

1. (5 points) Find $\frac{dy}{dx}$ by implicit differentiation: $x^2 + xy - y^2 = 4$.

$$\begin{aligned} & \cancel{x^2} \quad x^2 + xy(x) - y(x)^2 = 4 \\ \frac{d}{dx}: \quad & 2x + x \frac{dy}{dx} + 1 \cdot y - 2y \frac{dy}{dx} = 0 \\ & (2x + y) + (x - 2y) \frac{dy}{dx} = 0 \\ & (x - 2y) \frac{dy}{dx} = -(2x + y) \\ & \frac{dy}{dx} = \frac{-(2x + y)}{x - 2y} \end{aligned}$$

2. (5 points) Differentiate the function $f(x) = \log_5(xe^x)$. Simplify your answer.

$$\begin{aligned} f'(x) &= \frac{1}{xe^x} \cdot \frac{1}{\ln 5} \cdot \frac{d}{dx}(xe^x) \\ &= \frac{1}{xe^x} \cdot \frac{1}{\ln 5} \cdot (xe^x + 1 \cdot e^x) \\ &= \frac{xe^x + e^x}{xe^x \ln 5} \\ &= \frac{(x+1)e^x}{xe^x \ln 5} = \frac{x+1}{x \ln 5} \end{aligned}$$