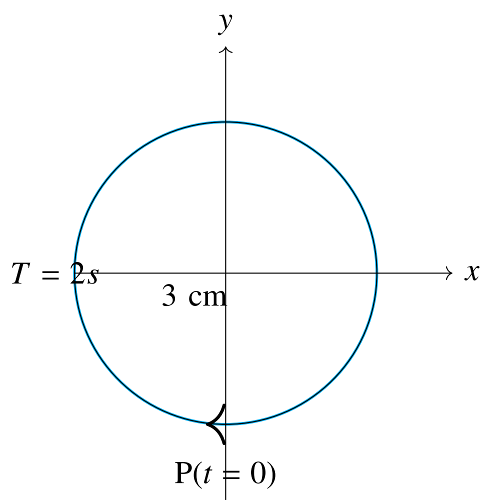
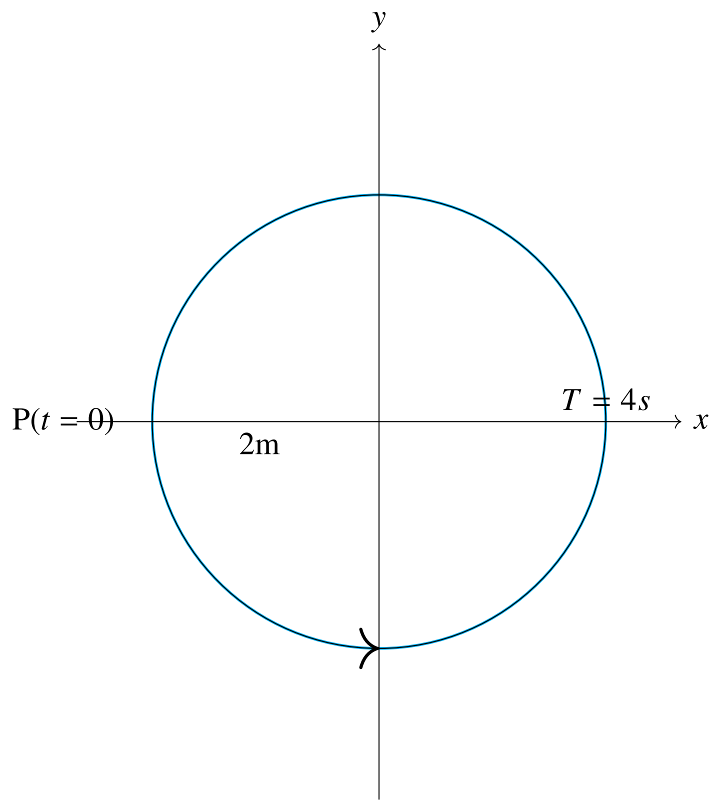
Q: Figures correspond to two circular motions. The radius of the circle, the period of revolution, the initial position and the sense of revolution(i.e. clockwise or anti-clockwise) are indicated on each figure. Obtain the corresponding simple harmonic motions of the x-projections of the radius vector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



(a)



(b)

Solution:

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

TABLE I
INPUT PARAMETERS TABLE

a. From Table I, Equation of x-projection of radius:

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

$$= 3\sin(\frac{2\pi}{2}t + \pi) \tag{2}$$

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

$$\mathcal{L}(x(t)) = \int_0^\infty -3sin(\pi t)e^{-st}\,ds \tag{4}$$

$$= \frac{-3}{2j}\int_0^\infty e^{-(s-j\pi)t} - e^{-(s+j\pi)t}\,ds \tag{5}$$

$$X(s) = \frac{-3\pi}{s^2 + \pi^2} \tag{6}$$

b. Similarly,

$$x(t) = r\sin(\frac{2\pi}{T}t + \phi) \tag{7}$$

$$= 2\sin(\frac{2\pi}{4}t + \frac{\pi}{2}) \tag{8}$$

$$= 2\cos(\frac{\pi}{2}t)\text{cm} \tag{9}$$

$$\mathcal{L}(x(t)) = \int_0^\infty 2\cos(\frac{\pi}{2}t)e^{-st}\,ds \tag{10}$$

$$= \frac{1}{j}\int_0^\infty e^{-(s-j(\frac{\pi}{2}))t} - e^{-(s+j(\frac{\pi}{2}))t}\,ds \tag{11}$$

$$X(s) = \frac{8s}{4s^2 + \pi^2} \tag{12}$$