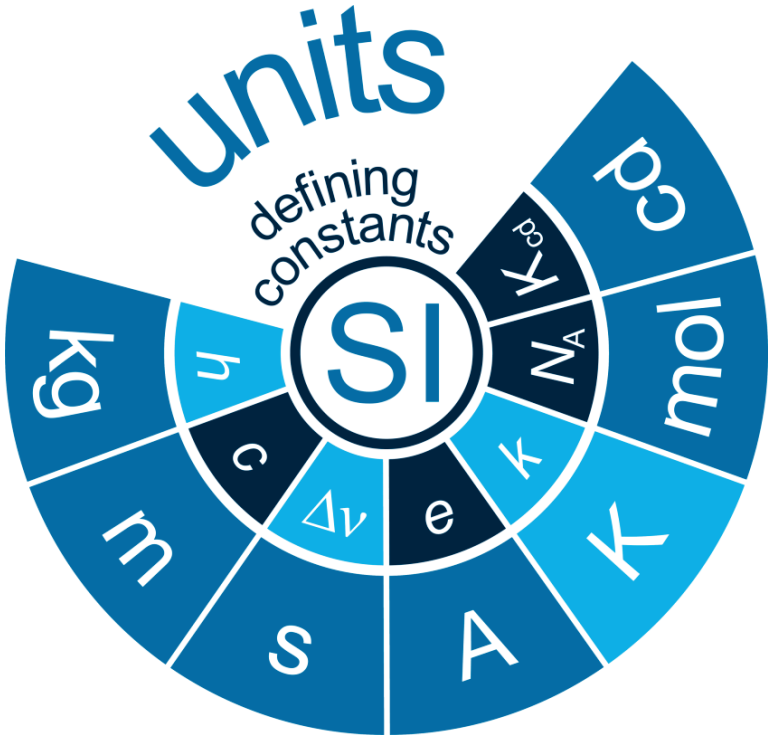
Physical World, Units and Measurements



PHYSICAL WORLD

Physics

- Physics deals with the study of the basic laws of nature and their manifestation in different phenomena. The basic laws of physics are universal and are applied in widely different contexts and conditions.

Physics, Technology and Society

- Science, Technology and Society have strong relationships among one on other. Science is the mother of technology and both of them are the reasons for the creation and development of the society.
- Science and technology issues are actually discussed worldwide today. Progress in this has led to produce the ability to integrate different types of physical products.
- Physics is a basic discipline in the category of natural sciences which also includes other disciplines like Chemistry and Biology. The word physics comes from a Greek word meaning nature.

Fundamental forces in nature :

- There are four fundamental forces in nature. They are the 'gravitational force', the 'electromagnetic force', the 'strong nuclear force', and the 'weak nuclear force'. Unification of different forces/domains in nature is a basic quest in physics.

Nature of physical laws :

- (i) The physical quantities that remain unchanged in a process are called conserved quantities. Some of the general conservation laws in nature include the laws of conservation of mass, energy, linear momentum, angular momentum, charge, etc. Some conservation laws are true for one fundamental force but not for the other.

  (ii) Conservation laws have a deep connection with symmetries of nature. Symmetries of space and time, and other types of symmetries play a central role in modern theories of fundamental forces in nature.

1.Some physicists from different countries of the world and their major contributions

Name	Major contribution /Discovery	Country of Origin
Archimedes	Principle of buoyancy; Principle of the lever	Greece
Galileo Galilei	Law of inertia	Italy
Christiaan Huygens	Wave theory of light	Holland
Isaac Newton	Universal law of gravitation ; Laws of motion ; Reflecting telescope	U.K.
Michael Faraday	Laws of electromagnetic induction	U.K.
James Clerk Maxwell	Electromagnetic theory; Light - an electromagnetic wave	U.K.
Heinrich Rudolf Hertz	Generation of electromagnetic waves	Germany
J.C. Bose	Short radio waves	India
W.K.Roentgen	X-rays	Germany
J.J. Thomson	Electron	U.K.
Marie sklodowska Curie	Discovery of radium and polonium; Studies on natural radio activity	poland
Albert Einstein	Explanation of photoelectric effect;Theory of relativity	Germany
Victor Francis Hess	Cosmic radiation	Austria
R.A. Millikan	Measurement of electronic charge	U.S.A.
Ernest Rutherford	Nuclear model of atom	New Zealand
Niels Bohr	Quantum model of hydrogen atom	Denmark
C.V. Raman	Inelastic scattering of light by molecules	India
Louis Victor de Broglie	Wave nature of matter	France
M.N. Saha	Thermal ionisation	India
S.N. Bose	Quantum statistics	India

Wolfgang Pauli	Exclusion principle	Austria
Enrico Fermi	Controlled nuclear fission	Italy
Werner Heisenberg	Quantum mechanics; Uncertainity principle	Germany
Paul Dirac	Relativistic theory of electron; Quantum statistics	U.K.
Edwin Hubble	Expanding universe	U.S.A.
Ernest Orlando Lawrence	Cyclotron	U.S.A.
James Chadwick	Neutron	U.K.
Hideki Yukawa	Theory of nuclear forces	Japan
Homi Jehangir Bhabha	Cascade process of cosmic radiation	India
Lev Davidovich Landau	Theory of condensed matter; Liquid helium	Russia
S.Chandrasekhar	Chandrasekhar limit, structure and evolution of stars	India
John Bardeen	Transistors ; Theory of super conductivity	U.S.A.
C.H. Townes	Maser; Laser	U.S.A.
Abdus Salam	Unification of weak and electromagnetic interactions	Pakistan

