Calculus 3.5 - Implicit Differentiation [total 53pts]

Review Problems [total 6pts]

1. Finding derivatives. [6pts: 3pts each]
   (a) \( f'(x) = \sin(\ln(x)) + \cos(\ln(x)) \)
   (b) \( g'(x) = \frac{x^2 + 1 - 2x \ln(x)}{x(x^2 + 1)^2} \)

Basic Knowledge [total 32pts]

2. [5pts each part: 3pts for differentiating, 2pts for solving for \( \frac{dy}{dx} \)]
   (a) \( \frac{dy}{dx} = \frac{2x}{3y} \)
   (b) \( \frac{dy}{dx} = \frac{12x^2 - 2y}{x} \)
   (c) \( \frac{dy}{dx} = \frac{3 - \sin(y)}{x \cos(y) + 3y^2} \)
   (d) \( \frac{dy}{dx} = \frac{-3y^2e^{3xy}}{e^{3xy} + 3xye^{3xy} + 4y} \)

3. [12pts each part: 2pts for differentiating, 2pts for solving for \( \frac{dy}{dx} \), 2pts for slope of tangent, 2pts for slope of normal, 2pts for tangent line, 2pts for normal line]
   (a) tangent \( y = \frac{1}{3}x + \frac{4}{3} \); normal \( y = -3x - 2 \)
   (b) tangent \( y = 1 \); normal \( x = \frac{π}{4} \)

Intermediate Knowledge

4. [total 8pts: 2pts for differentiating, 2pts for solving for \( \frac{dy}{dx} \), 2pts for finding x-coordinates, 2pts for finding y-coordinates]
   (a) horizontal tangent lines at \((0, -2), (0, 2)\)
   (b) vertical tangent lines at \((-4, 0), (4, 0)\)

Advanced Knowledge

5. [7pts: 2pts for differentiating, 2pts for solving for \( \frac{dy}{dx} \), 2pts for finding second der. 1pt for simplifying]
   \( \frac{d^2y}{dx^2} = \frac{2y}{x^2} \)