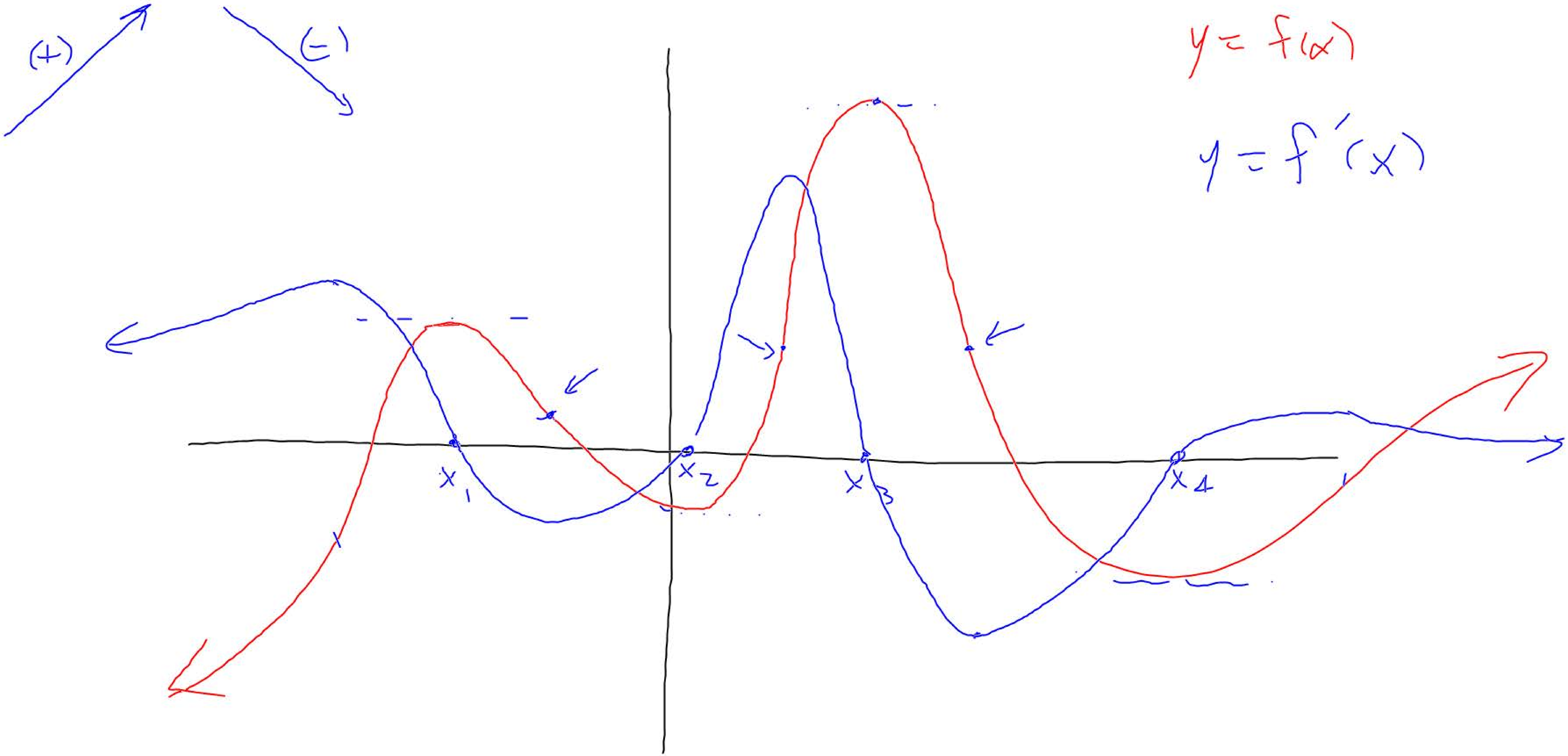
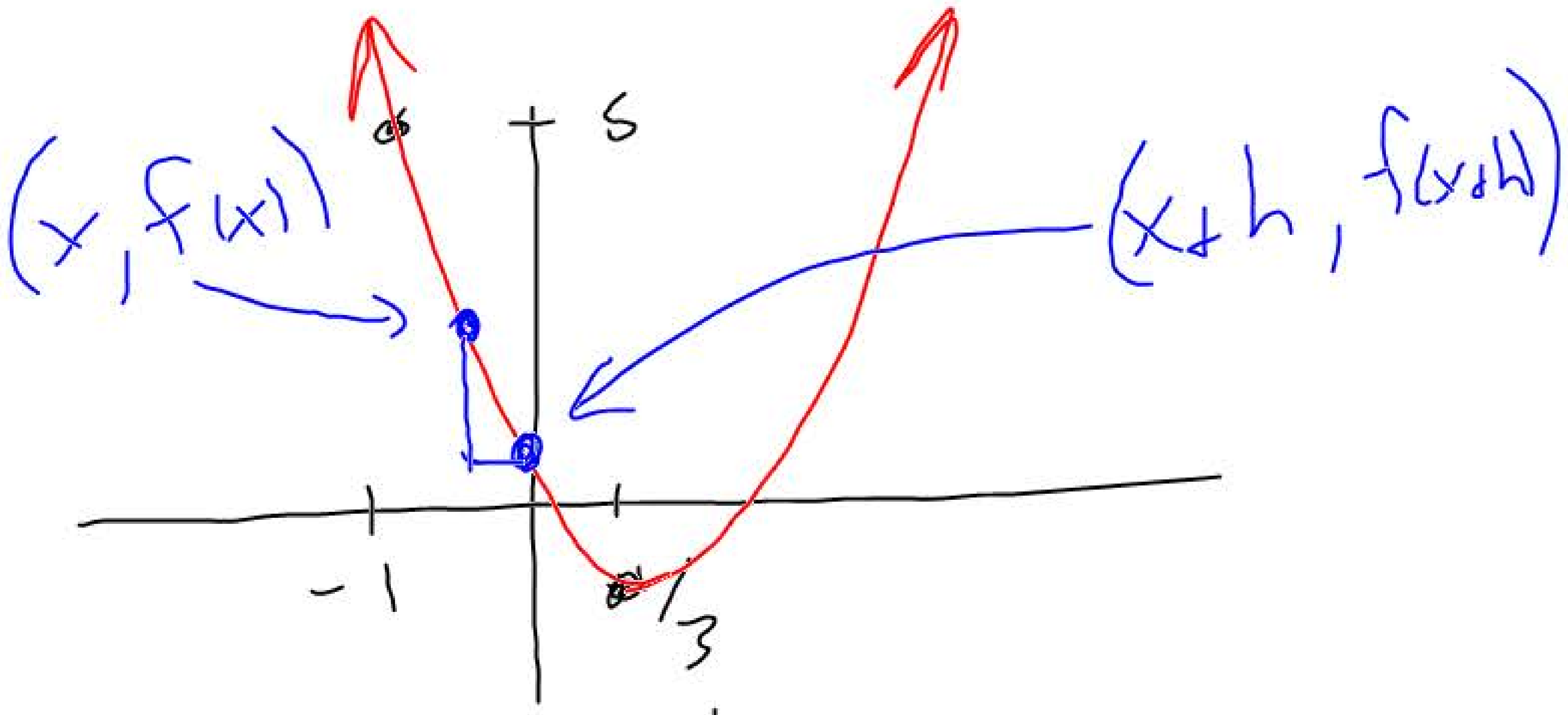


