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19/MHS01/300

Medicine and Surgery

7th April 2020

1. Examine whether or not these pairs of lines are perpendicular to each other:

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

let $y - 3x - 2 = 0$ be m_1

and $3y + x + 9 = 0$ be m_2

$\therefore$ for m_1

$\Rightarrow y - 3x - 2 = 0 \Rightarrow y = 3x + 2$

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

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

$\therefore$ for m_2

$\Rightarrow 3y + x + 9 = 0 \Rightarrow 3y = -x - 9$

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

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

$\therefore m_1 = 3$ and $m_2 = -1/3$

$\therefore \Rightarrow m_1 m_2 = -1$

$3x - 1/3 = -1$ //

$\therefore y - 3x - 2 = 0$ is Perpendicular to $3y + x + 9 = 0$

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

let: $3y - 4 = 2x + 3$ be m_1

and $y - 5 = x + 6$ be m_2

$\therefore$ for m_1

$3y - 4 = 2x + 3$

$\Rightarrow 3y = 2x + 3 + 4 \Rightarrow 3\frac{dy}{dx} = 2$

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

∴ for m_2

$y - 5 = x + 6$

$\Rightarrow y = x + 6 + 5$

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

$\therefore m_1 = \frac{2}{3}$ and $m_2 = 1$

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

$\therefore m_1 m_2 \neq -1$

$\therefore 3y - 4 = 2x + 3$ and $y - 5 = x + 6$ are not Perpendicular to each other

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

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

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

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

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

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

$m = \frac{dy}{dx}$ | $x = 1$ and $y = 2$ $\Rightarrow \frac{-3(2) - 2(1)}{2(2) + 3(1)} \Rightarrow \frac{-6 - 2}{4 + 3} \Rightarrow -\frac{8}{7}$

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

Equation for tangent $= y - y_1 = m(x - x_1)$

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

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

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

$\Rightarrow 8x + 7y - 14 + (8) = 0$

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

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

Equation for normal: $m_1 m_2 = -1$

$\Rightarrow m_2 = \frac{-1}{m_1} \Rightarrow \frac{-1}{-8/7} \Rightarrow +1 \times \frac{7}{1-8} \Rightarrow \frac{7}{8}$

$y - y_1 = m_2(x - x_1)$

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

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

$8y - 16 = 7x - 7$

$8y - 16 = 7x - 7$

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

$\Rightarrow 7x - 8y + 9 = 0$