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(1) $y_1 - 3x_1 - 2 = 0$ & $3y_2 + x_2 + 9 = 0$ (
perpendicular when $m_1 = \frac{-1}{m_2}$
where $m = \frac{dy}{dx}$

$y_1 = 3x_1 + 2$ $\quad$ $y_2 = -\frac{x_2}{3} + 9$

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

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

∴ they are perpendicular as $\frac{dy}{dx}$ is negative inverse of the other

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

(2) $3y - 4 = 2x + 3$

$3y = 2x + 3 + 4$

$3y = 2x + 7$

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

$\frac{dy}{dx} = \frac{2}{3}$ $\quad$ $m_1 = 2/3$

$y - 5 = x + 6$

$y = x + 6 + 5$

$y = x + 11$

$\frac{dy}{dx} = 1$ $\quad$ $m_2 = 1$

they are not perpendicular $m_1 \neq \frac{-1}{m_2}$

(3) $x^2 + y^2 + 3xy - 4 = 0$ $\quad$ $(\overset{x_1}{1}, \overset{y_1}{2})$

$2x + 2y\frac{dy}{dx} + 3\left[y + \frac{x\,dy}{dx}\right] - 0 = 0$

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

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

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

$$\frac{dy}{dx} = -\frac{[2x+3y]}{2y+3x} = -\frac{[2(1)+3(2)]}{2(2)+3(1)}$$

$$\frac{dy}{dx} = \frac{-[2+6]}{4+3} = \frac{-8}{7} = m_1$$

(a) equation of the tangent

$$m_1 = m_2$$

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

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

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

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

(b) equation of the normal $m_2 = \frac{-1}{m_1} = \frac{-1}{-8/7} = \frac{7}{8}$

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

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

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

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