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Topic: Q. 19: Perpendicular/394

$$\textcircled{1} \quad \begin{aligned} 4 - 3x - 2 &= 0 \\ 3x + x + 9 &= 0 \end{aligned}$$

For the lines to be perpendicular $m_1 m_2 = -1$

$$4 - 3x - 2 = 0$$

Making y the subject of the formula

$$4 = 3x + 2$$

By Comparison with $y = mx + c$

$$y = 3x + 2$$

$$y = mx + c$$

$$m_1 = 3$$

$$3y + 2c + 9 = 0$$

Making y the subject of the formula

$$3y = -x - 9$$

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

$$y = \frac{-1x}{3} - 3$$

$$\therefore y = mx + c \quad m_2 = -\frac{1}{3}$$

$$m_1 m_2 = -1 \quad \text{For Perpendicularity}$$

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

\therefore Since $m_1 m_2 = -1$, the lines $4 - 3x - 2 = 0$ and $3y + 2c + 9 = 0$ are perpendicular.

2) $3y - 4 = 2x + 3$ — ①
 $4 - 5 = x + 6$ — ②

Making y the subject of formula in ①

$3y = 2x + 3 + 4$
 $3y = 2x + 7$
 $y = \frac{2x + 7}{3}$

By comparing with $y = mx + c$

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

Making y the subject of formula in ②

$4 - 5 = x + 6$
 $y = x + 6 + 5$
 $y = x + 11$

By comparing with $y = mx + c$

$m_2 = 1$

But for the lines to be perpendicular;

$m_1 m_2 = -1$

$m_1 m_2 = \frac{2}{3} \times 1 = \frac{2}{3}$

$m_1 m_2 \neq -1$

\therefore the lines $3y - 4 = 2x + 3$ and $4 - 5 = x + 5$ are not perpendicular.

$$\textcircled{1} x^2 + y^2 + 3xy - 11 = 0 \quad (x_1 = 1, y_1 = 2)$$

$$M = dy/dx$$

$$x^2 + y^2 + 3xy - 11 = 0$$

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

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

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

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

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

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

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

ii) Equation of tangent

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

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

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

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

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

$7y + 8x - 22 = 0 \rightarrow$ is the equation of tangent.

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$$\textcircled{1} \quad y - y_1 = \frac{y_2 - y_1}{x_2 - x_1} (x - x_1)$$

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

$$y - 2 = \frac{9}{15} (x - 1)$$

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

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

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

$$8y - 7x - 9 = 0 \rightarrow \text{Equation of Normal.}$$