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

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

$\sigma = \frac{\sec^2 t}{[1 + \tan^2 t]^{3/2}}$

$\sigma = \frac{1}{R}$

$R = \frac{[1+\tan^2 t]^{3/2}}{\sec^2 t}$ $\quad 1 + \tan^2 t = \sec^2 t$

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

(h, k) $\quad R = \frac{\sec^3 t}{\sec^2 t}$

$R = \sec t$

(ii) $h = x - R\sin\alpha$

$k = y + R\cos\alpha$ $\quad$ i.e $dy/dx = \tan\alpha$

$\tan\alpha = \tan t$

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

$\alpha = t$

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

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

$K = (\sin t - t\cos t) + \sec t \cos t$

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

The co-ordinates $(H, K) = (\cos t + \sin t - \tan t,$
$\sin t - t\cos t)$

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Assignment

(1) The parametric equations of a curve are as given in equations (i) and (ii)

$x = \cos t + t\sin t$ —— (i)

$y = \sin t - t\cos t$ —— (ii)

In terms of t determine

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

(ii) expressions for the co-ordinates (h, k) of the centre of curvature

Solution

(i) $x = \cos t + t\sin t$ —— (1)

$y = \sin t - t\cos t$ —— (2)

solution

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

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

$dx/dt = t\cos t$

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

$dy/dt = \cos t - [-t\sin t + \cos t]$

$dy/dt = \cos t + t\sin t - \cos t$

$dy/dt = t\sin t$

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

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

$dy/dx = \tan t$

Use these vertical line markers to create columns, grids and tables.