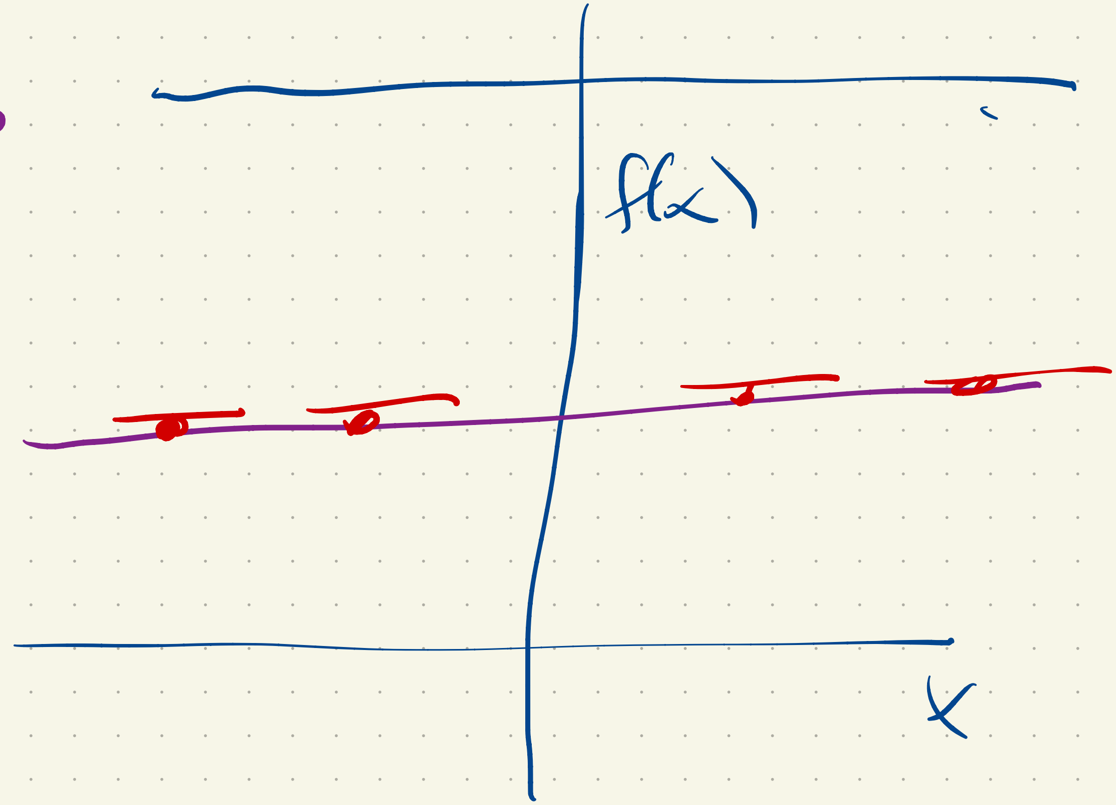
Derivative Rules

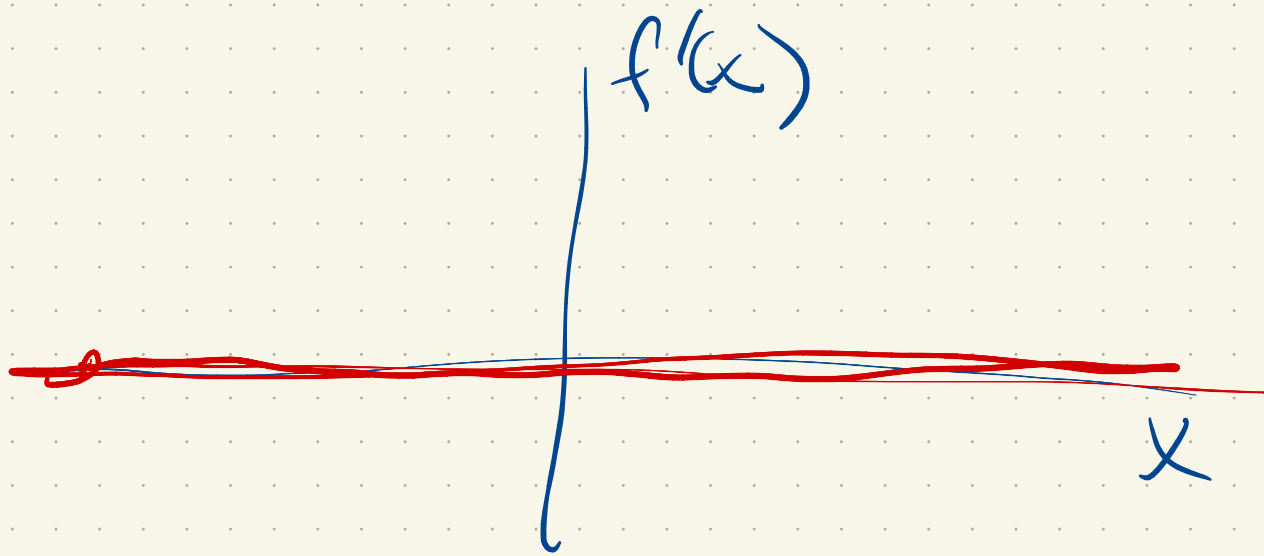
$f(x) = 1$

$f'(x) = 0$



$f(x) = 7$

$f'(x) = 0$

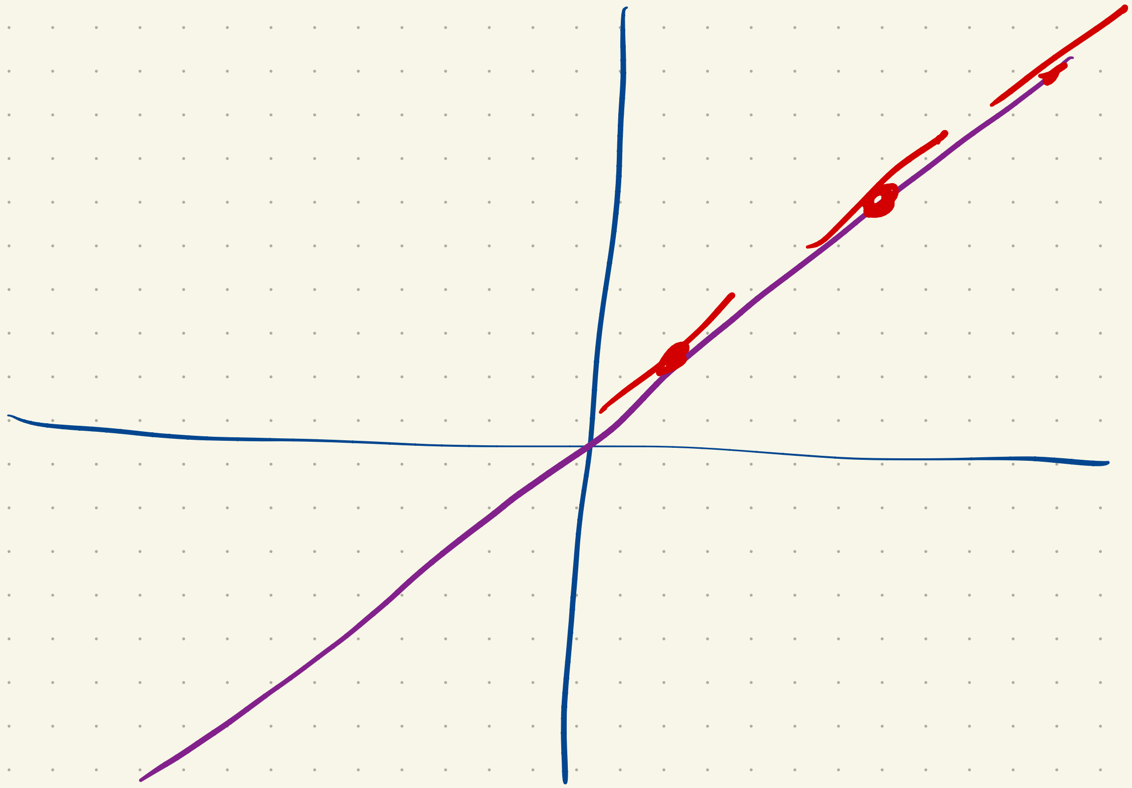


$$\boxed{f(x) = 1, \quad f'(x) = 0}$$

$$\boxed{\frac{d}{dx} 1 = 0}$$

$$\boxed{\frac{d}{dx} c = 0}$$

for any constant c



$f(x) = x$

$f'(x) = 1$

$$\boxed{\frac{d}{dx} x = 1}$$

$$\boxed{\frac{d}{dx} x^2}$$

$$f(x) = x^2$$

$$f'(x) = \lim_{h \to 0} \frac{(x+h)^2 - x^2}{h}$$

$$= \lim_{h \to 0} \frac{x^2 + 2xh + h^2 - x^2}{h}$$

$$= \lim_{h \to 0} \frac{2xh + h^2}{h}$$

$$= \lim_{h \to 0} 2x + h$$

$$= 2x + 0 = \boxed{2x}$$

