Find the derivative of each function.

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

$$y = \ln\left[x\sqrt{x^2 - 1}\right] = \ln x + \frac{1}{2}\ln\left(x^2 - 1\right)$$

$$\frac{dy}{dx} = \frac{1}{x} + \frac{1}{2}\left(\frac{2x}{x^2 - 1}\right) = \frac{2x^2 - 1}{x\left(x^2 - 1\right)}$$

1b) $y = \ln(t + 1)^2$

1c) $f(x) = \ln\left(\dfrac{\sqrt{4 + x^2}}{x}\right)$

1d) $g(t) = \dfrac{\ln t}{t^2}$

1e) $y = \ln(\ln x^2)$

Find the equation of the tangent line at the given point of each function.

2a) $f(x) = x^3 \ln x, \quad (1, 0)$

$$f'(x) = 3x^2 \ln x + x^2$$

$$f'(1) = 1$$

Tangent line: $y - 0 = 1(x - 1)$

$$y = x - 1$$

2b) $f(x) = \ln\sqrt{1 + \sin^2 x}, \quad \left(\dfrac{\pi}{4}, \ln\sqrt{\dfrac{3}{2}}\right)$

Use implicit differentiation to find $\frac{dy}{dx}$.

3a) $x^2 - 3\ln y + y^2 = 10$

$$2x - \frac{3}{y}\frac{dy}{dx} + 2y\frac{dy}{dx} = 0$$

$$2x = \frac{dy}{dx}\left(\frac{3}{y} - 2y\right)$$

$$\frac{dy}{dx} = \frac{2x}{(3/y) - 2y} = \frac{2xy}{3 - 2y^2}$$

3b) $4x^3 + \ln y^2 + 2y = 2x$

4a) **Find the equation of the tangent line at the given point of the function below.**

$$x + y - 1 = \ln(x^2 + y^2), \quad (1, 0)$$

Use logarithms to help find $\frac{dy}{dx}$.

5a) $y = x\sqrt{x^2 + 1}$

$$\ln y = \ln x + \frac{1}{2}\ln(x^2 + 1)$$

$$\frac{1}{y}\left(\frac{dy}{dx}\right) = \frac{1}{x} + \frac{x}{x^2 + 1}$$

$$\frac{dy}{dx} = y\left[\frac{2x^2 + 1}{x(x^2 + 1)}\right] = \frac{2x^2 + 1}{\sqrt{x^2 + 1}}$$

5b) $y = \dfrac{x^2\sqrt{3x - 2}}{(x + 1)^2}$

5c) $y = x^{2/x}$