Name: [1 pt]

Problem 1. If $x = \cot\sqrt{t}$, find $\dfrac{dx}{dt}$. [5 pts]

$$\frac{dx}{dt} = \frac{d}{dt}\left(\cot\sqrt{t}\right)$$

$$= -\left(\csc^2\sqrt{t}\right)\cdot\frac{d}{dt}\left(\sqrt{t}\right)$$

$$= -\left(\csc^2\sqrt{t}\right)\cdot\frac{1}{2\sqrt{t}}$$

$$= \boxed{-\frac{\csc^2\sqrt{t}}{2\sqrt{t}}}$$

Problem 2. Find the second derivative of $y = x\tan x$. [5 pts]

$$y' = [x]'\tan x + x[\tan x]' \quad [\text{Product rule}]$$

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

$$\Rightarrow y'' = [\tan x]' + \underbrace{[x\sec^2 x]'}_{\text{use Product rule again.}}$$

$$= \sec^2 x + [x]'\sec^2 x + x[\sec^2 x]' \quad \text{Chain rule}$$

$$= \sec^2 x + \sec^2 x + x\left(2\sec x\cdot[\sec x]'\right)$$

$$= 2\sec^2 x + 2x\sec x(\sec x\tan x)$$

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

$$= \boxed{2\sec^2 x(1 + x\tan x)}$$