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$$
\begin{tikzcd}
 & \operatorname{sen}(x) \arrow[dr, "'"] & \\
-\cos(x) \arrow[ur, "''''"] & & \cos(x) \arrow[dl, "''"] \\
 & -\operatorname{sen}(x) \arrow[ul, "'''"] &
\end{tikzcd}
$$

$$\operatorname{sen}^{64}(x) = \underbrace{(-1)^{32}}_{1} \operatorname{sen}(x)$$

$$\operatorname{sen}^{\overbrace{66}^{\approx 2}}(x) = -\operatorname{sen}(x) = \underbrace{(-1)^{\overset{33}{\overset{/\!/}{\frac{66}{2}}}}}_{-1} \operatorname{sen}(x)$$

$$\operatorname{sen}^{(n)}(x) = \begin{cases} (-1)^{\frac{n-1}{2}} \cos(x) & n \text{ impar} \\ (-1)^{\frac{n}{2}} \operatorname{sen}(x) & \boxed{n \text{ par}} \end{cases}$$

$$\operatorname{sen}^{\overbrace{''''''''}^{18}}(x)$$

$$= -1 \operatorname{sen}(x)$$

$$\frac{d^n e^x}{dx^n} = e^x \; ; \quad \frac{\partial^n \log(x)}{\partial x^n} = \boxed{\frac{(-1)^{n+1}(n-1)!}{x^n}}$$

$$\overset{3!}{}$$

$$\log'(x) = \frac{1}{x} = x^{-1} \overset{''}{\Longrightarrow} -1\, x^{-2} = \frac{-1}{x^2} \overset{'''}{\Longrightarrow} \frac{2}{x^3} \overset{''''}{\Longrightarrow} \frac{-6}{x^4}$$

$$-1$$

$$(x^3)' = 3x^2$$

$$\frac{2}{x^3} = \frac{+2x}{x^4}$$

$$= \left(\frac{-1}{x^2}\right)' = (-x^{-2})' = +2x^{-3} = \frac{2}{x^3}$$

$$''''' \quad \frac{24}{x^5} \qquad 4!$$

$$\left(e^{-x}\right)^{(n)} = (-1)^n e^{-x}$$

$$\text{tgh}(x) = \frac{\text{senh}(x)}{\cosh(x)}$$

3 $\text{senh}(x) = \dfrac{e^x - e^{-x}}{2}$ ; $\cosh(x) = \dfrac{e^x + e^{-x}}{2}$

$\text{sen}^2(x) + \cos^2(x) = 1$ ; $\cosh^2(x) - \text{senh}^2(x) = 1$

$$\frac{(e^x + e^{-x})^2}{4} - \frac{(e^x - e^{-x})^2}{4} = \frac{\cancel{e^{2x}} + \overbrace{2e^x e^{-x}}^{2e^{x-x} = 2e^0 = 2} + \cancel{e^{-2x}} - (\cancel{e^{2x}} - 2e^x e^{-x} + \cancel{e^{-2x}})}{4}$$

$$= \frac{4}{4} = 1$$

$$\operatorname{senh}'(x) = \left(\frac{e^{x} - e^{-x}}{2}\right)' = \frac{e^{x} - (-e^{-x})}{2} = \frac{e^{x} + e^{-x}}{2}$$

$$\operatorname{senh}'(x) = \cosh(x)$$

$$\cosh'(x) = \left(\frac{e^{x} + e^{-x}}{2}\right)' = \frac{e^{x} + (-e^{-x})}{2} = \frac{e^{x} - e^{-x}}{2} = \operatorname{senh}(x)$$

