

CURVILINEAR MOTION

MECHAN PROB. 11-89.

$$\left. \begin{aligned} x &= 4t^3 - 5t^2 + 5t \\ y &= 5t^2 - 15t \end{aligned} \right\} [x] = \text{mm}, [y] = \text{mm}, [t] = \text{s}$$

FIND \vec{v} AND \vec{a} @ $t = 1^{\text{s}}$ AND $t = 2^{\text{s}}$

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

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

$$\frac{dx}{dt} = 12t^2 - 10t + 5$$

$$\frac{dy}{dt} = 10t - 15$$

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

$$\frac{d^2x}{dt^2} = 24t - 10$$

$$\frac{d^2y}{dt^2} = 10$$

@ $t = 1^{\text{s}}$

$$\frac{dx}{dt} = 12 - 10 + 5 = 7 ; \quad \frac{dy}{dt} = 10 - 15 = -5$$

$$\vec{v} = (7)\hat{i} + (-5)\hat{j} \quad \frac{\text{mm}}{\text{s}}$$

$$|\vec{v}| = \sqrt{7^2 + 5^2} = 8.602 \frac{\text{mm}}{\text{s}}$$

$$\theta = \text{TAN}^{-1}\left(\frac{-5}{7}\right) = -35.5^\circ$$

PROB. 11-89 CONT.

$$\frac{d^2x}{dt^2} = 24 - 10 = 14; \quad \frac{d^2y}{dt^2} = 10$$

$$\vec{a} = (14)\hat{i} + (10)\hat{j} \frac{\text{mm}}{\text{s}^2}; \quad |\vec{a}| = 17.20 \frac{\text{mm}}{\text{s}^2}, \quad \theta = 35.5^\circ$$

@ $t = 2^s$,

$$\frac{dx}{dt} = 12(2)^2 - 10(2) + 5 = 33; \quad \frac{dy}{dt} = 10(2) - 15 = 5$$

$$\vec{v} = (33)\hat{i} + (5)\hat{j} \frac{\text{mm}}{\text{s}}; \quad |\vec{v}| = 33.4 \frac{\text{mm}}{\text{s}}, \quad \theta = 8.62^\circ$$

$$\frac{d^2x}{dt^2} = 24(2) - 10 = 38; \quad \frac{d^2y}{dt^2} = 10$$

$$\vec{a} = (38)\hat{i} + (10)\hat{j} \frac{\text{mm}}{\text{s}^2}$$

$$|\vec{a}| = 39.3 \frac{\text{mm}}{\text{s}^2}, \quad \theta = 14.7^\circ$$