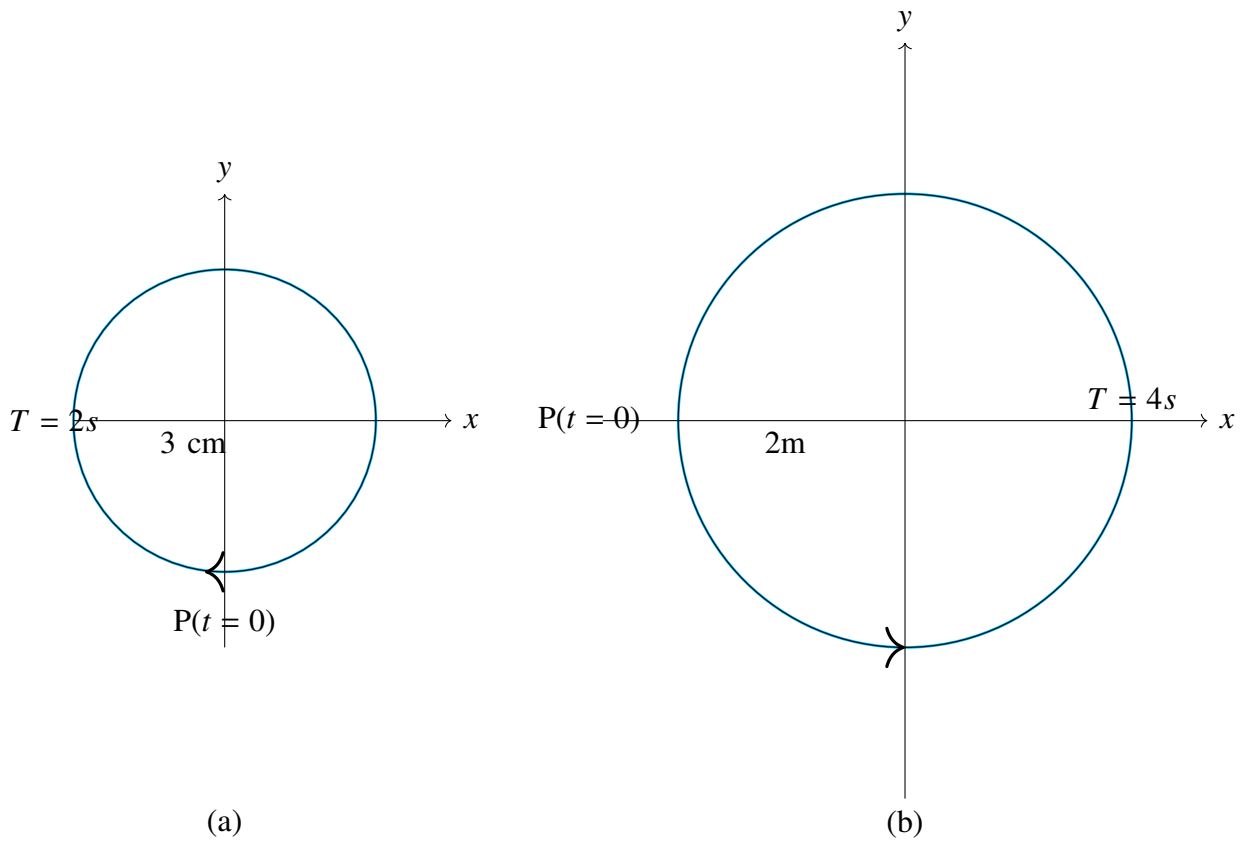
Q: Figures correspond to two circular motions. The radius of the circle, the period of revolution, the initial position and the sense of revolution(i.e. clockwise or anti-clockwise) are indicated on each figure. Obtain the corresponding simple harmonic motions of the x-projections of the radius vector of resolving particle P in each case.




(a) (b)

**Solution:**

| Parameter | (a) | (b) |
|---|---|---|
| Radius(r) | 3cm | 2m |
| Time Period(T) | 2s | 4s |
| Sense | clockwise | anti-clockwise |
| Initial Phase($\phi$) | $\frac{\pi}{2}$ | $\pi$ |

TABLE I
INPUT PARAMETERS TABLE

Given $\left(r\right)$ as radius vector making angle $\theta$ with positive x-axis, its x-projection = $\left(r\right)\cos\theta$

a. At $t = 0$, the radius vector makes an angle $\frac{\pi}{2}$ with the positive x-axis, $\phi = \frac{\pi}{2}$,
From Table I, equation of x-projection of radius:

$$x(t) = r\cos\left(\frac{2\pi}{T}t + \phi\right) \tag{1}$$

$$= 3\cos\left(\frac{2\pi}{2}t + \frac{\pi}{2}\right) \tag{2}$$

$$= -3\sin\left(\pi t\right)\text{cm} \tag{3}$$

b. Similarly,

At $t = 0$, radius vector makes an angle $\pi$ with x-axis in anti-clockwise direction, $\phi = \pi$,

$$x(t) = r\cos\left(\frac{2\pi}{T}t + \phi\right) \tag{4}$$

$$= 2\cos\left(\frac{2\pi}{4}t + \pi\right) \tag{5}$$

$$= -2\cos\left(\frac{\pi}{2}t\right)\text{m} \tag{6}$$