

(1) [2 points] Differentiate

$$h(\theta) = \theta \csc(\theta) - \cot(\theta)$$

$$h'(\theta) = \csc(\theta) - \theta \csc(\theta) \cot(\theta) + \csc^2(\theta)$$

(2) [3 points] Differentiate

$$y = \frac{\sin(x)}{x^2}$$

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

$$= \frac{x^2 \cos(x) - 2x \sin(x)}{x^4}$$

(3) [2 points] Differentiate

$$y = \sin(4x)$$

$$y' = \cos(4x) \cdot 4$$

(4) [3 points] Differentiate

$$y = \frac{r}{\sqrt{r^2+1}} = r[r^2+1]^{-\frac{1}{2}}$$

$$\begin{aligned}\frac{dy}{dr} &= [r^2+1]^{-\frac{1}{2}} + r \left(-\frac{1}{2}\right) [r^2+1]^{-\frac{3}{2}} (2r) \\ &= [r^2+1]^{-\frac{1}{2}} - r^2 [r^2+1]^{-\frac{3}{2}}\end{aligned}$$

(5) [5 points] Differentiate

$$y = \sin(\tan \sqrt{\sin x}) = \sin\left(\tan(\sin x)^{\frac{1}{2}}\right)$$

$$\begin{aligned}y' &= \cos(\tan \sqrt{\sin x}) \cdot \frac{d}{dx} \left[\tan(\sin x)^{\frac{1}{2}} \right] \\ &= \cos(\tan \sqrt{\sin x}) \cdot \sec^2(\sqrt{\sin x}) \cdot \frac{d}{dx} \left[(\sin x)^{\frac{1}{2}} \right] \\ &= \cos(\tan \sqrt{\sin x}) \cdot \sec^2(\sqrt{\sin x}) \cdot \frac{1}{2} (\sin x)^{-\frac{1}{2}} \cdot \frac{d}{dx} [\sin x] \\ &= \cos(\tan \sqrt{\sin x}) \cdot \sec^2(\sqrt{\sin x}) \cdot \frac{1}{2\sqrt{\sin x}} \cdot \cos x\end{aligned}$$