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

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

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

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

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

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

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

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

$\therefore \dfrac{dy}{dx} = \dfrac{dy}{dt} \div \dfrac{dx}{dt} = \dfrac{\cancel{t}\sin t}{\cancel{t}\cos t} = \dfrac{\sin t}{\cos t}$

$$\frac{d^2y}{dx^2} = \frac{d}{dx}\left(\frac{dy}{dx}\right) = \frac{d}{dt}\left(\frac{dy}{dx}\right)\frac{dt}{dx}$$

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

$$= \frac{V\frac{du}{dx} - U\frac{dv}{dx}}{v^2}$$

$$= \frac{V\frac{du}{dt} - U\frac{dv}{dt}}{v^2}$$

where $u = \sin t$, $v = \cos t$.

$\dfrac{du}{dt} = +\cos t$, $\dfrac{dv}{dt} = -\sin t$

$$\frac{d^2y}{dx^2} = \frac{\cos t(\cos t) - \sin t(-\sin t)}{\cos^2 t}$$

$$= \frac{\cos^2 t + \sin^2 t}{\cos^2 t}$$

Recall $\cos^2 t + \sin^2 t = 1$

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

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

B

Recall $R = \dfrac{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2}}{d^2y/dx^2}$

$$R = \left[1 + \left(\frac{\sin t}{\cos t}\right)^2\right]^{3/2} \div \frac{d^2y}{dx^2}$$

$$R = \left[\frac{1}{1} + \frac{\sin^2 t}{\cos t}\right]^{3/2} \times \frac{t\cos^3 t}{1}.$$

$$R = \left[\frac{\cos^2 t + \sin^2 t}{\cos^2 t}\right]^{3/2} \times t\cos^3 t.$$

$$R = \left(\frac{1}{\cos^2 t}\right)^{3/2} \times t\cos^3 t = \frac{1}{(\cos t)^{2 \times 3/2}} \times t\cos^3 t.$$

$$R = \frac{1}{\cos^3 t} \times t\cos^3 t = t. \quad \therefore R = t.$$

For the Coordinate (h, k) of the centre of curvature. Recall $h = x - R\sin\theta$

$k = y + R\cos\theta$

where $R = t$.

$$\theta = \tan^{-1}\left[dy/dx\right] = \tan^{-1}(\tan t) = t.$$

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

$h = \cos t.$

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

$k = \sin t$

The Co-ordinates for the Centre of Curvature are $(\cos t, \sin t)$

$\therefore I_{yy} =$

Similarly,

$I_{xx} = \Sigma \partial A y^2 = \int_A \partial A y^2$

Moment of Inertia to Simple Area.

Moment of Inertia

$I = \frac{bd^3}{}$, $I_{yy} = \frac{b^3 d}{12}$