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(1)

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

let $A = y - 3x - 2 = 0$

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

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

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

let $B = 3y + x + 9 = 0$

$3\frac{dy}{dx} + 1 + 0 = 0$

$3\frac{dy}{dx} + 1 = 0$

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

$\therefore \quad A \perp B$

i.e $y - 2x - 2 = 0$ is perpendicular to $3y + x + 9 = 0$

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

let $f = 3y - 4 = 2x + 3$

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

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

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

let $G = y - 5 = x + 6$

$\frac{dy}{dx} - 0 = 1 + 0$

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

$\therefore \; f \not\perp G$

i.e $3y - 4 = 2x + 3$ is not perpendicular to $y - 5 = x + 6$

3) $x^2 + y^2 + 3xy - 11 = 0$, at point $(1, 2)$

$2x + 2y\,{}^{dy}/_{dx} + 3(x \times {}^{dy}/_{dx} + y \times 1) - 0 = 0$

$2x + 2y\,{}^{dy}/_{dx} + 3x\,{}^{dy}/_{dx} + 3y = 0$

$2y\,{}^{dy}/_{dx} + 3x\,{}^{dy}/_{dx} = -2x - 3y$

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

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

when $x = 1$ and $y = 2$

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

$$= \frac{-(2+6)}{4+3} = \frac{-8}{7}$$

$m = {}^{-8}/_{7}$

a) Equation of the tangent to a curve

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

$y - 2 = {}^{-8}/_{7}(x - 1)$

$y - 2 = {}^{-8x}/_{7} + {}^{8}/_{7}$

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

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

$8x + 7y - 22 = 0$

b) Equation of the mormal to a curve

$y - y_1 = {}^{-1}/_{m}(x - x_1)$

$y - 2 = {}^{-1}/_{-8/7}(x - 1)$

$y - 2 = {}^{7x}/_{8} - {}^{7}/_{8}$

$8y - 16 = 7x - 7$

$8y = 7x - 7 + 16$

$7x - 8y + 9 = 0$