Physics

(Chapter 1 and 2)(Physical World, Units and Measurements)

(Class 11)

Physical World And Measurement

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

- Gravitational force
- Electromagnetic force
- Nuclear force
- Weak force

The relative strengths of these forces are

$$Fg : Fw : Fe : Fs = 1 : 10^{25} : 10^{36} : 10^{38}$$

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.

- ✓ Fundamental quantities
- ✓ Derived quantities.

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

System of units

- MKS
- CGS
- FPS
- 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:

- To convert a unit of given physical quantities from one system of units to another system for which we use

$$n_2 = n_1[M_1/M_2]^a[L_1/L_2]^b[T_1/T_2]^c$$

- To check the correctness of a given physical relation.
- 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:

- All non- zero digits are significant figure.
- All zero between two non-zero digits are significant figure.
- 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.
- All zeros to the right of a non-zero digit but to the left of a decimal point are significant.
- All zeros to the right of a decimal point are significant.
- 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.
- 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

$$a_{mean} = \frac{a_1 + a_2 + a_3 + \cdots ..... + a_n}{n}$$

Absolute error (Δa) = 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.

$$\delta a = |\Delta a| / a_{mean}$$

- ✓ 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 $x = a \times b$, $\Delta x/x = \pm (\Delta a/a + \Delta b/b)$

(iii) For $x = a/b$, $\Delta x/x = \pm (\Delta a/a + \Delta b/b)$

(iv) For $x = a^n b^m / c^p$ $\Delta x/x = \pm (n\Delta a/a + m \Delta b/b + p\Delta c/c$