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(1) $y - 3x - 2 = 0$

$3y + x + 9 = 0$

let $y - 3x - 2 = 0$ ... A

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

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

let $3y + x + 9 = 0$ ... B

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

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

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

A + B

i.e $y - 2x - 2 = 0$ is perpendicular to $3y + x + 9 = 0$

(2) $3y - 4 = 2x + 3$ ... A

$y - 5 = x + 6$ ... B

$3y - 2x - 7 = 0$

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

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

$y - x - 11 = 0$

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

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

$A \neq B$

i.e $3y - 4 \neq 2x + 3$ and $y - 5 = x + 6$ are not perpendicular.

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

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

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

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

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

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

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

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

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

$m = -8/7$

Equation of a tangent to a curve

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

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

$y - 2 = -8x/7 + 8/7$

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

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

$8x + 7y - 22 = 0$

Equation of the normal to a curve

$y - y_1 = -1/m (x - x_1)$

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

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

$y - 2 = 7x/8 - 7/8$

$8y - 16 = 7x - 7$

$8y = 7x - 7 + 16$

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