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$$f(x) = g(x) + (x - a)$$

$$f'(x) = g'(x) + 1$$

$$f(x) = g(x + g(a))$$

$$f'(x) = g'(x + g(a)) \cdot 1$$

$$f(x+3) = g(x^3)$$ cdev $u = x+3$

$$f(u) = g((u-3)^3)$$

$$f'(x+3) = 3x^2 g'(x^3)$$

$$f'(u) = g'((u-3)^3)3(u-3)^2$$

$$f'(x+3) = g(x^3)3x^2$$

$$f(x^3) = g(x+g(x))$$

cdev $u = x^3$

$$f(u) = g(\sqrt[3]{u} + g(\sqrt[3]{u})) \Rightarrow f'(u) = g'(\sqrt[3]{u} + g(\sqrt[3]{u})) \cdot \left(\frac{u^{-2/3}}{3} + g'(\sqrt[3]{u})\frac{u^{-2/3}}{3}\right)$$

$$f'(x^3) = g'(x+g(x))\left(\frac{x^{-2}}{3} + g'(x)\frac{x^{-2}}{3}\right)$$

$$\sqrt[3]{x} = x^{1/3}$$

$$\left(x^{1/3}\right)' = \frac{1}{3} x^{\overbrace{(1/3-1)}^{-2/3}}$$

consecuencia TVM

$$\left.\begin{array}{l} f \text{ y } g \text{ cont. } [a,b] \\ \quad \text{"} \quad \text{deriv. } (a,b) \end{array}\right\} \exists\, c \in (a,b) \,/\, f(c) = g(c) = 0$$

$$g'(x) \neq 0$$

$$\lim_{x\to 0} \frac{f(x)}{g(x)} = \lim_{x\to 0} \frac{f'(x)}{g'(x)} = L$$

indet.

0/0

$$\boxed{\lim_{x\to 0} \frac{x - \operatorname{sen}(x)}{x^3}} = \lim_{x\to 0} \frac{1 - \cos(x)}{3x^2} =$$

$$\operatorname{senh}(x) = \frac{e^{x} - e^{-x}}{2}$$

$$\lim_{x\to 0} \frac{\operatorname{sen}(x)}{6x} = \boxed{\lim_{x\to 0} \frac{\cos(x)}{6} = \frac{1}{6}}$$

$$1 - 1 = 0$$

$$\lim_{x\to 0} \frac{\overbrace{e^{x} - e^{-x}}^{2\operatorname{senh}(x)} - 2x}{x - \operatorname{sen}(x)} = \lim_{x\to 0} \frac{e^{x} + e^{-x} - 2}{1 - \cos(x)} = \lim_{x\to 0} \frac{e^{x} - e^{-x}}{\operatorname{sen}(x)} =$$

$$\operatorname{sen}(0) = 0$$

$$\lim_{x\to 0} \frac{e^{x} + e^{-x}}{\cos(x)} = 2 \qquad = 1 + 1 = 2 \qquad \cos(0) = 1$$

$$\lim_{x \to \infty} \frac{x^4}{x} = \lim_{x \to \infty} \frac{\frac{1}{x}}{\frac{1}{x^4}}$$

$$\lim_{x \to 0} x \log(x) = \lim_{x \to 0} \frac{\log(x)}{1/x} = \lim_{x \to 0} \frac{1/x}{-1/x^2} = \lim_{x \to 0} -x = 0$$

$$\lim_{x\to\infty} x - \sqrt{x^2 - x} = \lim_{x\to\infty} \frac{(x - \sqrt{x^2 - x})(x + \sqrt{x^2 - x})}{x + \sqrt{x^2 - x}}$$

$$\lim_{x\to\infty} \frac{x^2 - x^2 + x}{x + \sqrt{x^2 - x}} = \lim_{x\to\infty} \frac{x}{x + \sqrt{x^2 - x}} =$$

$$\lim_{x\to\infty} \frac{1}{1 + \frac{-2x+1}{2\sqrt{x^2 - x}}} = \lim_{x\to\infty} \frac{1}{1 + \frac{-2x}{2x}} = \infty$$

$$\rightarrow \lim_{x\to\infty} \frac{-2x+1}{2\sqrt{x^2 - x}} = \lim_{x\to\infty} \frac{-2x}{2\sqrt{x^2}} = \lim_{x\to\infty} -\frac{2x}{2x} = -1$$