

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

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

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

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

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

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

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

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

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

$$\therefore A \perp B$$

ie,  $y - 3x - 2 = 0$  is perpendicular to  $3y + x + 9 = 0$

$$2. 3y - 4 = 2x + 3 \text{ and } y - 5 = x + 6$$

$$\text{Let } F = 3y - 4 = 2x + 3$$

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

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

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

$$\text{Let } G = y - 5 = x + 6$$

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

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

$$\therefore F \neq G$$

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

3.  $x^2 + y^2 + 3xy - 11 = 0$  at <sup>point</sup>  $(1, 2)$

$$2x + 2y \frac{dy}{dx} + 3 \left( x \frac{dy}{dx} + y \cdot 1 \right) - 0 = 0$$

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

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

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

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

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

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

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

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

a. Equation of the tangent to a curve;

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

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

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

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

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

$$\underline{\underline{8x + 7y - 22 = 0}}$$

b. Equation of the normal to a curve;

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

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

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

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

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

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

$$\underline{\underline{7x - 8y + 9 = 0}}$$

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