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1. Examine whether or not these pair of lines are perpendicular to each other

1. $y - 3x - 2 = 0$ & $3y + x + 9 = 0$.

A: $y - 3x - 2 = 0$

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

$\frac{dy}{dx} - 3 = 0$

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

B: $3y + x + 9 = 0$

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

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

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

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

$\therefore y - 3x - 2 = 0$ is perpendicular to $3y + x + 9 = 0$

2. $3y - 4 = 2x + 3$ & $y - 5 = x + 6$

Let C be $3y - 4 = 2x + 3$

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

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

Let D be $y - 5 = x + 6$

$\frac{dy}{dx} - 0 = 1 + 0$

$dy/dx = 1$

$C \times D = 1$

$\therefore 3y - 4 = 2x + 3$ is not perpendicular to $y - 5 = x + 6$

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

$2x + 2y\,dy/dx + 3(x\,dy/dx + y) - 0 = 0$

$2x + 2y\,dy/dx + 3x\,dy/dx + 3y = 0$

$dy/dx\,(2y + 3x) = -2x - 3y$

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

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

when $x = 1$ & $y = 2$

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

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

$m = -8/7$

- Equation of the tangent

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

$y - 2 = -8/7\,(x - 1)$

$7(y - 2) = -8(x - 1)$

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

$1+7$
-8

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

$7y + 8x - 22 = 0$, $8x + 7y - 22 = 0$

- Equation of the normal

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

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

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

$8(y - 2) = 7(x - 1)$

$8y - 16 = 7x - 7$

$8y - 7x - 16 + 7 = 0$

$8y - 7x - 9 = 0$