NAME: IKOBIO DIGBORAI ELIJAH SURTAL NO. 200
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① $y - 3x - 2 = 0$ and $3y + x + 9 = 0$

Solution

$y - 3x - 2 = 0$

$y = 3x + 2$

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

$m_1 = 3$

$3y + x + 9 = 0$

$3y = -x - 9$

$y = -x/3 - 9/3$

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

$m_2 = -1/3$

For perpendicularity $m_1 m_2 = -1$

$3(-1/3) = -1$

∴ It is perpendicular as it satisfies the equation $m_1 m_2 = -1$

② $3y - 4 = 2x + 3$ and $y - 5 = x + 6$

Solution

$3y - 4 = 2x + 3$

$3y = 2x + 3 + 4$

$3y = 2x + 7$

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

$\frac{dy}{dx} = \frac{2}{3}$, $m = 2/3$

$y = x + 6 + 5$

$y = x + 11$

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

$m = 1$

For perpendicularity $m_1 m_2 = -1$

$2/3(1) = 2/3$

$m_1 \neq m_2$

It is not perpendicular as $m_1 m_2 \neq -1$

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

Solutions

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

$2x+2y\frac{dy}{dx}+3(x\cdot\frac{dy}{dx}+y\cdot1)=0$

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

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

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

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

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

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

$m=4/7$

Eqn of tangent $y-y_1=m(x-x_1)$

$y-2=4/7(x-1)$

$y-2=\frac{4x}{7}-\frac{4}{7}$

$7y-14=4x-4$

$7y-4x-14+4=0$

$7y-4x-10=0$

Eqn of normal: $y-y_1=\frac{-1}{m}(x-x_1)$

$\therefore y-2=\frac{-1}{4/7}(x-x_1) \Rightarrow y-2=-7/4(x-1)$

$y-2=-7/4x+7/4 \Rightarrow 4y-8=-7x+7$

$4y+7x-8-7=0$

$4y+7x-15=0$

$= 2$

0

y

$= -7/4(x - 1)$

$x + 7$

$-4y + 7x - 8 - 7 = 0$

$4y + 7x - 15 = 0$