(+)
(−)
y = f(x)
y = f′(x)
x1
x2
x3
x4

$$f(x) = 3x^2 - 2x$$



vertex

$$x = -b/2a = 2/6 = \frac{1}{3}$$

$$f\left(\frac{1}{3}\right) = \frac{1}{3} - \frac{2}{3} = -\frac{1}{3}$$

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

$$= \lim_{x \to 0} \frac{[3(x+h)^2 - 2(x+h)] - [3x^2 - 2x]}{h}$$

$$= \lim_{x \to 0} \frac{3(\cancel{x^2} + 2xh + h^2) - \cancel{2x} - 2h - \cancel{3x^2} + \cancel{2x}}{h}$$

$$= \lim_{x \to 0} \frac{6xh + 3h^2 - 2h}{h} = \lim_{h \to 0} \frac{\cancel{h}(6x + 3h - 2)}{\cancel{h}} = 6x - 2$$

Notation

prime: the derivative

$$f'(x) = \frac{d}{dx}\left[f(x)\right]$$

(Newton)

the derivative of f . . .

(Leibniz)

$$\frac{d}{dx}\left[3x^2 - 2x\right] = 6x - 2$$

$$\frac{d}{dx}\left[\sqrt{x}\right] = \lim_{h \to 0} \frac{\sqrt{x+h} - \sqrt{x}}{h}$$

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

$$= \lim_{h \to 0} \frac{\sqrt{x+h} - \sqrt{x}}{h} \cdot \frac{\left(\sqrt{x+h} + \sqrt{x}\right)}{\left(\sqrt{x+h} + \sqrt{x}\right)}$$

$$= \lim_{h \to 0} \frac{\cancel{x} + h - \cancel{x}}{h\left(\sqrt{x+h} + \sqrt{x}\right)} = \lim_{h \to 0} \frac{\cancel{h}}{\cancel{h}\left(\sqrt{x+h} + \sqrt{x}\right)} = \frac{1}{\sqrt{x} + \sqrt{x}}$$

$$= \frac{1}{2\sqrt{x}}$$

$$\frac{d}{dx}\left[x^n\right] = n x^{n-1}$$

$$\frac{d}{dx}\left[x^5\right] = 5x^4$$

$$\frac{d}{dx}\left[\frac{1}{x^3}\right] = \frac{d}{dx}\left[x^{-3}\right] = -3x^{-4} = \frac{-3}{x^4}$$

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

$$\frac{d}{dx}\left[k f(x)\right] = k f'(x)$$

$$\frac{d}{dx}\left[5x^3 - 3x\right] = 5\left(3x^2\right) - 3\left(1x^0\right)$$

$$= 15x^2 - 3$$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