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1) $y - 3x - 2 = 0$ and $3y + x + 9 = 0$

$y - 3x - 2 = 0 \Rightarrow y = 3x + 2$

$m_1 = 3$

$3y + x + 9 = 0 \Rightarrow 3y = -x - 9$

$y = \frac{-x}{3} - \frac{9}{3}$

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

$m_2 = \frac{-1}{3}$

$m_1 m_2 = -1$ if a pair of linear perpendicular to each other

$3 \times -\frac{1}{3} = -1$

$\therefore$ $y - 3x - 2 = 0$ and $3y + x + 9 = 0$ are perpendicular to each other.

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

$3y - 4 = 2x + 3 \Rightarrow 3y = 2x + 3 + 4$

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

~~$m_1 = \frac{2}{3}$~~ $y = \frac{2x}{3} + \frac{7}{3}$

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

$y - 5 = x + 6 \Rightarrow y = x + 6 + 5$

$y = x + 11$

$m_2 = 1$

$m_1 m_2 = -1$ if a pair of lines are perpendicular to each other

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

$\therefore$ $3y - 4 = 2x + 3$ and $y + 5 = x + 6$ are perpendicular to each other.

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

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

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

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

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

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

when $x = 1$ and $y = 2$

$m = \frac{-(2[1] + 3[2])}{2[2] + 3[1]}$

$= \frac{-(2+6)}{4+3} = \frac{-8}{7}$

$m = \frac{-8}{7}$

Equation of the tangent to a curve

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

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

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

$7y - 14 = -8x + 8$

$8x + 7y - 14 - 8 = 0$

$8x + 7y - 22 = 0$

8.

b.) Equation of the normal to a curve

$y - y_1 = -\frac{1}{m}(x - x_1)$

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

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

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

$8y - 16 = 7x - 7$

$8y = 7x - 7 + 16$

$7x - 8y + 9 = 0$