

Answer on Question #56925-Physics-Mechanics-Relativity

A particle of mass 3 kg is rotating in a circle of radius 1 m such that the angle rotated by its radius is given by $\theta = 3(t + \sin t)$. Find the net force acting on the particle when $t = \pi/2$

Solution

The net force is

$$\vec{F} = mr\vec{\alpha} + m\vec{r}\omega^2.$$

$$\alpha = \frac{d^2}{dt^2}\theta = \frac{d^2}{dt^2}3(t + \sin t) = -3\sin t.$$

$$\left|\alpha\left(\frac{\pi}{2}\right)\right| = 3\sin\left(\frac{\pi}{2}\right) = 3.$$

$$\omega^2 = \frac{d}{dt}\theta = \frac{d}{dt}3(t + \sin t) = 3(1 + \cos t).$$

$$\omega^2\left(\frac{\pi}{2}\right) = \left(3\left(1 + \cos\frac{\pi}{2}\right)\right)^2 = 3^2 = 9.$$

$$F = 3 \cdot 1 \cdot \sqrt{3^2 + 9^2} = 9\sqrt{10} \text{ N}.$$

Answer: $9\sqrt{10}$ N.

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