

(1) [2 points] Differentiate

$$g(t) = t^3 \cos(t)$$

$$g'(t) = 3t^2 \cos(t) - t^3 \sin(t)$$

(2) [3 points] Differentiate

$$y = \frac{t^2}{3t^2 - 2t + 1}$$

$$\begin{aligned} y' &= \frac{(3t^2 - 2t + 1)(2t) - (t^2)(6t - 2)}{(3t^2 - 2t + 1)^2} \\ &= \frac{\cancel{6t^3} - 4t^2 + 2t - \cancel{6t^3} + 2t^2}{(3t^2 - 2t + 1)^2} \\ &= \frac{2t - 2t^2}{(3t^2 - 2t + 1)^2} \end{aligned}$$

(3) [2 points] Differentiate

$$y = \sqrt{\sin(x)} = [\sin(x)]^{\frac{1}{2}}$$

$$\frac{dy}{dx} = \frac{1}{2} [\sin(x)]^{-\frac{1}{2}} \cdot \cos(x)$$

(4) [3 points] Differentiate

$$F(z) = \sqrt{\frac{z-1}{z+1}} = \left[\frac{z-1}{z+1} \right]^{\frac{1}{2}}$$

$$\begin{aligned} F'(z) &= \frac{1}{2} \left[\frac{z-1}{z+1} \right]^{-\frac{1}{2}} \cdot \left[\frac{(z+1)(1) - (z-1)(1)}{(z+1)^2} \right] \\ &= \frac{1}{2} \left[\frac{z-1}{z+1} \right]^{-\frac{1}{2}} \cdot \left[\frac{2}{(z+1)^2} \right] \end{aligned}$$

(5) [5 points] Differentiate

$$y = \sec^2 x + \tan^2 x$$

$$\begin{aligned} \frac{dy}{dx} &= 2(\sec x)(\sec x)(\tan x) + 2(\tan x)(\sec^2 x) \\ &= 4(\sec^2 x)(\tan x) \end{aligned}$$