

CURVILINEAR MOTION

PROB. 11-90

$$x = 2 \cos \pi t, \quad y = 1 - 4 \cos 2\pi t$$

$$[x] = m, \quad [y] = m, \quad [t] = s$$

SHOW THAT THE PARTICLE FOLLOWS $y = 5 - 2x^2$
 DETERMINE v AND a AT $t = 0$ and ~~1.5~~ 1.5^s

$$\vec{r} = (x)\hat{i} + (y)\hat{j}$$

$$\vec{v} = \frac{d\vec{r}}{dt} = \left(\frac{dx}{dt}\right)\hat{i} + \left(\frac{dy}{dt}\right)\hat{j}$$

$$\vec{a} = \frac{d\vec{v}}{dt} = \left(\frac{d^2x}{dt^2}\right)\hat{i} + \left(\frac{d^2y}{dt^2}\right)\hat{j}$$

$$\frac{dx}{dt} = -2\pi \sin \pi t, \quad \frac{d^2x}{dt^2} = -2\pi^2 \cos \pi t$$

$$\frac{dy}{dt} = 8\pi \sin 2\pi t, \quad \frac{d^2y}{dt^2} = 16\pi^2 \cos 2\pi t$$

$$\vec{v} = (-2\pi \sin \pi t)\hat{i} + (8\pi \sin 2\pi t)\hat{j} \quad \frac{m}{s}$$

$$\vec{a} = (-2\pi^2 \cos \pi t)\hat{i} + (16\pi^2 \cos 2\pi t)\hat{j} \quad \frac{m}{s^2}$$

@ $t = 0$,

$$\vec{v} = (0)\hat{i} + (0)\hat{j} \quad \boxed{= 0}$$

$$\vec{a} = (-2\pi^2)\hat{i} + (16\pi^2)\hat{j} \quad \boxed{|\vec{a}| = 159 \frac{m}{s^2}, \quad \theta = 97.1^\circ}$$

@ $t = \frac{3}{2}^s$,

$$\vec{v} = \left(-2\pi \sin \frac{3\pi}{2}\right)\hat{i} + \left(8\pi \sin 3\pi\right)\hat{j}$$

PROB. 11-90 CONT.

$$\vec{v} = (2\pi) \hat{i}, \quad \boxed{|\vec{v}| = 6.28 \frac{m}{s}, \quad \theta = 0^\circ}$$

$$\vec{a} = \left(-2\pi^2 \cos \frac{3\pi}{2}\right) \hat{i} + \left(16\pi^2 \cos 3\pi\right) \hat{j}$$

$$\vec{a} = (-16\pi^2) \hat{j}$$

$$\boxed{|\vec{a}| = 158 \frac{m}{s^2}, \quad \theta = 270^\circ}$$