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Course: ENG Math

Subject: Mechanics

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$$x = \cos t + t \sin t$$

$$y = \sin t - t \cos t$$

$$\frac{dx}{dt} = -\sin t + (\cos t + t \sin t)$$

$$\frac{dy}{dt} = \cos t - (-t \sin t + \cos t)$$
$$= \cos t + t \sin t - \cos t$$

$$\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx} = \cos t + t \sin t - \cos t \times \frac{1}{-\sin t + (\cos t + t \sin t)}$$

$$\frac{dy}{dx} = \frac{t \sin t}{t \cos t}$$

$$\frac{dy}{dx} = \frac{\sin t}{\cos t}$$

$$\frac{dy}{dx} = \tan t$$

$$\frac{d^2y}{dx^2} = \sec^2 t$$

$$s = \frac{ds}{dx} \left[1 + \left(\frac{dy}{dx} \right)^2 \right]^{\frac{1}{2}}$$

$$= \frac{ds}{dx} = \frac{\sec^2 t}{(1 + (\tan t)^2)^{\frac{1}{2}}} = \frac{\sec^2 t}{1 + (\tan t)^2}$$
$$= \frac{\sec^2 t}{\sec^2 t} = 1$$
$$\frac{ds}{dx} = \frac{1}{\sec^2 t}$$

$$R = \frac{1}{\cos \theta} = \sec \theta$$

$$h = x - R \sin \theta$$

$$= \cos t + t \sin t - \sec t \sin \theta$$

$$\frac{dy}{dx} = \tan t$$

$$\tan \theta = \tan t$$

$$\theta = t$$

$$= \cos t + t \sin t - \sec t \sin t$$

$$h = \cos t + t \sin t - t \sec t \sin t$$

$$k = \sin t - t \cos t + \sec t \cos t$$

$$\therefore h = \cos t + t \sin t - t \sec t \sin t$$

$$\text{and } k = \sin t - t \cos t + \sec t \cos t$$