

$$\begin{aligned} \lim_{x \rightarrow +\infty} e^x &= +\infty \\ \lim_{x \rightarrow -\infty} e^x &= 0^+ \\ \lim_{x \rightarrow +\infty} \frac{e^x}{x} &= +\infty \\ \lim_{x \rightarrow -\infty} x \cdot e^x &= 0^- \\ n \in \mathbb{N}^* : \begin{cases} \lim_{x \rightarrow -\infty} x^n \cdot e^x = 0 \\ \lim_{x \rightarrow +\infty} \frac{e^x}{x^n} = +\infty \end{cases} \\ \lim_{x \rightarrow 0} \frac{e^x - 1}{x} &= 1 \end{aligned}$$

$$\begin{aligned} x > 0 : (\ln x)' &= \frac{1}{x} \\ u(x) > 0 : (\ln(u(x)))' &= \frac{u'(x)}{u(x)} \\ v(x) \neq 0 : (\ln(|v(x)|))' &= \frac{v'(x)}{v(x)} \\ (e^x)' &= e^x \\ (e^{u(x)})' &= u'(x) \cdot e^{u(x)} \\ (\log_a(x))' &= \frac{1}{x \ln a} \\ (a^x)' &= (\ln a) \cdot a^x \end{aligned}$$

بالتفريق

$$\begin{aligned} \lim_{x \rightarrow +\infty} \ln(x) &= +\infty \\ \lim_{x \rightarrow 0^+} \ln(x) &= -\infty \\ \lim_{x \rightarrow +\infty} \frac{\ln(x)}{x} &= 0^+ \\ \lim_{x \rightarrow 0^+} x \cdot \ln(x) &= 0^- \\ n \in \mathbb{N}^* : \begin{cases} \lim_{x \rightarrow 0^+} x^n \cdot \ln(x) = 0^- \\ \lim_{x \rightarrow +\infty} \frac{\ln(x)}{x^n} = 0^+ \end{cases} \\ \lim_{x \rightarrow 1} \frac{\ln(x)}{x-1} &= 1 \\ \lim_{x \rightarrow 0} \frac{\ln(1+x)}{x} &= 1 \end{aligned}$$

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$$\begin{aligned} x \in \mathbb{R}, y \in \mathbb{R}, r \in \mathbb{Q}^* \\ e^x \cdot e^y &= e^{(x+y)} \\ \frac{e^x}{e^y} &= e^{(x-y)} \\ \frac{1}{e^x} &= e^{(-x)} \\ (e^x)^r &= e^{(r \cdot x)} \\ \sqrt{e^x} &= e^{(\frac{1}{2} \cdot x)} \\ e^{(\ln x)} &= x, x \in]0, +\infty[\\ \ln(e^x) &= x, x \in \mathbb{R} \end{aligned}$$

$$\begin{aligned} x > 0, y > 0, r \in \mathbb{Q}^* \\ \ln(x \cdot y) &= \ln(x) + \ln(y) \\ \ln\left(\frac{x}{y}\right) &= \ln(x) - \ln(y) = -\ln\left(\frac{y}{x}\right) \\ \ln\left(\frac{1}{x}\right) &= -\ln(x) \\ \ln((x)^r) &= r \cdot \ln(x) \\ \ln(\sqrt{x}) &= \frac{1}{2} \cdot \ln(x) \\ \ln(e) &= 1 ; \ln(1) = 0 ; e^0 = 1 \\ x > 0 : (\ln x = y \Leftrightarrow x = e^y) \end{aligned}$$

$$\begin{aligned} \ln(x) > 1 &\Leftrightarrow x > e \\ \ln(x) = 1 &\Leftrightarrow x = e \\ \ln(x) < 1 &\Leftrightarrow 0 < x < e \\ \ln(x) > 0 &\Leftrightarrow x > 1 \\ \ln(x) = 0 &\Leftrightarrow x = 1 \\ \ln(x) < 0 &\Leftrightarrow 0 < x < 1 \\ \forall x \in \mathbb{R} : e^x &> 0 \\ \forall x > 0 : e^x &> 1 \\ x = 0 &\Leftrightarrow e^x = 1 \\ \forall x < 0 : 0 &< e^x < 1 \end{aligned}$$

$$\begin{aligned} x \in \mathbb{R}, y \in \mathbb{R}, r \in \mathbb{Q}^* \\ e^x \cdot e^y &= e^{(x+y)} \\ \frac{e^x}{e^y} &= e^{(x-y)} \\ \frac{1}{e^x} &= e^{(-x)} \\ (e^x)^r &= e^{(r \cdot x)} \\ \sqrt{e^x} &= e^{(\frac{1}{2} \cdot x)} \\ e^{(\ln x)} &= x, x \in]0, +\infty[\\ \ln(e^x) &= x, x \in \mathbb{R} \end{aligned}$$

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$$\begin{aligned} & \quad \quad \quad u \\ & \quad \quad \quad I \\ & \quad \quad \quad : \\ I & \quad x \mapsto \frac{u'(x)}{u(x)} \\ & \quad \quad \quad : \\ & \quad \quad \quad x \mapsto \ln(|u(x)|) + c \\ & \quad \quad \quad \cdot \\ & \quad \quad \quad c \end{aligned}$$

$$\begin{aligned} x \mapsto \frac{1}{x} : \\]0, +\infty[\\ : \\ 1 \\ \cdot \\ x \mapsto \ln(x) \\ \\ t > 0, a > 0, a \neq 1 \\ 10^x = t \Leftrightarrow x = \log(t) \\ a^x = t \Leftrightarrow x = \log_a(t) \end{aligned}$$

$$\begin{aligned} x > 0, a > 0, a \neq 1, r \in \mathbb{Q}^* \\ \log_a(x) &= \frac{\ln(x)}{\ln(a)} \\ \log_a(1) &= 0 ; \log(1) = 0 \\ \log_a(a^r) &= r ; \log_a(a) = 1 \\ \log(10^r) &= r ; \log(10) = 1 \\ a^x &= e^{(x \cdot \ln a)} \\ \log_a(x) = y &\Leftrightarrow x = a^y = e^{y \cdot \ln a} \end{aligned}$$

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