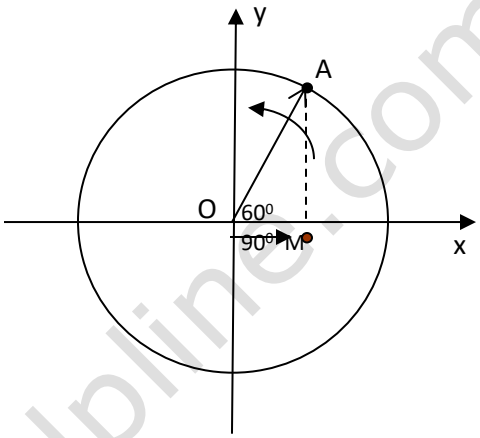
Q- A Particle M executes simple harmonic motion along x axis. The reference particle for this SHM moves on a circular path of radius R = 40 cm with a constant speed of 80 cm/s.
(a) Find the angular frequency, frequency and the time period for this SHM.
(b) If at t = 0, the reference particle makes an angle 60^0 with + x axis, write equation of motion for it.

(a) The linear speed of the reference particle is v = 80 cm/s = 0.8 m/s and the radius is R = 40 cm = 0.4 m, hence the angular frequency is given by



$\omega = v/R = 0.8/0.4 = 2$ **rad/s**.

The frequency is given by

$$n = \omega/(2\pi) = 1/\pi = 0.318 \text{ Hz}$$

and the time-period is inverse of the frequency hence given by

$$T = 1/n = \pi = 3.14 \text{ s}$$

(b)

For the particle M to be at equilibrium position x = 0 at t = 0 and moving in +x direction the reference particle should be at the lower most point at t = 0.

And the equation in that situation will be

$$X = A \sin \omega t$$

But here at t = 0, the reference particle is at point A and the phase angle corresponding to this is $90^0+60^0 = 150^0$ which will be the initial phase ϕ_0 and hence the equation for the motion of the x component is given by

$$X = A \sin (\omega t + \phi_0)$$

Or $x = (0.4\text{m}) \sin [(2 \text{ rad/s}) t + 150^0]$

Or $x = (0.4\text{m}) \cos [(2 \text{ rad/s}) t + 60^0]$

Or $x = (0.4\text{m}) \cos [(2 \text{ rad/s}) t + \pi/3]$