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

1. $y - 3x - 2 = 0$ and $3y + x + 9 = 0$
2. $3y - 4 = 2x + 3$ and $y - 5 = x + 6$
3. find the equations of the tangent and normal to the curve x square $+ y$ square $+ 3xy - 11 = 0$ at the point $x = 1, y = 2$

Solution

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

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

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

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

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

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

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

$\therefore A = B$

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

2. let $A - 3y - 4 = 2x + 3$

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

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

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

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Let $b = y - 5 = x + 6$

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

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

$\therefore A \neq B$

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

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

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

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

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

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

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

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

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

Equation of the tangent, $y - y_1 = m(x - x_1)$

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

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

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

$8x + 7y - 22 = 0$

Equation of the normal, $y - y_1 = \frac{-1}{m}(x - x_1)$

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

$8y - 16 = 7x - 7$

$8y = 7x - 7 + 16$

$7x - 8y + 9 = 0$