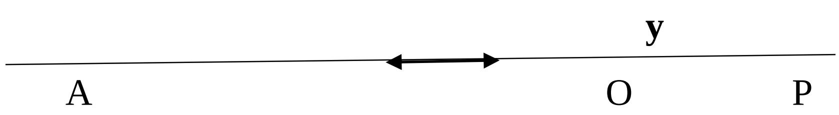
3.1 Differential Equation of simple harmonic motion(S.H.M):

A particle executing S.H.M is called a harmonic oscillator.Consider a particle of mass 'm' executes S.H.M along a straight line (as in fig).Let y be the displacement of particle from mean position at any time t.



B

The restoring force F is proportional to displacement y and oppositely directed i.e:

$$F \alpha \ -y$$

$$F = -ky \text{ -------------------------(1)}$$

k- Constant of proportionality (spring factor)

If $a = \frac{d^2y}{dt^2}$ is acceleration at any instant t

Then by Newton's second law of motion

F = mass X acceleration

= ma --(2)

From the equations (1) and (2)

$$m\frac{d^2y}{dt^2} = -ky$$

$$m\frac{d^2y}{dt^2} + ky = 0$$

$$\frac{d^2y}{dt^2} + \frac{k}{m}y = 0$$

$$\frac{d^2y}{dt^2} + \omega^2 y = 0 \text{ ---------------------------(3)}$$

Where $\omega^2 = \frac{k}{m}$ is a constant

ω is known as angular frequency.

The eqn(3) represents the differential equation of S.H.M.

The general solution of differential equation for S.H.M is given by

Y = Asin (ωt + φ)

Where A - Amplitude of the S.H.M

φ - is the initial phase.