10. **Linear momentum (P)** = $\boldsymbol{mv} = [\boldsymbol{M}][\boldsymbol{LT^{-1}}] = [\boldsymbol{MLT^{-1}}]$

11. **Gravitational constant (G)** = $\frac{\mathbf{Fr^2}}{\boldsymbol{Mm}} = \frac{[\boldsymbol{MLT^{-2}}][\boldsymbol{L^2}]}{[\boldsymbol{M^2}]} = [\boldsymbol{M^{-1}L^3T^{-2}}]$

12. **Specific Heat Capacity (S)** = $\frac{\boldsymbol{Q}}{\boldsymbol{m\Delta\theta}} = \frac{[\boldsymbol{ML^2T^{-2}}]}{[\boldsymbol{M}][\boldsymbol{K}]} = [\boldsymbol{M^0L^2T^{-2}K^{-1}}]$

13. **Power** $(\boldsymbol{P}) = \frac{\boldsymbol{work(W)}}{\boldsymbol{time(t)}} = \frac{[\boldsymbol{ML^2T^{-2}}]}{[\boldsymbol{T}]} = [\boldsymbol{ML^2T^{-3}}]$

Quantities Having Same Dimensions

- ✓ *$[M^oL^oT^{-1}]$ = Frequency, angular frequency, angular velocity, velocity gradient.*
- ✓ *$[M^1L^2T^{-2}]$ =Work, energy, P.E, K.E, torque, moment of force*
- ✓ *$[M^1L^{-1}T^{-2}]$ =Pressure, stress, young's modules (stress/Strain), bulk modulus (Pressure/fraction change in volume), modulus of rigidity (Force/Area), energy density*
- ✓ *$[M^1L^1T^{-1}]$ =Momentum, Impulse*
- ✓ *$[M^oL^1T^{-2}]$ = g, gravitational field intensity*
- ✓ *$[M^1L^1T^{-2}]$ = Thrust, force, weight, energy gradient*
- ✓ *$[M^1L^2T^{-1}]$ = Angular momentum, plank's constant*

Dimensionless quantities:

- ✓ ***Strain, Refractive index, Relative density (Specific Gravity), Angle, Solid Angle, exponential term, Trigonometric functions***

- ✓ Numerical constants, trigonometric functions, exponential functions, logarithmic functions have no dimension - $[M^0L^0T^0]$.
- ✓ Some quantities may have unit but no dimension. For example: plane angle (unit: rad), solid angle (unit: Sr).

Principle of Homogeneity:

It states that "only the physical quantities having the same dimensions can be added or subtracted. For a correct physical equation, the dimensions on LHS and RHS are always the same." i.e.: $A + B + C = 0$,

$$Dimension\ of\ A\ =\ Dimension\ of\ B\ =\ Dimension\ of\ C$$

Example:

In an equation:$v = u + at$, the dimension of v, u and at must be the same.

Problem: The force F is given in terms of time (t) and displacement(x) by the equation $F = A\ sinBx + C\ sinDt$. What is the dimension of A, B, C, D, and D/B?

Sol^n:

From principle of homogeneity,

$$[F] = [Asin\ Bx] = [CsinDt] \text{ …. …. ….. ….. …. (1)}$$

Where, $[sinBx] = [M^0L^0T^0]$.

$[sinDt] = [M^0L^0T^0]$

$[Bx] = [M^0L^0T^0]$

$[Dt] = [M^0L^0T^0]$