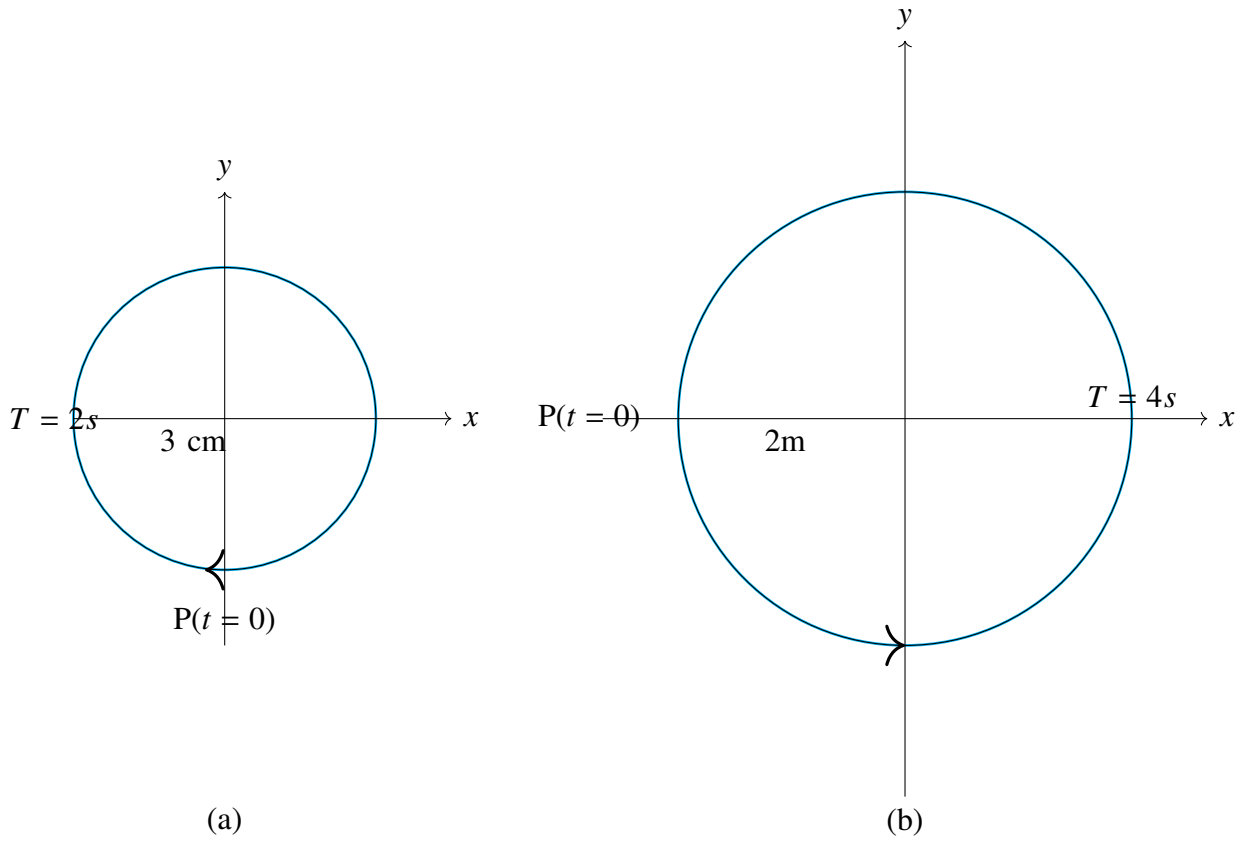
Q: Figures correspond to two circular motions. The radius of the circle, the period of revolution, the initial position and the sense of revolution(i.e. clockwise or anti-clockwise) are indicated on each figure. Obtain the corresponding simple harmonic motions of the x-projections of the radius vector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



Solution:

Parameter	Value(a)	Value(b)	Description
Radius(r)	3cm	2m	Radius of each circle
Time Period(T)	2s	4s	Time period
Sense	clockwise	anti-clockwise	Indicated by arrow
Initial Phase(ϕ)	$\frac{\pi}{2}$	π	Initial angle with x-axis

