

Differentiation Rules: The Basics

Derivative of a constant: $= 0$ $c' = 0$

$$\frac{d}{dx}[6] = 0$$

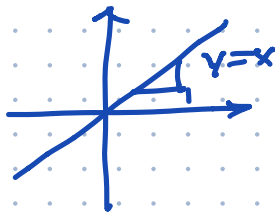


$$\frac{d}{dx}[\pi] = 0$$

$$\frac{d}{dx}[1.096 \times 10^9] = 0$$

Of $x := 1$ $x' = 1$

$$\frac{d}{dx}[x] = 1$$



Of a constant times a function: $(cf)' = c \cdot f'$

$$\frac{d}{dx}[c \cdot f(x)] = c \cdot \frac{d}{dx}[f(x)] = c \cdot f'(x)$$

$$\frac{d}{dx}[5x] = 5 \cdot \frac{d}{dx}[x] = 5 \cdot 1 = 5$$

$$\begin{aligned} \frac{d}{dx}[49\pi x] &= 49\pi \cdot \frac{d}{dx}[x] \\ &= 49\pi \cdot 1 = 49\pi \end{aligned}$$

Of a sum or difference of two functions: $(f \pm g)' = f' \pm g'$

$$\frac{d}{dx}[f(x) \pm g(x)] = \frac{d}{dx}[f(x)] \pm \frac{d}{dx}[g(x)] = f'(x) \pm g'(x)$$

$$\begin{aligned} \frac{d}{dx}[4x + 7] &= \frac{d}{dx}[4x] + \frac{d}{dx}[7] \\ &= 4 \cdot 1 + 0 = 4 \end{aligned}$$

Of x to a power: $(x^p)' = p \cdot x^{p-1}$

$$\frac{d}{dx}[x^p] = p \cdot x^{p-1} \quad \frac{d}{dx}[x^7] = 7x^{7-1} = 7x^6$$

$$\frac{d}{dx}[x^{5/2}] = \frac{5}{2} \cdot x^{5/2-1} = \frac{5}{2} x^{3/2}$$

$$\begin{aligned} \frac{d}{dx}[x^{-2}] &= -2 \cdot x^{-2-1} \\ &= -2x^{-3} \\ &= -2 \cdot \frac{1}{x^3} = -\frac{2}{x^3} \end{aligned}$$

of a polynomial. No new rule.

$$y = 5x^3 - x^2 + 4$$

$$\begin{aligned}\frac{d}{dx}[y] &= \frac{d}{dx}[5x^3 - x^2 + 4] \\ &= \frac{d}{dx}[5x^3] - \frac{d}{dx}[x^2] + \frac{d}{dx}[4] \\ &= 5 \frac{d}{dx}[x^3] - 2x^{2-1} + 0 \\ &= 5 \cdot 3x^{3-1} - 2x\end{aligned}$$

$$\frac{dy}{dx} = 15x^2 - 2x$$

$$\frac{dp}{dx} = p'(x)$$

$$\begin{aligned}\frac{d^2y}{dx^2} &= \frac{d}{dx}[15x^2] - \frac{d}{dx}[2x] \\ &= 15 \frac{d}{dx}[x^2] - 2 \frac{d}{dx}[x] \\ &= 15 \cdot 2x - 2 \\ &= 30x - 2\end{aligned}$$

$$\begin{aligned}\frac{d^3y}{dx^3} &= \frac{d}{dx}[30x] - \frac{d}{dx}[2] \\ &= 30 \cdot 1 - 0 \\ &= 30\end{aligned}$$

$$\frac{d^4y}{dx^4} = 0$$

$$p(x) = 2x^{301} + \pi^4$$

$$\begin{aligned}p'(x) &= 3 \cdot 301 x^{300} + 0 \\ &= 903 x^{300}\end{aligned}$$