Find the derivative of each of the following functions and SIMPLIFY as much as possible.

1) \( y = \ln(\cos x) \) (2 points)

\[
y' = \frac{1}{\cos x} \cdot -\sin x = -\tan x
\]

2) \( y = \ln(\sec x + \tan x) \) (4 points)

\[
y' = \frac{1}{\sec x + \tan x} \cdot (\sec x \tan x + \sec^2 x) = \frac{1}{\sec x + \tan x} \cdot \sec x \cdot (\tan x + \sec x) = \frac{1}{\sec x + \tan x} \cdot (\sec x + \tan x) \cdot \sec x = \sec x
\]

3) Choose one of the two following functions, find its derivative, and SIMPLIFY as much as possible. You may choose to find the derivative of both functions; in which case, I will give you credit for which ever one is most correct. (4 points)

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

\[
y' = 2\sqrt{x} \cdot \frac{1}{1 + \left(\frac{1}{\sqrt{x}}\right)^2} \cdot \frac{1}{2} \cdot (x)^{-\frac{1}{2}} + 2 \cdot \frac{1}{2} \cdot (x)^{-\frac{1}{2}} \cdot \tan^{-1}\left(\frac{1}{\sqrt{x}}\right) = \sqrt{x} \cdot \frac{1}{1 + x} \cdot \frac{1}{\sqrt{x}} + \frac{1}{\sqrt{x}} \cdot \tan^{-1}\left(\frac{1}{\sqrt{x}}\right) = \frac{1 + \frac{1}{\sqrt{x}}}{\sqrt{x}} + \frac{1}{\sqrt{x}} \cdot \tan^{-1}\left(\frac{1}{\sqrt{x}}\right)
\]

or

\[
y' = 2\sqrt{x} \cdot \frac{1}{\sqrt{1 - \left(\frac{1}{\sqrt{x}}\right)^2}} \cdot \frac{1}{2} \cdot (x)^{-\frac{1}{2}} + 2 \cdot \frac{1}{2} \cdot (x)^{-\frac{1}{2}} \cdot \sin^{-1}\left(\frac{1}{\sqrt{x}}\right) = \sqrt{x} \cdot \frac{1}{\sqrt{1 - x}} \cdot \frac{1}{\sqrt{x}} + \frac{1}{\sqrt{x}} \cdot \sin^{-1}\left(\frac{1}{\sqrt{x}}\right) = \frac{1}{\sqrt{1 - x}} + \frac{\sin^{-1}\left(\frac{1}{\sqrt{x}}\right)}{\sqrt{x}}
\]

or

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

\[
y' = 2\sqrt{x} \cdot \frac{1}{\sqrt{1 - \left(\frac{1}{\sqrt{x}}\right)^2}} \cdot \frac{1}{2} \cdot (x)^{-\frac{1}{2}} = \sqrt{x} \cdot \frac{1}{\sqrt{1 - x}} \cdot \frac{1}{\sqrt{x}} + \frac{1}{\sqrt{x}} \cdot \sin^{-1}\left(\frac{1}{\sqrt{x}}\right) = \frac{1}{\sqrt{1 - x}} + \frac{\sin^{-1}\left(\frac{1}{\sqrt{x}}\right)}{\sqrt{x}}
\]
BONUS: Earlier in the semester, I wore a very “inspiring” math-related t-shirt to class. What was the message on that t-shirt? (1 point)

CALCULUS RULES!
(You know, like Product Rule, Quotient Rule, Chain Rule, etc.)