Answer on Question #39382, Physics, Other

Question:

The displacement of a particle executing SHM is given by

x(t) = 6sin5(pi)t + 8cos5(pi)t

where x is in cm and t is in seconds. Calculate the amplitude, time period and initial phase of the SHM. Also, obtain the expression for the velocity of the particle.

Answer:

$$x(t) = 6\sin 5\pi t + 8\cos 5\pi t$$

$$x(t) = 10\left(\frac{1}{10}6\sin 5\pi t + \frac{1}{10}8\cos 5\pi t\right) = 10\left(\frac{3}{5}\sin 5\pi t + \frac{4}{5}\cos 5\pi t\right)$$

$$\frac{3}{5} = \cos\varphi \ \ and \ \ \frac{4}{5} = \sin\varphi$$

where $\varphi = \arctan\frac{4}{3}$

Therefore:

$$x(t) = 10(\cos\varphi \sin 5\pi t + \sin\varphi \cos 5\pi t) = 10\sin(5\pi t + \varphi)$$

Therefore amplitude equals:

$$A = 10\ cm$$

and initial phase equals:

$$\varphi = \arctan\frac{4}{3} \cong 53.13°$$

time period equals:

$$T = \frac{2\pi}{5\pi} = 0.4\ s$$

velocity of the particle equals:

$$v = \frac{dx}{dt} = \frac{d}{dt}(10\sin(5\pi t + \varphi)) = 50\pi\cos(5\pi t + \varphi)$$