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Course: Mat 104 (CO)

1) $y + \sin\left(\frac{6}{x^2}\right)$

Let $u = 6/x^2$ ...(i)

$\cancel{\Delta y = \sin u}$ $y = \sin u$

$y + \Delta y = \sin(u + \Delta u)$

$\Delta y = \sin(u + \Delta u) - y$

$\Delta y = \sin(u + \Delta u) - \sin u$

$\Delta y = 2\cos\left(\frac{2u + \Delta u}{2}\right) \cdot \sin\left(\frac{\Delta u}{2}\right)$

$$\frac{\Delta y}{\Delta u} = \frac{2\cos\left(\frac{2u + \Delta u}{2}\right) \cdot \sin\left(\frac{\Delta u}{2}\right) \times \frac{1}{2}}{\Delta u/2}$$

$$\frac{\Delta y}{\Delta u} = \cos\left(\frac{2u + \Delta u}{2}\right) \cdot \frac{\sin\left(\frac{\Delta u}{2}\right)}{\Delta u/2}$$

$$\lim_{\Delta u \to 0}\left(\frac{\Delta y}{\Delta u}\right) = \lim_{\Delta u \to 0}\left[\cos\frac{(2u + \Delta u)}{2}\right] \lim_{\Delta u \to 0}\left[\frac{\sin(\Delta u/2)}{\Delta u/2}\right]$$

$\frac{dy}{du} = \cos u$

from equation (i); $u = 6/x^2$

$u + \Delta u = \frac{6}{(x + \Delta x)^2}$

2) $x = 4t^3 - t^2$, $y = t^4 + 2t^2$

$\frac{dx}{dt} = 12t^2 - 2t$, $dx = (12t^2 - 2t)dt$

Let A represent the area

$A = \int_1^3 y\,du$

$A = \int_1^3 (t^4 + 2t^2)(12t^2 - 2t)\,dt$

$A = \int_1^3 (12t^6 - 2t^2 + 24t^4 - 4t^3)\,dt$

$\Rightarrow \left[\frac{12t^7}{7} - \frac{t^6}{3} + \frac{24t^5}{5} - t^4 + C\right]_1^3$

$\left(\frac{26244}{7} - 243 + \frac{5832}{5} - 81\right) - \left(\frac{12}{7} - \frac{1}{3} + \frac{24}{5} - 1\right)$

$= \frac{160704}{35} - \frac{544}{105}$

$A = 4586.36$ sq units

3) $x = 4t^3 - t^2$, $y = t^4 + 2t^2$

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

$\frac{dy}{dx} = 4t^3 - 4t$

$\frac{dx}{dt} = 12t^2 - 2t$, $\frac{dt}{dx} = \frac{1}{12t^2 - 2t}$

$\frac{dy}{dx} = \frac{4t^3 - 4t}{12t^2 - 2t} = \frac{4t(t^2 - 1)}{2t(6t - 1)}$

$\frac{dy}{dx} = \frac{2(t^2 - 1)}{6t - 1}$