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Quadratic Equation

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

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

$\therefore M = 4$

Tangent:

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

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

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

$$y - 4x + 2 = 0 \text{ --- equation of tangent}$$

Normal

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

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

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

$$4y + x - 9 = 0 \text{ --- equation of normal}$$

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

$$\frac{dy}{dx} = 6x - 2 = 12 - 2 = 10 = M$$

Tangent

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

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

$$y - 10x + 12 = 0 \text{ --- equation of tangent}$$

Normal

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

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

$$10y + x - 82 = 0 \text{ --- equation of normal}$$

$$3 \quad y = \frac{x^3}{2} \quad (-1, -\frac{1}{2})$$

Using Quotient Rule

let $u = x^3 - u + 2 = 4$

$$\frac{dy}{dx} = \frac{2(3x^2) - x^3(0)}{2^2} = \frac{6x^2}{4} = \frac{6}{4} = \frac{3}{2} = M$$

Tangent

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

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

$$2y - 3x - 2 = 0 \quad \text{— equation at tangent}$$

Normal

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

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

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

$$3y + 2x + 3\frac{1}{2} = 0 \quad \text{— equation at normal.}$$

$$4. y = 1 + x - x^2 \quad (-2, -5)$$

$$\frac{dy}{dx} = 1 - 2x = 1 - 2(-2) = 5$$

Tangent

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

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

$$y - 5x - 5 = 0 \text{ — equation at Tangent}$$

Normal

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

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

$$5y - x + 27 = 0 \text{ — equation at Normal}$$

$$5. y = \frac{1}{x} \quad (3, \frac{1}{3})$$

Quotient rule; take $u = 1$, $x = v$

$$\frac{dy}{dx} = \frac{x(0) - 1(1)}{x^2} = \frac{-1}{3^2} = \frac{-1}{9}$$

Tangent

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

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

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

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

$$\textcircled{9y + x - 6 = 0}$$

$$9y + x - 6 = 0 \text{ — equation at tangent}$$

$$\textcircled{9y - x = 6}$$

$$\textcircled{9y + 3x - 18 = 0} \text{ — equation at tangent}$$

5b Normal

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

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

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

$$y - 9x + 26 \cdot 7 = 0 \text{ — equation at Normal.}$$