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Find.

1) $y = 2x^2$ (1, 2)

Solution.

$$y = 2x^2$$

$$\frac{dy}{dx} = 4x \text{ (1, 2)}$$

$$m = \frac{dy}{dx} \Big|_{x=1}$$

$$m = 4$$

a) Equation of tangent

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

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

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

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

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

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

b) Equation of normal

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

$$m = \frac{-1}{\frac{1}{4}} = -4$$

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

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

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

$$4y + x - 9 = 0$$

2) $y = 3x^2 - 2x$ (2, 8)

Solution.

$$y = 3x^2 - 2x$$

$$\frac{dy}{dx} = 6x - 2 \text{ (2, 8)}$$

$$m = \frac{dy}{dx} \Big|_{x=2}$$

$$m = 6(2) - 2 = 10$$

a) Equation of tangent

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

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

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

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

$$y - 10x + 12 = 0$$

b) Equation of normal

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

$$m = \frac{-1}{\frac{1}{10}} = -10$$

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

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

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

$$10y + x - 82 = 0$$

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

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

$$10y + x - 82 = 0$$

$$3) y = \frac{x^3}{2} \quad (x_1, y_1)$$

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

$$m_1 = \frac{3}{2}x^2 = \text{Gradient}$$

Gradient, $m = -1$

$$m_1 = \frac{3}{2} \times 1 = \frac{3}{2}$$

Equation of tangent.

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

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

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

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

$$2y = 3x + 2$$

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

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

Equation of normal

$$m_1 m_2 = -1$$

$$\frac{3}{2} m_2 = -1$$

$$m_2 = -\frac{2}{3}$$

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

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

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

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

$$y = \frac{-4x - 7}{6}$$

$$4) y = 1 + x - x^2 \text{ at } (-2, 5)$$

Solution.

$$y = 1 + x - x^2$$

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

$$m = \frac{dy}{dx} \Big|_{x = -2}$$

$$m = 1 - 2(-2) = 5$$

Equation of tangent

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

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

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

$$y + 5 = 5x + 10$$

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

$$y - 5x - 5 = 0$$

Equation of normal

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

$$m = -\frac{1}{5} = -\frac{1}{5}$$

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

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

$$m = \frac{-1}{m} = \frac{-1}{10}$$

$$5y + 25 = -x - 2$$

$$5y + 25 + x + 2 = 0$$

$$5y + x + 27 = 0$$

$$5) y = \frac{1}{9}x \quad \begin{matrix} (3, \frac{1}{3}) \\ x \quad y \end{matrix}$$

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

$$m_1 = \frac{-1}{x^2} = \text{Gradient}$$

Gradient, $x = 3$.

$$m_1 = \frac{-1}{3^2} = \frac{-1}{9}$$

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

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

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

$$9y - 3 = 3 - x$$

$$9y = 6 - x$$

$$y = \frac{1}{9}(6 - x) \quad \text{--- Equation}$$

Equation of normal.

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

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

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

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

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

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

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