

③ $x^2 + y^2 + 3y - 11 = 0$ at point $(1, 2)$
 $2x + 2y \frac{dy}{dx} + 3(x + y \times 1) - 0 = 0$

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

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

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

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

When $x=1$ and $y=2$

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

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

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

Equation of the tangent to a curve

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

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

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

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

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

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

b Equation of the normal to a curve

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

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

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

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

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

$$b \quad m = -1 / \frac{+8}{7}$$

$$m = -7/8$$

$$y - y_1 = \frac{7}{8} (x - x_1)$$

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

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

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

$$8y - 7x + 9 = 0 \rightarrow \text{equation of normal}$$

$$3x^2 + y^2 + 3xy - 11 = 0 \text{ at the point } x=1, y=2$$

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

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

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

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

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

m at the point $x=1$ and $y=2$

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

$$m = \frac{dy}{dx} \Big|_{x=1, y=2} = \frac{-2(1) - 3(2)}{2(2) + 3(1)} = \frac{-2 - 6}{4 + 3}$$

$$m = \frac{-8}{7} \text{ or } -1\frac{1}{7}$$

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

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

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

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

$$7y + 8x - 22 = 0 \rightarrow \text{equation of tangent}$$

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

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

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

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

$A \perp B$

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

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

Let $A = 3y - 4 = 2x + 3$

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

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

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

Let $B = y - 5 = x + 6$

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

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

$\therefore A \not\perp B$

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

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

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