Write complete solutions, showing all work. (5 points each, 10 points total)

1. (3.6.10) Find the derivative of \( f(x) = x \ln(\sin x) \). DO NOT NEED TO SIMPLIFY.

(2 points) Recognize need to use the Product Rule. Let \( f(x) = x \) and 
\[ g(x) = \ln(\sin x). \]
Then 
\[ \frac{d}{dx} \left[ x \ln(\sin x) \right] = \frac{d}{dx}(x) \cdot \ln(\sin x) + x \cdot \frac{d}{dx}(\ln(\sin x)) = \]
\[ 1 \cdot \ln(\sin x) + x \cdot \frac{d}{dx}(\ln(\sin x)) = \ln(\sin x) + x \cdot \frac{d}{dx}(\ln(\sin x)). \]

(2 points) Recognize need to use the Chain Rule to find \( \frac{d}{dx}[\ln(\sin x)] \). Let the inner function, \( f(x) \), equal \( \sin x \), and the outer function, \( g(x) \), equal \( \ln(x) \). Then 
\[ f'(x) = \cos x, \quad g'(x) = \frac{1}{x}, \quad \text{and} \quad g'(f(x)) = \frac{1}{\sin x}. \]
So 
\[ \frac{d}{dx}[\ln(\sin x)] = \frac{\cos x}{\sin x} \quad \text{or} \quad \cot x. \]

(1 point) Combine results above to write derivative. 
\[ f'(x) = \ln(\sin x) + \frac{x \cos x}{\sin x} \quad \text{or} \quad \ln(\sin x) + x \cot x. \]

2. (3.7.11) Find \( \frac{dy}{dx} \) for \( x\sqrt{y} + y^3 = \ln(x) \). DO NOT NEED TO SIMPLIFY.

(1 point) Recognize need to use the Product Rule on the first term.
\[ \frac{d}{dx}(x\sqrt{y}) = \frac{d}{dx}(x) \cdot \sqrt{y} + x \cdot \frac{d}{dx}(\sqrt{y}) = 1 \cdot \sqrt{y} + x \cdot \frac{d}{dx}(\sqrt{y}) = \sqrt{y} + x \cdot \frac{d}{dx}(\sqrt{y}). \]

(2 points) Recognize need to use Chain Rule or Implicit Differentiation on \( \sqrt{y} \) and 
\[ y^3. \]
\[ \frac{d}{dx}(\sqrt{y}) = y' \cdot \frac{1}{2\sqrt{y}} \quad \text{and} \quad \frac{d}{dx}(y^3) = y' \cdot 3y^2. \]

(1 point) Combine results above to write differentiation of both sides of equation.
\[ \sqrt{y} + x \cdot y' \cdot \frac{1}{2\sqrt{y}} + y' \cdot 3y^2 = \frac{1}{x}. \]

(1 point) Solve for \( \frac{dy}{dx} \). 
\[ \sqrt{y} + x \cdot y' \cdot \frac{1}{2\sqrt{y}} + y' \cdot 3y^2 = \frac{1}{x}, \]
\[ y' \left( \frac{x}{2\sqrt{y}} + 3y^2 \right) = \frac{1}{x} - \sqrt{y}, \quad y' = \frac{\frac{1}{x} - \sqrt{y}}{\frac{x}{2\sqrt{y}} + 3y^2}. \]