$$\boxed{\begin{aligned} \frac{d}{dx} x^2 &= 2x \\ \frac{d}{dx} x &= 1 \\ \frac{d}{dx} c &= 0 \end{aligned}}$$

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

$$\frac{d}{dx} 7x^2 = 7 \frac{d}{dx} x^2 = 7 \cdot 2x = 14x$$

$$\lim_{h \to 0} \frac{7(x+h)^2 - 7x^2}{h} = \lim_{h \to 0} 7 \cdot \left[\frac{(x+h)^2 - x^2}{h} \right]$$

$$= 7 \cdot \lim_{h \to 0} \left[\frac{(x+h)^2 - x^2}{h} \right]$$

$$= 7 \cdot 2x$$

$$f(x) = 2x^2 - 5x + 9$$

$$\log(12)$$

$$\downarrow$$

$$\log(5+7)$$

$$= \log(5) + \log(7)$$

$$\frac{d}{dx}\left(2x^2 - 5x + 9\right) =$$

$$\frac{d}{dx}\left(2x^2\right) + \frac{d}{dx}\left(-5x\right) + \frac{d}{dx} 9$$

$$= 2\frac{d}{dx}x^2 - 5\frac{d}{dx}x + 0$$

$$= 2 \cdot 2x - 5 \cdot 1$$

$$= 4x - 5$$

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

$$\frac{d}{dx} x^2 = 2x$$

$$\frac{d}{dx} x^n = n x^{n-1}$$

$n = 1, 2, 3, 4, \ldots$

$n = 0$

$n = -1$

$$\frac{d}{dx} x^a = a x^{a-1}$$

$x > 0$

a, real

$$\frac{d}{dx} x^{\pi} = \pi x^{\pi - 1}$$

$$\boxed{\frac{d}{dx} c f(x) = c \frac{d}{dx} f(x)}$$

$$\boxed{\frac{d}{dx}\left(f(x) + g(x)\right) = \frac{d}{dx} f(x) + \frac{d}{dx} g(x)}$$

$$x^2$$

$$f(x) = 2^x$$

$$f(7) = 2^7$$

$$f(-1) = 2^{-1} \qquad f(\text{☺}) = 2^{\text{☺}}$$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$= \lim_{h \to 0} \frac{2^{x+h} - 2^x}{h}$$

