DATE: _____

$y - y_1 = m(x - x_1)$ — m is opp. recip.

Write the equation of the tangent line and normal line for each of the following:

1. $x^{\frac{1}{3}} + y^{\frac{1}{3}} = 3$ at (8,1)

$\frac{1}{3}x^{-\frac{2}{3}} + \frac{1}{3}y^{-\frac{2}{3}}\frac{dy}{dx} = 0$

$\frac{1}{3}(8)^{-\frac{2}{3}} + \frac{1}{3}(1)^{-\frac{2}{3}}\frac{dy}{dx} = 0$

$\frac{1}{3}\cdot\frac{1}{(\sqrt[3]{8})^2} + \frac{1}{3}\frac{dy}{dx} = 0$

$\frac{1}{3}\cdot\frac{1}{4} + \frac{1}{3}\frac{dy}{dx} = 0$

$3\left(\frac{1}{3}\frac{dy}{dx}\right) = \left(-\frac{1}{12}\right)^3$

$\frac{dy}{dx} = -\frac{1}{4}$

tangent line: $y - 1 = -\frac{1}{4}(x - 8)$

normal line: $y - 1 = 4(x - 8)$

2. $x\cos y = 1$ at $\left(2, \frac{\pi}{3}\right)$

$\cos y \cdot 1 + x \cdot -\sin y\frac{dy}{dx} = 0$

$\cos\frac{\pi}{3} + 2 \cdot -\sin\frac{\pi}{3}\frac{dy}{dx} = 0$

$\frac{1}{2} - 2\left(\frac{\sqrt{3}}{2}\right)\frac{dy}{dx} = 0$

$\frac{1}{2} - \sqrt{3}\frac{dy}{dx} = 0$

$-\sqrt{3}\frac{dy}{dx} = -\frac{1}{2}$

$\left.\frac{dy}{dx}\right|_{(2,\pi/3)} = +\frac{1}{2\sqrt{3}}$

tangent line: $y - \frac{\pi}{3} = \frac{1}{2\sqrt{3}}(x - 2)$

normal line: $y - \frac{\pi}{3} = -2\sqrt{3}(x - 2)$

3. $x^2y^2 = 9$ at (-1,3)

$y^2 \cdot 2x + x^2 \cdot 2y\frac{dy}{dx} = 0$

$3^2 \cdot 2(-1) + (-1)^2 \cdot 2(3)\frac{dy}{dx} = 0$

$-18 + 6\frac{dy}{dx} = 0$

$6\frac{dy}{dx} = 18$

$\left.\frac{dy}{dx}\right|_{(-1,3)} = 3$

tangent line: $y - 3 = 3(x + 1)$

normal line: $y - 3 = -\frac{1}{3}(x + 1)$

4. $y^2 - 2x = 4y + 1$ at (-2,1)

$2y\frac{dy}{dx} - 2 = 4\frac{dy}{dx}$

$2(1)\frac{dy}{dx} - 2 = 4\frac{dy}{dx}$

$2\frac{dy}{dx} - 2 = 4\frac{dy}{dx}$

$-2\frac{dy}{dx} - 2 = 0$

$-2\frac{dy}{dx} = 2$

$\left.\frac{dy}{dx}\right|_{(-2,1)} = -1$

tangent line: $y - 1 = -1(x + 2)$

normal line: $y - 1 = 1(x + 2)$