3 $x^2 + y^2 + 3xy - 11 = 0$ at point $x = 1, y = 2$

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

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

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

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

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

$\frac{dy}{dx}\Big|_{(1,2)} = \frac{-2(1) - 3(2)}{2(2) + 3(1)}$

$= \frac{-2 - 6}{4 + 3}$

$\frac{dy}{dx} = \frac{-8}{7}$

$\therefore m = -8/7$

Equation of tangent

$y - y_1 = m(x - x_1)$

$y - 2 = \frac{-8}{7}(x - 1)$

$y - 2 = \frac{-8}{7}x + \frac{8}{7}$

$y + 8/7\,x - \frac{22}{7} = 0$

$7y + 8x - 22 = 0$

2 $3y - 4 = 2x + 3$ and $y - 5 = x + 6$

For perpendicular lines $m_1 m_2 = -1$

$3y - 4 = 2x + 3$

$3y = 2x + 7$

$y = \frac{2}{3}x + \frac{7}{3}$

$\frac{dy}{dx} = \frac{2}{3}$

$\therefore m_1 = \frac{2}{3}$

$y - 5 = x + 6$

$y = x + 11$

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

$\therefore m_2 = 1$

$m_1 m_2 = \frac{2}{3} \times 1 = \frac{2}{3}$

$\therefore$ The lines $3y - 4 = 2x + 3$ and $y - 5 = x + 6$ are NOT PERPENDICULAR

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1 $y - 3x - 2 = 0$

$3y + x + 9 = 0$

and for perpendicular lines $m_1 m_2 = -1$

$y = 3x + 2$

$\frac{dy}{dx} = 3$

$\therefore m = 3$

$3y + x + 9 = 0$

$3y = -x - 9$

$y = \frac{-x}{3} - 3$

$\frac{dy}{dx} = -1/3$

$\therefore m_2 = -1/3$

$m_1 m_2 = 3 \times -1/3$

$= -1$

∴ The lines $y - 3x - 2 = 0$ and $3y + x + 9 = 0$ are Perpendicular