Answer on Question #50225, Physics, Mechanics | Kinematics | Dynamics

Find the radial and transverse components of acceleration of a particle moving along the circle $x^2 + y^2 = a^2$ with a constant velocity c.

Solution:

Given that

$$\frac{d\theta}{dt} = c$$

Differentiate w.r.t "t" we get

$$\frac{d^2\theta}{dt^2} = 0$$

Also given that

$$x^2 + y^2 = a^2$$

First we change this into polar form by putting $x = r\cos\theta$ and $y = r\sin\theta$

$r^2\cos^2\theta + r^2\sin^2\theta = a^2$

⇨ $r^2(\cos^2\theta + \sin^2\theta) = a^2$

⇨ $r^2 = a^2$

⇨ $r = a$

⇨ $\frac{dr}{dt} = 0$ =>$\frac{d^2r}{dt^2}$=0

Radial component of acceleration = $a_r = \frac{d^2r}{dt^2} - r(\frac{d\theta}{dt})^2 = 0 - ac^2 = -ac^2$

Transverse component of acceleration = $a_\theta = 2\frac{dr}{dt}\left(\frac{d\theta}{dt}\right) + r\frac{d^2\theta}{dt^2} = 0$