TABLE I
INPUT PARAMETERS TABLE

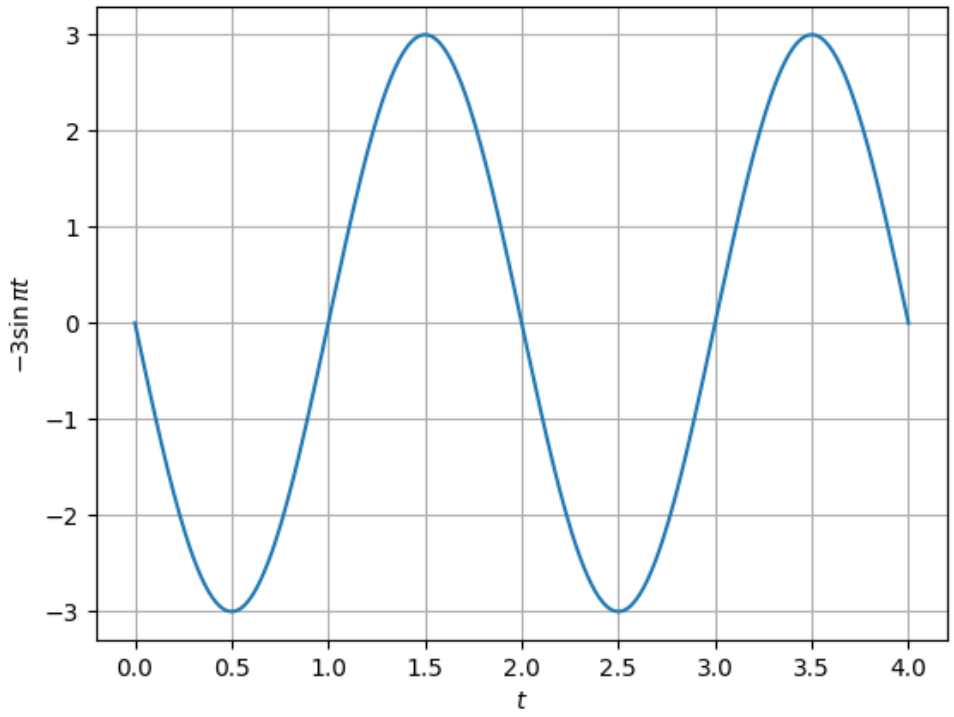
Given $\left(r\right)$ as radius vector making angle θ with positive x-axis, its x-projection = $\left(r\right)\cos\theta$

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:

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

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

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

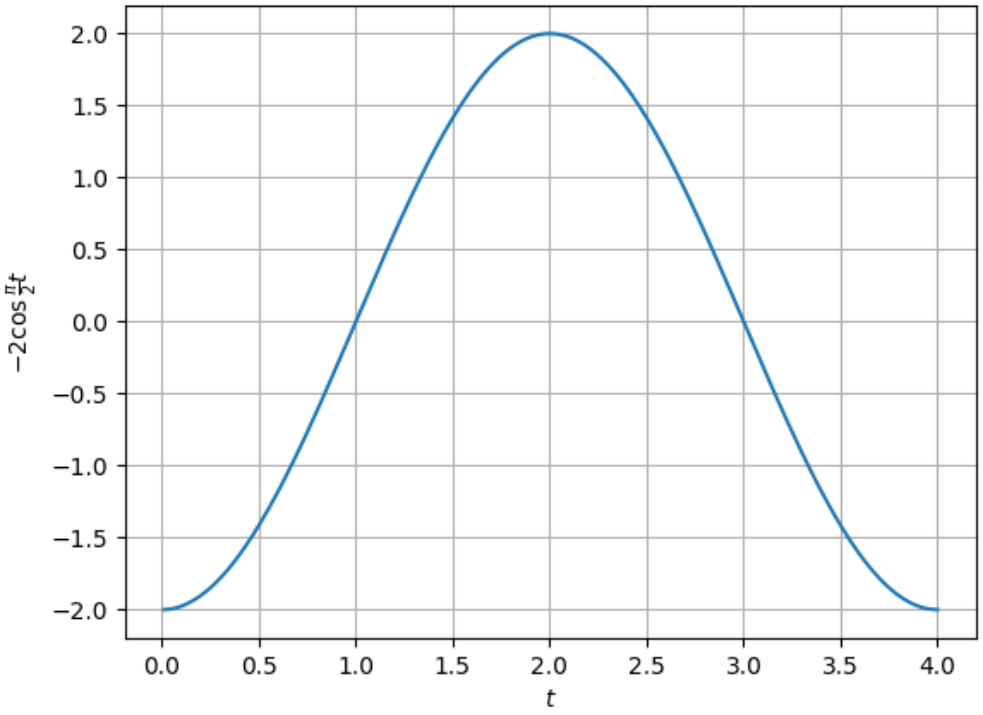


b. Similarly,
At $t = 0$, radius vector makes an angle π with x-axis in anti-clockwise direction, $\phi = \pi$,

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

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

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


2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
$-2\cos\frac{\pi}{2}t$
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
t