

$$\frac{\frac{d}{dx} e^x}{\ln(x)} = \frac{\frac{1}{x}}{\ln(x)} \quad \text{Let } x=a$$

"the power to which one raises e to get x
is a."

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

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

$$\lim_{h \rightarrow 0} \frac{1}{h} \left(\ln \frac{x+h}{x} \right)$$

$$\lim_{h \rightarrow 0} \ln \left(\frac{x+h}{x} \right)^{\frac{1}{h}}$$

$$\lim_{h \rightarrow 0} \ln \left(1 + \frac{h}{x} \right)^{\frac{1}{h}}$$

$$\text{Let } u = \frac{h}{x}; ux = h \Rightarrow \frac{1}{ux} = \frac{1}{h}$$

as $h \rightarrow 0$, then $u \rightarrow 0$.

$$\lim_{u \rightarrow 0} \ln \left(1 + u \right)^{\frac{1}{ux}}$$

$$\lim_{u \rightarrow 0} \ln \left(1 + u \right)^{\frac{1}{u}}$$

$$\lim_{u \rightarrow 0} \frac{1}{x} \cdot \ln \left(1 + u \right)^{\frac{1}{u}}$$

$$\frac{1}{x} \cdot \lim_{u \rightarrow 0} \ln \left(1 + u \right)^{\frac{1}{u}}$$

$$\text{Let } n = \frac{1}{u}; un = 1 \Rightarrow u = \frac{1}{n}$$

as $u \rightarrow 0, n \rightarrow \infty$

$$\frac{1}{x} \cdot \lim_{n \rightarrow \infty} \ln \left(1 + \frac{1}{n} \right)^n$$

$$\frac{1}{x} \cdot \ln \left(\lim_{n \rightarrow \infty} \left(1 + \frac{1}{n} \right)^n \right)$$

$$\frac{1}{x} \cdot \ln(e) \rightarrow 1$$

$$\ln a - \ln b = \ln \frac{a}{b}$$

$$a \cdot \ln b = \ln b^a$$

$$x^{a \cdot b} = (x^a)^b$$

$$(x^a)^b = x^{ab}$$

$$(x^2)^3 = x^6$$

$$e = \lim_{n \rightarrow \infty} \left(1 + \frac{1}{n} \right)^n$$

$$\frac{1}{x}$$

$$\boxed{\frac{d}{dx} \ln(x) = \frac{1}{x}}$$

$$\cancel{\frac{d}{dx}} \ln 3x^2 \rightarrow \frac{1}{3x^2} \underbrace{i \cdot 6x}_{\text{Chain}} \\ \frac{6x}{3x^2} \rightarrow \boxed{\frac{2}{x}}$$

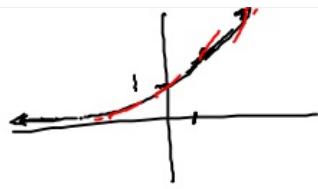
$$\frac{d}{dx} \ln(\sin(x))$$

$$\frac{1}{\sin(x)} \cdot \cos x = \frac{\cos}{\sin} \rightarrow \boxed{\cot(x)}$$

$$\frac{d}{dx} \sin(\ln(x))$$

$$\cos(\ln(x)) \cdot \frac{1}{x} \rightarrow \frac{\cos(\ln x)}{x}$$

$$e^x$$



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

Consider: $\ln e^x = x$

$$\frac{d}{dx} \ln(e^x) = \frac{d}{dx} x$$

~~e^x~~ : $\frac{1}{e^x} \cdot \frac{d}{dx} e^x = 1 \cdot e^x$

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

~~e^x~~ : $\frac{d}{dx} 2e^x = 2e^x$

$$\frac{d}{dx} e^{x^2} = e^{x^2} \cdot 2x \rightarrow \underline{2x \cdot e^{x^2}}$$

$$\frac{d}{dx} \underline{\ln e^x} = \frac{1}{e^x} \cdot e^x = \textcircled{1}$$

$$\frac{d}{dx} x$$