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(1) $y - 3x - 2 = 0$ and $3y + x + 9 = 0$

be $y = 3x + 2$

Let $M_1 = y = 3x + 2$

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

$3y + x + 9 = 0$

$3y = -x - 9$ divide through by 3

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

Let $M_2 = y = \frac{-x}{3} - 3$

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

To find if they are perdicular using

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

Therefore $y - 3x - 2 = 0$ and $3y + x + 9 = 0$ are

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

$3y = 2x + 3 + 4$

$3y = 2x + 7$

divide through by 3

$y - 5 = x + 6$

$y = x + 6 + 5$

$y = x + 11$

Let $M_2 = y = x + 11$

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

they are Pendicular using

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

Therefore $y - 3x - 2 = 0$ and $3y + x + 9 = 0$ are perpendicular.

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

$3y = 2x + 3 + 4$

$3y = 2x + 7$

divide through by 3

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

$y - 5 = x + 6$

$y = x + 6 + 5$

$y = x + 11$

let $m_2 = y = x + 11$

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

let $m_1 = y = \frac{2x}{3} + 7$

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

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

Therefore $3y - 4 = 2x + 3$ and $y - 5 = x + 6$ are not perpendicular.

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

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

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

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

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

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

$m=\left.\frac{dy}{dx}\right|_{x=1\,y=2}=\frac{-2(1)-3(2)}{2(2)+3(1)}=\frac{-2-6}{4+3}$

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

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

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

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

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

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

$7y+8x-22=0 \longrightarrow$ Eqn of tangent.

$m=-1/m=-1/-8/7=7/8$

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

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

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

$8y-16=7x-7$

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

$8y-7x-9=0 \longrightarrow$ eqn of normal