Name: Alawode [illegible] Dept ELECT/ELECT MATRIC No: [illegible]

The parametric equation of a curve are as given in equation 1 & 2

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

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

In terms of t, determine

i) an expression for the radius of curvature (R) and

ii) expression for the co-ordinates (h, k) of the centre of curvature (R) and ...

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

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

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

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

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

$$= t\cos t$$

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

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

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

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

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

$$R = \frac{\left(1 + (dy/dx)^2\right)^{3/2}}{d^2y/dx^2} = \frac{(1 + (\tan t)^2)^{3/2}}{t^{-1}\sec^3 t}$$

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

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

Centre of curvature:

$x = h + R\sin\theta$

$k = y_1 + R\cos\theta$

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

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

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

$\theta = \tan^{-1}(dy/dx)$

$\theta = \tan^{-1}(\tan t)$

$\theta = 1$

$k = y + R\cos\theta$

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

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

$k = \sin t - \cancel{t\cos t} + \cancel{t\cos t}$

$k = \sin t$

Centre of curvature $= (\cos t, \sin t)$

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i) an expression for the radius of curvature (R) and

ii) expression for the co-ordinates (h, k) of the centre of curvature (C) [illegible]

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

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

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

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$$R = \frac{\left(1 + (dy/dx)^2\right)^{3/2}}{d^2y/dx^2} = \frac{\left(1 + (\tan t)^2\right)^{3/2}}{t^{-1}\sec^3 t}$$