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

Solution

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

$\frac{dy}{dx}\Big|_{x=2} = 6(2) - 2$
$= 10$

$m = 10$

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

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

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

$y - 8 = 10x - 20$

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

$y - 10x + 12 = 0$

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

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

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

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

$10y - 80 = -x + 2$

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

$10y + x - 82 = 0.$

$\therefore$ The Equation of the normal is

$10y + x - 82 = 0.$

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

Solution.

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

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

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

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

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

$2y + 1 = 3x + 3$

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

$2y - 3x - 2 = 0$

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

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

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

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

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

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

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

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

$\therefore$ The Equation of the normal is,

$6y + 4x + 7 = 0$