$$= \lim_{h \to 0} \frac{2^x \cdot 2^h - 2^x}{h}$$

$$= \lim_{h \to 0} 2^x \left[\frac{2^h - 1}{h} \right]$$

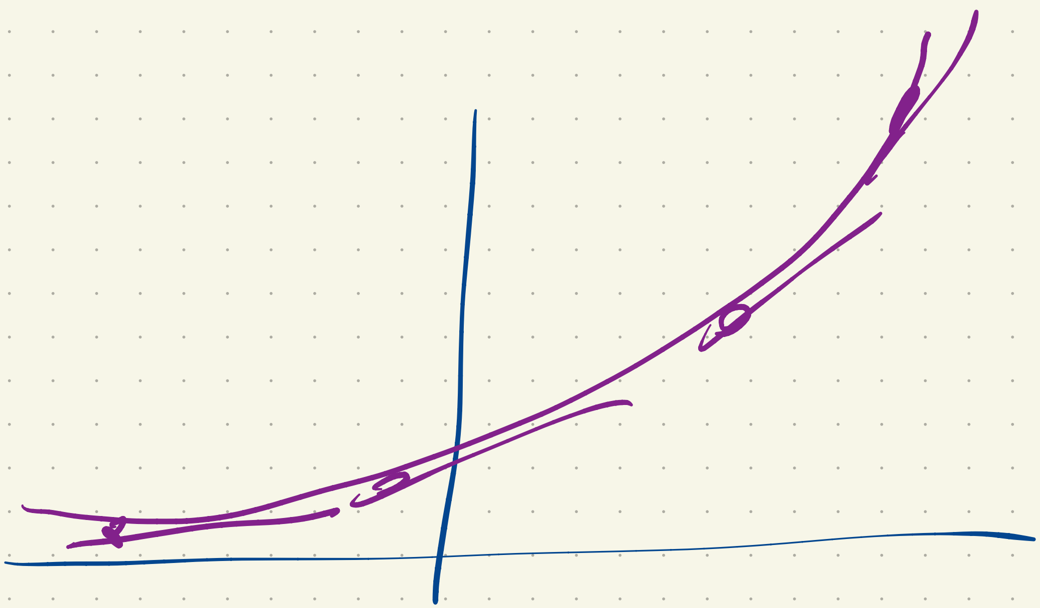
$$= 2^x \lim_{h \to 0} \left[\frac{2^h - 1}{h} \right]$$

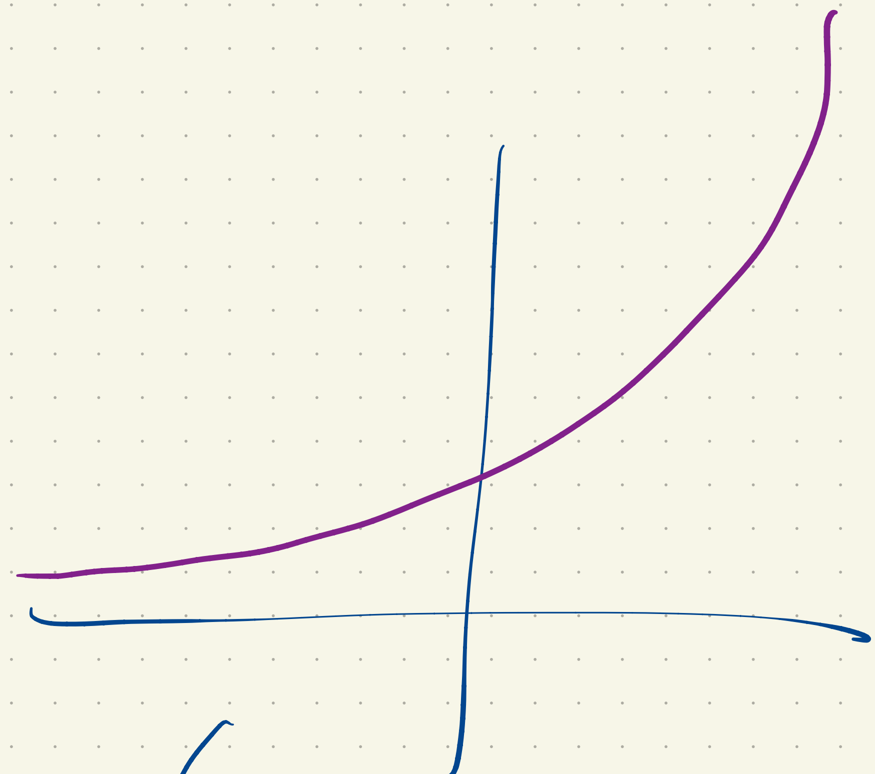
$$\frac{d}{dx} 2^x = 2^x \lim_{h \to 0} \left[\frac{2^h - 1}{h} \right]$$

$h = 0.1$

$h = 0.01$, $h = 0.001$

$$\approx (0.693)\, 2^x$$





$$\frac{d}{dx} 10^x = 10^x \lim_{h \to 0} \frac{10^h - 1}{h}$$

$$\approx 2.305 \; 10^x$$

$$\frac{d}{dx} 2^x \approx 0.693 \; 2^x$$

There is a number e $\quad 2 < e < 10$

$$e \approx 2.7$$

$$\boxed{\frac{d}{dx} e^x = e^x}$$