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DEPARTMENT: MEDICINE AND SURGERY

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COURSE CODE: ~~19~~ MAT 104

Examine whether or not these pair of lines are ~~pap~~ perpendicular to each other.

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

$y - 3x - 2 = 0$

$y = 3x + 2$

$y = m_1 x + c$

$m_1 = 3$

$3y + x + 9 = 0$

$3y = -x - 9$

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

$y = m_2 x + c$

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

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

$m_1 m_2 = -1$

∴ The lines $y - 3x - 2 = 0$ and $3y + x + 9 = 0$ are perpendicular to each other.

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

$3y - 4 = 2x + 3$

$3y = 2x + 3 + 4$

$3y = 2x + 7$

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

$y = m_1 x + c$

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

$y - 5 = x + 6$

$y = x + 6 + 5$

$y = x + 11$

$y = m_2 x + c$

$m_2 = 1$

For 2 lines to be perpendicular, $m_1 m_2 = -1$

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

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

$m_1 m_2 \neq -1$

∴ The lines $3y - 4 = 2x + 3$ and $y - 5 = x + 6$ are not perpendicular to each other.

3 Find the equations of the tangent and normal to the line $x^2 + y^2 + 3xy - 11 = 0$ at the point $x_1 = 1$ and $y = 2$

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

$\frac{d}{dx}(x^2 + y^2 + 3xy - 11) = 0$

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

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

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

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

3 $m = \left.\frac{dy}{dx}\right|_{x=1,\, y=2}$

$$m = \frac{-2(1) - 3(2)}{2(1) + 3(1)}$$

$$m = \frac{-2 - 6}{4 + 3}$$

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

a The equation of the tangent

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

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

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

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

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

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

OR

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

b The equation of the normal:

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

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

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

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

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

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

$$8y = 7x + 9$$

OR

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