

Lesson 2

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$$2. h) f(x) = \frac{1}{\sqrt{x}}$$

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

$$= \lim_{h \rightarrow 0} \frac{\frac{1}{\sqrt{x+h}} - \frac{1}{\sqrt{x}}}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\frac{\sqrt{x} - \sqrt{x+h}}{\sqrt{x}\sqrt{x+h}}}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\sqrt{x} - \sqrt{x+h}}{h\sqrt{x}\sqrt{x+h}} \times \frac{\sqrt{x} + \sqrt{x+h}}{\sqrt{x} + \sqrt{x+h}}$$

$$= \lim_{h \rightarrow 0} \frac{x - (x+h)}{h\sqrt{x}\sqrt{x+h}(\sqrt{x} + \sqrt{x+h})}$$

$$= \lim_{h \rightarrow 0} \frac{-h}{h\sqrt{x}\sqrt{x+h}(\sqrt{x} + \sqrt{x+h})}$$

$$= \lim_{h \rightarrow 0} \frac{-1}{x\sqrt{x+h} + \sqrt{x}(x+h)}$$

$$= \frac{-1}{x\sqrt{x} + x\sqrt{x}} = \frac{-1}{2x\sqrt{x}} \text{ same as } \rightarrow \frac{-1}{2\sqrt{x^2}\sqrt{x}} = \frac{-1}{2\sqrt{x^3}}$$

$$2 i) f(x) = \sqrt{x^2+1}$$

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

$$= \lim_{h \rightarrow 0} \frac{\sqrt{(x+h)^2+1} - \sqrt{x^2+1}}{h} \times \frac{\sqrt{(x+h)^2+1} + \sqrt{x^2+1}}{\sqrt{(x+h)^2+1} + \sqrt{x^2+1}}$$

$$= \lim_{h \rightarrow 0} \frac{(x+h)^2+1 - (x^2+1)}{h (\sqrt{(x+h)^2+1} + \sqrt{x^2+1})}$$

$$= \lim_{h \rightarrow 0} \frac{x^2 + 2xh + h^2 + 1 - x^2 - 1}{h (\sqrt{(x+h)^2+1} + \sqrt{x^2+1})}$$

$$= \lim_{h \rightarrow 0} \frac{2xh + h^2}{h (\sqrt{(x+h)^2+1} + \sqrt{x^2+1})}$$

$$= \lim_{h \rightarrow 0} \frac{2x + h}{\sqrt{(x+h)^2+1} + \sqrt{x^2+1}}$$

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

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$$3 f) y = \sqrt{3-11x}$$

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$$\frac{dy}{dx} = \lim_{h \rightarrow 0} \frac{\sqrt{3-11(x+h)} - \sqrt{3-11x}}{h} \times \frac{\sqrt{3-11(x+h)} + \sqrt{3-11x}}{\sqrt{3-11(x+h)} + \sqrt{3-11x}}$$

$$= \lim_{h \rightarrow 0} \frac{3-11(x+h) - (3-11x)}{h (\sqrt{3-11(x+h)} + \sqrt{3-11x})}$$

$$= \lim_{h \rightarrow 0} \frac{3-11x-11h-3+11x}{h (\sqrt{3-11(x+h)} + \sqrt{3-11x})}$$

$$= \lim_{h \rightarrow 0} \frac{-11h}{h (\sqrt{3-11(x+h)} + \sqrt{3-11x})}$$

$$= \lim_{h \rightarrow 0} \frac{-11}{\sqrt{3-11(x+h)} + \sqrt{3-11x}}$$

$$= \frac{-11}{\sqrt{3-11x} + \sqrt{3-11x}} = \frac{-11}{2\sqrt{3-11x}}$$

9. $f(x) = C$

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

$$= \lim_{h \rightarrow 0} \frac{C - C}{h}$$

$$= \lim_{h \rightarrow 0} 0$$

$$= 0.$$

← this is ok. since $\frac{0}{h}$ is zero, ~~the~~ different than limit approaching $\frac{0}{0}$.

10 $f(x) = mx + b$

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

$$= \lim_{h \rightarrow 0} \frac{m(x+h) + b - mx - b}{h}$$

$$= \lim_{h \rightarrow 0} \frac{mx + mh + b - mx - b}{h}$$

$$= \lim_{h \rightarrow 0} \frac{mh}{h}$$

$$= \lim_{h \rightarrow 0} m$$

$$= m.$$