

<b>The Constant Rule</b> The derivative of a constant function is zero. $\frac{d}{dx}[c] = 0$	<b>The Power Rule</b> If $n$ is a rational number, then the function $f(x) = x^n$ is differentiable and... $\frac{d}{dx}[x^n] = n \cdot x^{n-1}$
<b>The Constant Multiple Rule</b> If $f$ is a differentiable function and $c$ is a real number, then $cf$ is differentiable and... $\frac{d}{dx}[c \cdot f(x)] = c \cdot f'(x)$	<b>The Sum and Difference Rules</b> The sum (or difference) of two differentiable functions, $f$ and $g$ , is differentiable and... $\frac{d}{dx}[f(x) \pm g(x)] = f'(x) \pm g'(x)$

Use an applicable rule to find each derivative.

1. $f(x) = x^5 - 2x^3 + 7x - 12$ $5x^4 - 6x^2 + 7$	2. $g(x) = 3x^2 + 2x + 1$ $6x + 2$	3. $s(t) = -16t^2 + 70t + 500$ $-32t + 70$
4. $y = \frac{2}{x}$ $-\frac{2}{x^2}$	5. $y = 2\sqrt{x}$ $\frac{1}{\sqrt{x}}$	6. $y = \frac{4x^2}{5}$ $\frac{8}{5}x$
7. $y = -\frac{3}{2}x$ $-\frac{3}{2}$	8. $y = \frac{1}{2\sqrt[3]{x^2}} = \frac{1}{2}x^{-2/3}$ $\frac{1}{3x^{5/3}}$	9. $f(x) = x^3 - 4x + 5$ $3x^2 - 4$
10. $g(x) = -\frac{x^4}{2} + 3x^3 - 2x$ $-2x^3 + 9x^2 - 2$	11. $h(x) = \sqrt[5]{x} - \sqrt[4]{x} - \frac{1}{x^3}$ $\frac{1}{5}x^{-4/5} - \frac{1}{4}x^{-3/4} + \frac{2}{3}x^{-5/3}$ $\frac{1}{5x^{4/5}} - \frac{1}{4x^{3/4}} + \frac{2}{3x^{5/3}}$	12. $f(x) = -\frac{1}{2} + \frac{7}{5}x^2$ $\frac{14}{5}x$
13. $f(x) = x^2 + 5 - 3x^{-2}$ $2x + \frac{6}{x^3}$	14. $h(s) = s^{4/5} - s^3$ $\frac{4}{5s^{1/5}} - \frac{2}{3s^2}$	15. $F(T) = T^{2/3} - T^{1/3} + 4$ $\frac{2}{T^{1/3}} - \frac{1}{T^{2/3}}$
16. $y = 3x(6x - 5x^2) = 18x^2 - 15x^3$ $36x - 45x^2$	17. $f(x) = \frac{x^3 - 3x^2 + 4}{x^2} = x - 3 + \frac{4}{x^2}$ $1 - \frac{8}{x^3}$	18. $h(x) = \frac{2x^2 - 3x + 1}{x} = 2x - 3 + \frac{1}{x}$ $2 - \frac{1}{x^2}$

## Higher Order Derivatives

For each problem, find the indicated derivative with respect to  $x$ .

1)  $y = -x^2$  Find  $\frac{d^2y}{dx^2}$

$$-2$$

2)  $f(x) = 4x^3$  Find  $f''$

$$24x$$

3)  $y = -4x$  Find  $\frac{d^3y}{dx^3}$

$$0$$

4)  $f(x) = 5x^4$  Find  $f'''$

$$120x$$

5)  $y = -5x^4$  Find  $\frac{d^4y}{dx^4}$

$$-120$$

$$y' = -5 \cdot 4x^3 = -20x^3$$

$$y'' = -20 \cdot 3x^2 = -60x^2$$

$$y''' = -60 \cdot 2x = -120x$$

6)  $y = 3x^5 - 2x$  Find  $\frac{d^3y}{dx^3}$

$$180x^2$$

7)  $y = -2x^3 - 4x^{-3}$  Find  $\frac{d^3y}{dx^3}$

$$\frac{-12 + 240}{x^6}$$

8)  $y = -x^2 + 2\sqrt[5]{x^2}$  Find  $\frac{d^3y}{dx^3}$

$$\frac{96}{125x^{13/5}}$$

$$y' = -2x + 2 \cdot \frac{2}{5}x^{-3/5}$$
$$= -2x + \frac{4}{5}x^{-3/5}$$

$$y'' = -2 + \frac{4}{5} \cdot \frac{-3}{5}x^{-8/5}$$
$$= -2 - \frac{12}{25}x^{-8/5}$$

Critical thinking questions. Find the indicated derivatives with respect to  $x$ .

9)  $y = 99x^{99}$  Find  $\frac{d^{100}y}{dx^{100}}$

$$0$$

10)  $f(x) = x^{99}$  Find  $f^{(99)}$

$$99!$$

$$f'(x) = 99x^{98}$$

$$f''(x) = 99 \cdot 98x^{97}$$

$$f'''(x) = 99 \cdot 98 \cdot 97x^{96}$$