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200 level

Maths assignment

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

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

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

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

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

$$\frac{dy}{dt} = t \sin t$$

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

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

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

$$\frac{dx}{dt} = t \cos t$$

$$\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx} = \frac{t \sin t}{t \cos t} = \tan t$$

$$\frac{d^2y}{dx^2} = \frac{d(\tan t)}{dt} \times \frac{dt}{dx}$$

$$\frac{d^2y}{dx^2} = \sec^2 t \times \frac{1}{t \cos t}$$

$$= \frac{1}{t} \times \frac{1}{\cos^3 t} = t^{-1} \sec^3 t$$

$$\therefore \frac{d^2y}{dx^2} = t^{-1} \sec^3 t$$

$$R = \left(1 + \left(\frac{dy}{dx} \right)^2 \right)^{3/2}$$

$$\frac{\left(1 + (\tan t)^2 \right)^{3/2}}{t^{-1} \sec^3 t}$$

$$R = \frac{(1 + \tan^2 t)^{3/2}}{t^{-1} \sec^3 t}$$

$$R = \frac{(\sec t)^{2+3/2}}{t^{-1} \sec^3 t}$$

$$R = \frac{(\sec t)^3}{t^{-1} (\sec t)^3} = t^1 = \underline{\underline{t \text{ units}}}$$

Centre of Curvature

$$x_1 = h + R \sin \theta$$

$$h = x_1 - R \sin \theta$$

$$k = y_1 + R \cos \theta$$

$$\theta = \tan^{-1} \left[\frac{dy}{dx} \right]$$

$$\theta = \tan^{-1} [\tan t]$$

$$\theta = t$$

$$x_1 = \cos t + \sin t$$

$$h = \cos t + \sin t - (t)(\sin t)$$

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

$$\underline{h = \cos t}$$

$$k = y_1 + R \cos \theta$$

$$y_1 = \sin t - t \cos t$$

$$k = \sin t - t \cos t + (t) \cos t$$

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

$$k = \sin t$$

Centre of curvature =

$$\underline{\underline{\cos t, \sin t}}$$