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MAT 104 Assignment

1. 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 equation of the tangent and normal to the curve $x^2 + y^2 + 3xy - 11 = 0$ at point $x = 1, y = 2$.

Solution

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

$3y + x + 9 = 0$

The lines are said to be perpendicular if $m_1 m_2 = -1$

$y - 3x - 2 = 0$

make y subject of formula.

$y = 3x + 2$, $y = mx + c$.

$m_1 = 3$.

$3y + x + 9 = 0$.

make y subject of formula

$3y = -x - 9$.

$y = -x/3 - 3$

$y = -x/3 - 3$.

$y = mx + c$

$m_2 = -1/3$.

Remember $m_1 m_2 = -1$

$m_1 = 3, m_2 = -1/3$

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

\therefore They are perpendicular to each other.

$$2) \quad 3y - 4 = 2x + 3, \quad 3y - 2x - 7 = 0.$$

$$y - 5 = x + 6; \quad y - x - 11 = 0.$$

The lines are said to be perpendicular if $m_1 m_2 = -1$

$$3y - 2x - 7$$

make y subject of formula.

$$3y = 2x + 7$$

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

$$y = mx + c$$

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

$$y - x - 11 = 0$$

make y subject of formula.

$$y = x + 11$$

$$y = mx + c$$

$$m_2 = 1$$

Recall $m_1 m_2 = -1$

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

∴ Hence the lines are not perpendicular to each other.

$$3. \quad x^2 + y^2 + 3xy - 1 \text{ at point } (1, 2).$$

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

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

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

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

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

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

$$\frac{dy}{dx} \Big|_{x=1, y=2} = \frac{-2(1) - 3(2)}{2(2) + 3(1)} = \frac{-2 - 6}{4 + 3} = \frac{-8}{7}$$

$$m = -8/7.$$

Equation of tangent

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

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

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

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

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

Equation of normal

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

$$y - y_1 = -1/(-8/7)(x - x_1)$$

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

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

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

$$8y - 7x - 9 = 0$$