

DIMENSIONAL ANALYSIS -1



Applications of dimensional analysis:-

- 1) Checking the Dimensional Consistency of Equations.
- 2) Deducing Relation among the Physical Quantities.

The recognition of concepts of dimensions, which guide the description of physical behaviour is of basic importance as only those physical quantities can be added or subtracted which have the same dimensions. A thorough understanding of dimensional analysis helps us in deducing certain relations among different physical quantities and checking the derivation, accuracy and dimensional consistency or homogeneity of various mathematical expressions. When magnitudes of two or more physical quantities are multiplied, their units should be treated in the same manner as ordinary algebraic symbols. We can cancel identical units in the numerator and denominator. The same is true for dimensions of a physical quantity. Similarly, physical quantities represented by symbols on both sides of a mathematical equation must have the same dimensions.

Choose correct dimensions and match them

Pressure X volume $[M^0 L^0 T^0]$

Force/ Length $[M^1 L^2 T^{-2}]$

Arc/Radius $[M^0 L^0 T^{-1}]$

Moment of inertia X angular velocity $[M^1 L^0 T^{-2}]$

0.693/ half life $[M^1 L^2 T^{-1}]$

If an equation fails this consistency test, it is proved wrong, but if it passes, it is not proved right. Thus, a dimensionally correct equation need not be actually an exact (correct) equation, but a dimensionally wrong (incorrect) or inconsistent equation must be wrong.

$$\frac{1}{2} m v^2 = m g h$$

$$m a = v^2$$

$$\frac{3}{5} m a^2 = v^2 x$$

Dimensionally consistent

Dimensionally inconsistent

Correct

wrong