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Assignment 9

(1) Examine whether or not the pair of lines are perpendicular to each other

① $y-3x-2=0$ and $3y+x+9=0$.

$y-3x-2=0$
$y=3x+2$
$dy/dx=3$
$m_1=3$

$3y+x+9=0$
$y=\frac{-x-9}{3}$
$y=\frac{-x}{3}-\frac{9}{3}$

$dy/dx=-1/3$
$m_2=-1/3$

Perpendicular lines $m_1 \cdot m_2=-1$
But $m_1 \cdot m_2=3\times -1/3=-1$
∴ The pair of lines are perpendicular.

② $3y-4=2x+3$ and $y-5=x+6$

$3y=2x+3+4$
$y=\frac{2x+7}{3}$
$y=\frac{2x}{3}+\frac{7}{3}$
$dy/dx=2/3$
$m_1=2/3$

$y=x+6+5$
$\frac{dy}{dx}=1$
$m_2=1$

Perpendicular lines $m_1 \cdot m_2=1$
But $m_1 \cdot m_2=2/3\times 1=2/3$

The pair of lines are not perpendicular.

③ $x^2 + y^2 + 3xy - 11 = 0$ $(1, 2)$

For $3xy$ make use of product rule.

$x = x$, $dx/dy = 1$

$y = y$ $dy/dx = dy/dx$

$$\frac{dy}{dx} = x\frac{dy}{dx} + y\frac{dx}{dy}$$

$$2x + 2y + 3[x\, dy/dx + y \cdot 1] = 0$$

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

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

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

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

$$\frac{dy}{dx} = \frac{2y + 3x}{-2x - 3y} = \frac{2(1) + 3(2)}{-2(2) - 3(1)} = \frac{8}{-7} = \frac{-8}{7}.$$

For tangent

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

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

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

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

$7y + 8x - 22 = 0$ which gives equation of tangent.

$(y - y_1) = -1/m\,(x - x_1)$

$$\frac{-1}{m} = -1 \div \frac{-8}{7} = \frac{7}{8}$$

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

$8y - 16 = 7x - 7$

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

$8y - 7x - 9 = 0$ which gives equation of normal.