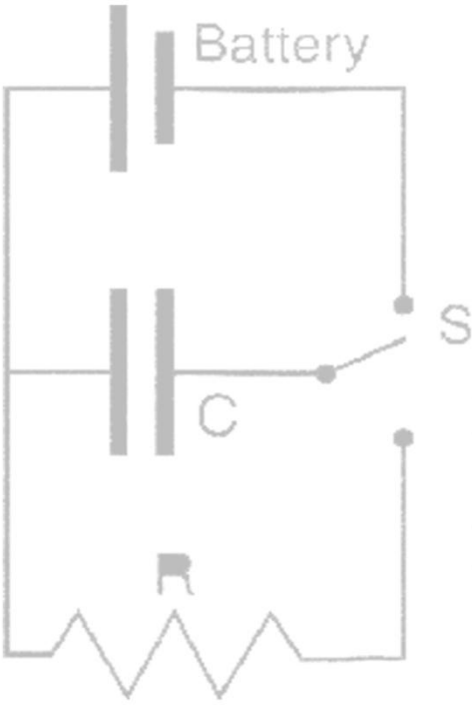
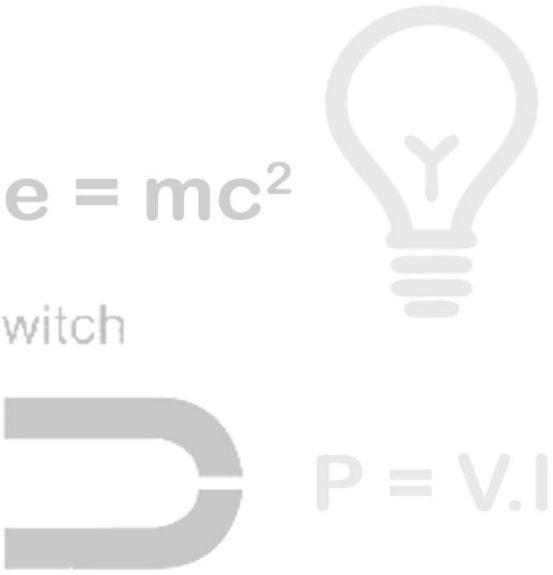
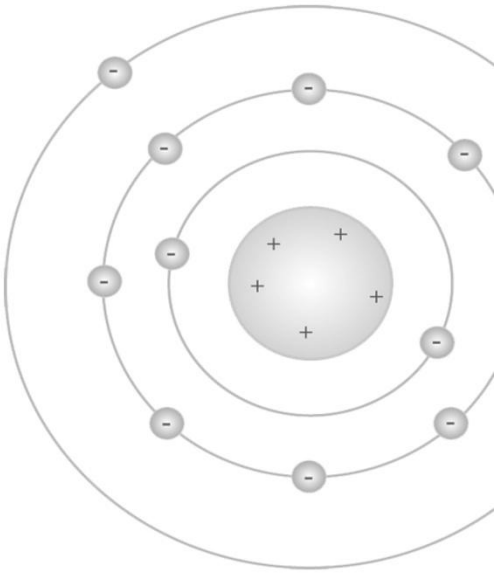
PHYSICS