2) Link between technology and physics

Technology	Scientific principle (s)
Steam engine	Laws of thermodynamics
Nuclear reactor	Controlled nuclear fission
Radio and Television	Generation, propagation and detection of electromagnetic waves
Computers	Digital logic
Lasers	Light amplification by stimulated emission of radiation
Production of ultra high magnetic fields	Superconductivity
Rocket propulsion	Newton's laws of motion
Electric generator	Faraday's laws of electromagnetic induction
Hydroelectric power	Conversion of gravitational potential energy into 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
Non-reflecting coatings	Thin film optical interference
Electron microscope	Wave nature of electrons
Photocell	Photoelectric effect
Fusion test reactor (Tokamak)	Magnetic confinement of plasma
Giant Metrewave Radio Telescope (GMRT)	Detection of cosmic radio waves
Bose-Einstein condensate	Trapping and cooling of atoms by laser beams and magnetic fields

Units and Measurements

2.1 Units

Fundamental quantities

The physical quantities which are independent of other quantities are called fundamental quantities.

Example: Mass, length, time etc.

Quantities are those which can be measured using an instrument. Any physical phenomenon or observation that can be measured using an instrument is called **quantity.**

Derived quantities

The physical quantities which are derived from fundamental quantities are known as derived quantities.

Example: Density, volume, speed, force etc.

The SI system of units

In 1971, General conference of weights and measures introduced a logical and rationalized system of units known as international system of units, abbreviated as SI in all languages. In this system, there are seven fundamental quantities and two supplementary quantities.

Fundamental quantities and their units

S. No.	Physical quantity	Unit	Symbol
1.	Length	Metre	m
2.	Mass	Kilogram	Kg
3.	Time	Second	s
4.	Temperature	Kelvin	K
5.	Electric current	Ampere	A
6.	Luminous intensity	Candela	Cd
7.	Amount of substance	Mole	mol

Supplementary quantities and their units

S. No.	Physical quantity	Unit	Symbol
1.	Plane angle	radian	rad
2.	Solid angle	Steradian	Sr

Rules of writing unit

1. In writing the unit of any quantity, small letters must be used for symbol of unit. Eg., m, ms^{-1} etc.
2. Symbols are not followed by full stop.
3. If any unit is named after a scientist, its symbol should be initial capital letter. Eg., N(newton), W(watt), K(kelvin) etc.
4. The full name of a unit always begins with a small letter, even if it is named after a scientist.
   Eg., 5 N or 5 newton.
5. Symbols do not take plural form.

Some practical units

There are some practical units which are simultaneously used with SI units.

(i) 1 fermi = 10^{-15} m

(ii) 1 angstrom ($\overset{0}{A}$) = 10^{-10} m

(iii) 1 nanometer (nm) = 10^{-9} m

(iv) 1 micron (μm) = 10^{-6} m

(v) 1 light year = 9.46×10^{15} m

(vi) 1 astronomical unit (AU) = 1.496×10^{11} m

(vii) 1 parsec = 3.03×10^{18} m

(viii) 1 amu = 1.66×10^{-27} kg

(ix) 1 quintal = 100 kg

(x) 1 tonne = 1000 kg

(xi) 1 lunar month = 27.3 days

(xii) 1 Shake = 10^{-8} s

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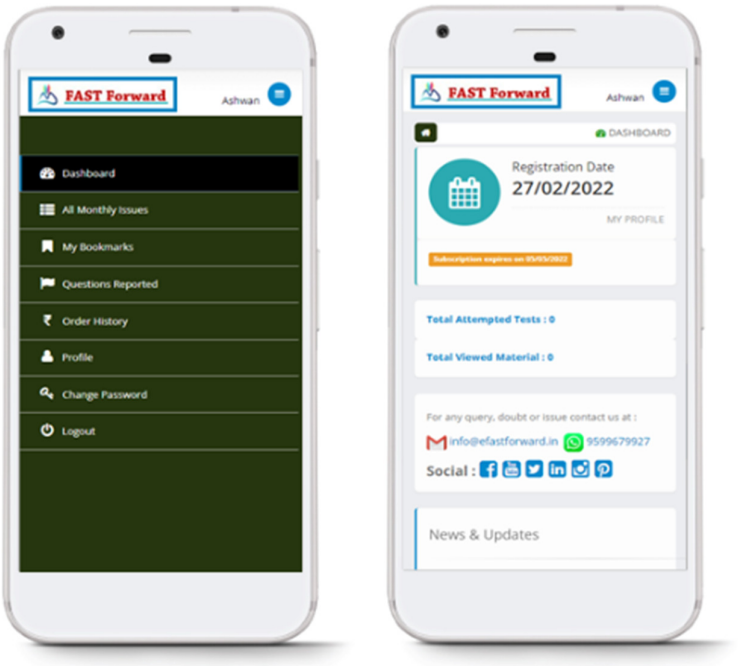

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