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

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

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

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

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

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

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

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

$\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt}$

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

$\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{t\sin t}{t\cos t}\right) \cdot \frac{dt}{dx} = \frac{\frac{du}{dx}v - u\frac{dv}{d}}{v^2}$

$=$

$$\frac{d^2y}{dx^2} = \frac{d(\tan t)}{dt} \times \frac{dt}{dt}$$ [from, $\frac{dx}{dt} = t\cos t$ ∴ $\frac{dt}{dx} = \frac{1}{t\cos t}$]

$= \sec^2 t \times \frac{1}{t\cos t}$ But se

$= \sec^2 t \times \frac{1}{t} \times \frac{1}{\cos t}$ [But $\frac{1}{\cos t} = \sec t$]

$= \sec^2 t \times t^{-1} \times \sec t \Rightarrow t^{-1}\sec^3 t$

from, $\frac{1}{R} = \frac{\frac{d^2y}{dx^2}}{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}$ ∴ $R = \frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\frac{d^2y}{dx^2}}$

$$R = \frac{\left[1+(\tan t)^2\right]^{\frac{3}{2}}}{t^{-1}\sec^3 t}$$

$$= \frac{\left[1+\tan^2 t\right]^{\frac{3}{2}}}{\sec^3 t} \times t$$

$$= \frac{(\sec^2 t)^{\frac{3}{2}}}{\sec^3 t} \times t \Rightarrow \frac{(\sec t)^{2\times\frac{3}{2}}}{(\sec t)^3} \times t$$

∴ $R = t$ units

Coordinates of centre of curvature, (h, K):

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

$K = y_1 + R\cos\theta$ where, $R = t$ & $\theta = t$

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

∴ $h = \cos t$

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

∴ $K = \sin t$ ∴ $(h, K) = (\cos t, \sin t)$