Units and Measurements

Top Formulae

Mean value	$a_{mean} = (a_1 + a_2 + a_3 + \ldots + a_n)/n$ or $a_{mean} = \sum_{i=1}^{n} a_i / n$
Errors in the individual measurement values from the true value (Absolute Error)	$\Delta a_1 = a_1 - a_{mean}$ $\Delta a_2 = a_2 - a_{mean}$. = . . . = . . $\Delta a_n = a_n - a_{mean}$
Mean absolute error	$\Delta a_{mean} = (\lvert\Delta a_1\rvert + \lvert\Delta a_2\rvert + \lvert\Delta a_3\rvert + \ldots + \lvert\Delta a_n\rvert)/n$ $= \sum_{i=1}^{n} \lvert a_i\rvert / n$
Relative error	$\Delta a_{mean}/a_{mean}$
Percentage error	$\delta a = (\Delta a_{mean}/a_{mean}) \times 100\%$
Error of a sum or a difference	$\pm \Delta Z = \pm \Delta A \pm \Delta B$ or The maximum value of the error ΔZ is $\Delta A + \Delta B$.
Error of a product or a quotient	$\Delta Z/Z = (\Delta A/A) + (\Delta B/B)$
Error in case of a measured quantity raised to a power	If $Z = A^p B^q/C^r$, then $\Delta Z/Z = p(\Delta A/A) + q(\Delta B/B) + r(\Delta C/C)$

Top Concepts

- The system of units used around the world is the International System of Units or SI.
- The units for the base quantities are called fundamental or base units. The units of all other physical quantities can be expressed as a combination of base units. Such units obtained are called derived units.

Base quantity	Name	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	Mol
Luminous intensity	candela	cd

- Other physical quantities, derived from the base quantities, can be expressed as a combination of the base units and are called derived units. A complete set of units, both fundamental and derived, is called a system of units.
- In computing any physical quantity, the units of derived quantities involved in the relationship(s) are treated as algebraic quantities till the desired units are obtained.
- The apparent shift in the position of the object against the reference point in the background is called parallax.
- Parallax is caused whenever there is a change in the point of observation. The distance between the two points of observation is called the basis. Let the basis be b and the angle subtended by it at some point be θ, then the distance of the point D = $\frac{b}{\theta}$.
- The size of the molecules of a solution = volume of film/area of film
- The unit used to measure the size of the nucleus of an atom is fermi which is 10^{-15} m.
- The unit used to measure the distance between the Earth and the Sun is the astronomical unit (AU).
- The smallest value measured by an instrument is called its least count. The least count of the vernier callipers is 0.01 cm and that of the screw gauge is 0.001 cm.
- The different types of errors are absolute error, relative error and percentage error.
- True value is the mean of all the observed readings.

- The absolute error is the magnitude of the difference between the individual measured value and the true value.

  Absolute error = Measured value − True value

- The fractional error is the ratio of the mean absolute error to the true value. It is also known as relative error.

$$\text{Relative error} = \frac{\text{Mean absolute error}}{\text{True value}}$$

- Direct and indirect methods can be used for the measurement of physical quantities. In measured quantities, while expressing the result, the accuracy and precision of measuring instruments along with errors in measurements should be taken into account.

- Significant figures in measured or observed values are the number of reliable digits plus the first uncertain digit.

- Rules to identify significant figures
  i. All non-zero digits are significant. Powers of ten are not counted in significant figures. Example: 1.7×10^5 has two significant figures.
  ii. In a number with a decimal, the zeroes appearing to the left of a digit are not counted in significant figures. Example: 0.002 has only one significant figure in it.
  iii. In a number with a decimal, the number of zeroes at the end is counted in significant figures. Example: 1.700 has four significant figures.
  iv. Shifting the position of the decimal does not change the number of significant figures. Example: 2.340 and 234.0 have four significant figures.
  v. All the zeros between two non-zero digits are significant, no matter where the decimal place if at all. Examples: 203.4 cm has four significant digits, 2.05 has three significant digits.
  vi. The terminal or trailing zeros in a number without a decimal point are not significant. Thus, 125 m = 12500 cm = 125000 mm has three significant figures.

- Changing the units does not change the number of significant figures.

- Dimensions of a physical quantity are the powers (or exponents) to which the base quantities are raised to represent that quantity.

- Dimensional formula: The expression which shows how and which of the base quantities represent the dimensions of a physical quantity.

- Applications of dimensional analysis
  i. To derive a physical equation.
  ii. To verify if the given equation is dimensionally correct.
  iii. To find the dimensions of an unknown parameter in the equation.