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The equation of a line is expressed $y = mx + c$, has a gradient m, $y = m_1x + c_1$ and $y = m_2x + c_2$ are perpendicular if $m_1 m_2 = -1$

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

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

$y = 3x + 2$ $\quad y = -1x/3 - 3$

$m_1 = 3$ $\quad m_2 = -1/3$.

$m_1 \cdot m_2 = 3 \times -1/3$

$m_1 \cdot m_2 = -1$ ∴ The two lines are perpendicular

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

$3y = 2x + 7$ and $y = x + 11$

$y = 2/3x + 7/3$ and $y = x + 11$

$m_1 = 2/3$ and $m_2 = 1$

$m_1 \cdot m_2 = 2/3 \times 1$

$= 2/3$ ∴ Therefore the two are not perpendicular

3) $x^2 + y^2 + 3xy - 11 = 0$ find dy/dx $(1, 2)$

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

$2x + 2y\,dy/dx + 3[x\,dy/dx + y] = 0$

$2x + 2y\,dy/dx + 3[x\,dy/dx + y] = 0$

$2x + 2y\,dy/dx + 3x\,dy/dx + 3y$

$dy/dx[2y + 3x] = -3y - 2x$

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

Equation of the tangent

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

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

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

$$m = \frac{-6 - 2}{4 + 3} = -8/7$$

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

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

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

$7y - 14 = -8(x - 1)$

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

$7y + 8x - 22 = 0$ (Equation of tangent

$y - y_1 = 1/m_1(x - x_1)$

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

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

$8y - 16 = 7(x - 1)$

$8y - 16 = 7x - 7$

$8y - 7x - 9 = 0$ (Equation of the normal