PHYSICAL WORLD

1 Physics-Scope and Excitement

2 Physics, technology and society

3 Nature of physical laws

There are four fundamental forces which govern both macroscopic and microscopic phenomena. There are

(i) Gravitational force

(ii) Nuclear force

(iii) Electromagnetic force

(iv) Weak force

The relative strengths of these forces are $F_g : F_w : F_e : F_s = 1 : 10^{25} : 10^{36} . 10^{38}$

All those quantities which can be measured directly or indirectly and in terms of which the laws of physics can be expressed are called physical quantities.

(a) Fundamental quantities

(b) Derived quantities.

The units of the fundamental quantities called fundamental units , and the units of derived quantities called derived units.

System of units:-

(a) MKS
(b) CGS
(c) FPS
(d) SI

- The dimensions of a physical quantity are the powers to which the fundamental quantities are raised to represent that physical quantity.
- The equation which expresses a physical quantity in terms of the fundamental units of mass, length and time, is called dimensional equation.
- According to this principle of homogeneity a physical equation will be dimensionally correct if the dimensions of all the terms in the all the terms occurring on both sides of the equation are the same.
- If any equation is dimensionally correct it is not necessary that must be mathematically correct too.
- There are three main uses of the dimensional analysis-
  (a) To convert a unit of given physical quantities from one system of units to another system for which we use $n2 = n1[M1/M2]a[L1/L2]b[T1/T2]c$
  (b) To check the correctness of a given physical relation.
  (c) To derive a relationship between different physical quantities.
- **Significant figures: -** The significant figures are normally those digits in a measured quantity which are known reliably plus one additional digit that is uncertain.

For counting of the significant figure rule are as:

(i) All non- zero digits are significant figure.

(ii) All zero between two non-zero digits are significant figure.

(iii) All zeros to the right of a non-zero digit but to the left of an understood decimal point are not significant. But such zeros are significant if they come from a measurement.

(iv) All zeros to the right of a non-zero digit but to the left of a decimal point are significant.

(v) All zeros to the right of a decimal point are significant.

(vi) All zeros to the right of a decimal point but to the left of a non-zero digit are not

significant. Single zero conventionally placed to the left of the decimal point is not significant.

(vii) The number of significant figures does not depend on the system of units.

- In addition or subtraction, the result should be reported to the same number of decimal places as that of the number with minimum number of decimal places.
- In multiplication or division, the result should be reported to the same number of significant figures as that of the number with minimum of significant figures.
- Accuracy refers to the closeness of a measurement to the true value of the physical quantity and precision refers to the resolution or the limit to which the quantity is measured.
- Difference between measured value and true value of a quantity represents error of measurement. It gives an indication of the limits within which the true value may lie.
- Mean of n measurements
- $a_{mean} = \frac{a_1+a_2+.....+a_n}{n}$
  Absolute error $(\Delta a) = a_{mean} - a_i$ Where a_i = measured value it may be – positive, negative or zero.

- Mean absolute error
- Relative error - it is the ratio of the mean absolute error to the true value.
  $\delta \mathrm{a} = |\Delta \mathrm{a}/a_{mean}$
- The relative error expressed in percent is called percentage error.
- The error is communicated in different mathematical operations as detailed below:
  $(i)\ for\ x = (a \pm b)$
  $\Delta\, x = \pm(\Delta a + \Delta b)$
  $(ii)\ for\ x = (a \times b)$
  $\Delta x = \pm(\Delta a/a + \Delta b/b)$
  $(iii)\ for\ x = a/b$
  $\Delta x = \pm(\Delta a/a + \Delta b/b)$
  $(iv)\ for\ x = a^n b^m/c^p$
  $\Delta x = \pm(n\Delta a/a + m\Delta b/b + p\Delta c/c)$

SUMMARY

Physics deals with the study of the basic laws of nature and their manifestation indifferent phenomena. The basic laws of physics are universal and apply in widely differentcontexts and conditions.

1. The scope of physics is wide, covering a tremendous range of magnitude of physicalquantities.

2. Physics and technology are related to each other. Sometimes technology gives rise tonew physics; at other times physics generates new technology. Both have direct impact on society.

3. There are four fundamental forces in nature that govern the diverse phenomena of themacroscopic and the microscopic world. These are the ë gravitational force í, the ë electromagnetic force í, the ë strong nuclear force í, and the ë weak nuclear force í . Notification of different forces/domains in nature is a basic quest in physics.

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

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