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1. $y = 2x^2$ at the point $(1, 2)$

Solution

$$y = 2x^2, \quad \frac{dy}{dx} = 4x$$

$$\left.\frac{dy}{dx}\right|_{x=1} = 4(1) = 4$$

$$\therefore m = 4$$

$$x_1 = 1, \quad y_1 = 2$$

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

$$y - 2 = 4(x - 1)$$

$$y - 2 = 4x - 4$$

$$y - 4x - 2 + 4 = 0$$

$$y - 4x + 2 = 0$$

$\therefore$ Equation for the tangent is $y - 4x + 2 = 0$.

For Equation of the normal, $m_1 m_2 = -1$

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

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

$$y - 2 = \frac{-1}{4}(x - 1)$$

$$4y - 8 = -x + 1$$

$$4y + x - 8 - 1 = 0$$

$\therefore$ The Equation of the normal is $4y + x - 9 = 0$

19/MHS01/397

2. $y = 3x^2 - 2x$ at the point $(2, 8)$

Solution

$\frac{dy}{dx} = 6x - 2$

$\frac{dy}{dx}|_{x=2} = 6(2) - 2$

$= 10$

$m = 10$

$(2, 8) = (x_1, y_1)$

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

$y - 8 = 10(x - 2)$

$y - 8 = 10x - 20$

$y - 10x - 8 + 20 = 0$

$y - 10x + 12 = 0$

∴ The Equation of Tangent is $y - 10x + 12 = 0$

$M_1 M_2 = -1$ (For Equation of the normal)

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

$y - 8 = \frac{-1}{10}(x - 2)$

$10y - 80 = -x + 2$

$10y + x - 80 - 2 = 0$

$10y + x - 82 = 0$.

∴ The Equation of the normal is

$10y + x - 82 = 0$.

3. $y = \frac{x^3}{2}$ at the point $(-1, -\frac{1}{2})$

Solution.

$y = \frac{x^3}{2}$, $\frac{dy}{dx} = \frac{2 \cdot 3x^2 - x^3 \cdot 0}{4}$

$\frac{dy}{dx} = \frac{6x^2}{4} = \frac{3x^2}{2}$

$\frac{dy}{dx}|_{x=-1} = \frac{3(-1)^2}{2}$

$m = \frac{3}{2}$

$y + \frac{1}{2} = \frac{3}{2}(x + 1)$

$2y + 1 = 3x + 3$

$2y - 3x + 1 - 3 = 0$

$2y - 3x - 2 = 0$

∴ Equation of the tangent is, $2y - 3x - 2 = 0$

$M_1 M_2 = -1$ (i.e Equation of the normal)

$y + \frac{1}{2} = \frac{-1}{\frac{3}{2}}(x + 1)$

$y + \frac{1}{2} = -\frac{2}{3}(x + 1)$

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

$6y + 3 = -4x - 4$

$6y + 4x + 3 + 4 = 0$.

$6y + 4x + 7 = 0$.

∴ The Equation of the normal is,

$6y + 4x + 7 = 0$

19/MHS01/397

4. $y = 1 + x - x^2$ at the point $(\overset{x_1}{-2}, \overset{y_1}{-5})$

Solution

$y = 1 + x - x^2$

$\frac{dy}{dx} = 1 - 2x$

$\frac{dy}{dx}|_{x=-2} = 1 - 2(-2)$

$m = 5$

For tangent, $y - y_1 = m(x - x_1)$

$y + 5 = 5(x + 2)$

$y + 5 = 5x + 10$

$y - 5x + 5 - 10 = 0$

$y - 5x - 5 = 0$

∴ The Equation of tangent is,

$y - 5x - 5 = 0$

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

$y + 5 = \frac{-1}{5}(x + 2)$

$5y + 5 = -x - 2$

$5y + x + 5 + 2 = 0$

$5y + x + 7 = 0$.

∴ The equation of the normal, is $5y + x + 7 = 0$.

5. $y = 1/x$ at the point $(3, 1/3)$

Solution

$y = \frac{1}{x} = x^{-1}$

$\frac{dy}{dx} = -x^{-2} = -\frac{1}{x^2}$

$\frac{dy}{dx}|_{x=3} = -\frac{1}{3^2} = \frac{-1}{9}$

$m = \frac{-1}{9}$

For tangent, $y - \frac{1}{3} = \frac{-1}{9}(x - 3)$

$9y - 3 = -x + 3$

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

$9y + x - 6 = 0$

∴ The equation of the tangent is;

$9y + x - 6 = 0$

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

$y - \frac{1}{3} = \frac{-1}{\frac{-1}{9}}(x - 3)$

$y - \frac{1}{3} = 9(x - 3)$

$y - \frac{1}{3} = 9x - 27$

$y - 9x - \frac{1}{3} + 27 = 0$

$3y - 27x - 1 + 81 = 0$

$3y - 27x + 80 = 0$

∴ The equation of the normal is $3y - 27x + 80 = 0$.