Dimensional analysis

Dimension:

Dimension of a physical quantity is the numbers to be raised over fundamental quantities involved in the physical quantity.

For example: $velocity = \frac{displacement}{time} = \frac{length}{time} = \frac{L^1}{T^1} = [M^0L^1T^{-1}]$

Thus, the dimension of velocity is 0 in mass, 1 in length and -1 in time.

Fundamental units and their dimensions

SN	*Physical Quantity*	*SI unit*	*Dimension*
1	*Length*	*Meter (m)*	*[L]*
2	*Mass*	*Kilogram (kg)*	*[M]*
3	*Time*	*Second (s)*	*[T]*
4	*Temperature*	*Kelvin (K)*	*[K] or [θ]*
5	*Electric Current*	*Ampere (A)*	*[A] or [I]*
6	*Luminous Intensity*	*Candela (cd)*	*[Cd]*
7	*Amount of Substance*	*Mole (mol)*	*[N] or [mol]*

Dimensional formula:

A relation that relates a physical quantity with fundamental quantities involved in it is called as dimensional formula.

Dimensional formula is expressed in square bracket.

For example: The dimensional formula of velocity is $[M^0L^1T^{-1}]$.

Dimensional equation:

An equation which relates a physical quantity with its dimensional formula is called as dimensional equation.

'OR'

An equation (relation) written in dimensional form is called as dimensional equation.

For example: For the relation, $F = ma$,

the dimensional equation is: $[\boldsymbol{F}] = [M^1L^1T^{-2}]$

Dimension of some derived quantities:

1. $\boldsymbol{Area(A) = l^2 = [L^2] = [M^0L^2T^0]}$
2. $\boldsymbol{Volume\ (V) = l^3 = [L^3] = [M^0L^3T^0]}$
3. $\boldsymbol{Density\ (\rho) = \frac{mass(M)}{volume\ (V)} = \frac{[M]}{[L^3]} = [M^1L^{-3}] = [ML^{-3}T^0]}$
4. $\boldsymbol{velocity\ (v) = \frac{length\ (l)}{time\ (T)} = \frac{[L]}{[T]} = [LT^{-1}] = [M^0LT^{-1}]}$
5. $\boldsymbol{Acceleration\ (a) = \frac{change\ in\ velocity(\Delta v)}{time\ (t)} = \frac{[LT^{-1}]}{[T]} = [LT^{-2}] = [M^0LT^{-2}]}$
6. $\boldsymbol{Force(F) = mass(m) \times acceleration(a) = [M] \times [M^0LT^{-2}] = [MLT^{-2}]}$
7. $\boldsymbol{Work\ (W) = force\ (F) \times displacement(s) = [MLT^{-2}] \times [L] = [ML^2T^{-2}] = Dimension\ of Energy}$

   [All different forms of energy have the same dimensions as those of work]

9. $\boldsymbol{Pressure\ (P) = \frac{force(F)}{area(A)} = \frac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]}$