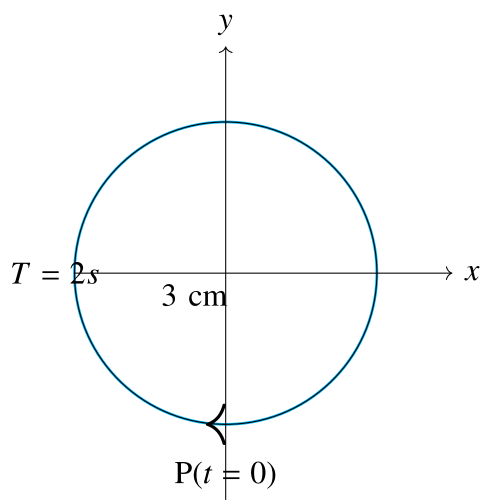
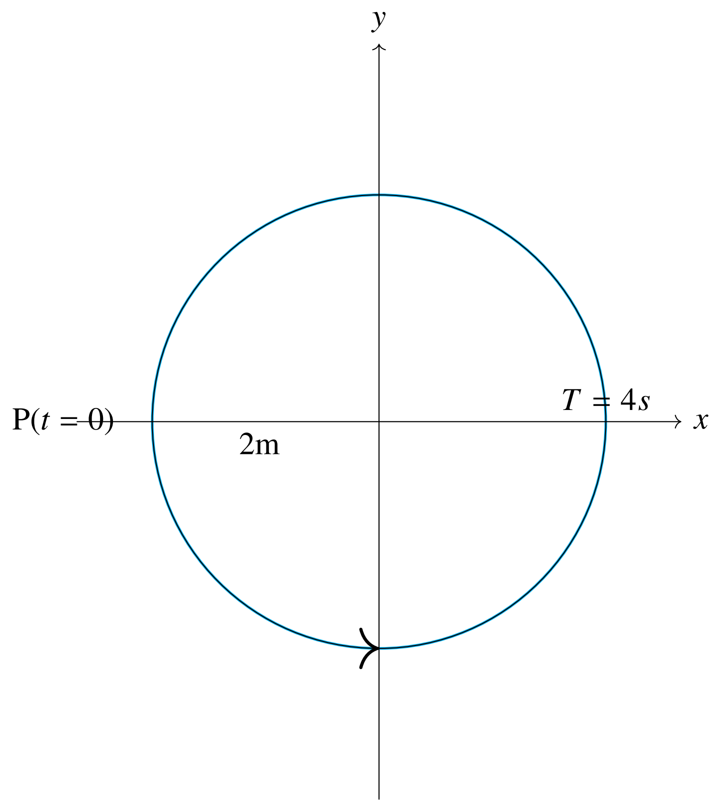
Q: Figures correspond to two circular motions. The radius of the circle, the period of revolution, the initial position and the sense of revolution(i.e. clockwise or anti-clockwise) are indicated on each figure. Obtain the corresponding simple harmonic motions of the x-projections of the radius vector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

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

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

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

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

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

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

b. Similarly,

$$
\begin{aligned}
x(t) &= r\sin(\frac{2\pi}{T}t+\phi) && (7)\\
&= 2\sin(\frac{2\pi}{4}t+\frac{\pi}{2}) && (8)\\
&= 2\cos(\frac{\pi}{2}t)\mathrm{cm} && (9)\\
\mathcal{L}(x(t)) &= \int_0^\infty 2\cos(\frac{\pi}{2}t)e^{-st} && (10)\\
&= \frac{1}{i}\int_0^\infty e^{-(s-i(\frac{\pi}{2}))t} - e^{-(s+i(\frac{\pi}{2}))t} && (11)\\
X(s) &= \frac{8s}{4s^2+\pi^2} && (12)
\end{aligned}
$$