

Listab

5f

$$\lim_{x \rightarrow +\infty} \frac{1-2^x}{1-3^x} = \lim_{x \rightarrow +\infty} \frac{2^x(2^{-x}-1)}{3^x(3^{-x}-1)}$$

$p \neq 0$
 $q \neq 0$
multi
real $\neq 0$

$$= \lim_{x \rightarrow +\infty} \left(\frac{2}{3}\right)^x \left(\frac{2^{-x}-1}{3^{-x}-1}\right) = 0$$

$0 < \frac{2}{3} < 1$
 $x \rightarrow +\infty$

$p \neq 0$
 $q \neq 0$
multi
real $\neq 0$

(7e)

$$\ln a - \ln b = \ln\left(\frac{a}{b}\right)$$

$$\lim_{x \rightarrow +\infty} [\ln(2x+1) - \ln(x+3)]$$

$$= \lim_{x \rightarrow +\infty} \ln\left(\frac{2x+1}{x+3}\right) = \ln 2$$

composta de contínuas

$$\star \lim_{x \rightarrow +\infty} \frac{2x+1}{x+3} = \lim_{x \rightarrow +\infty} \frac{x}{x} \cdot \frac{(2+\frac{1}{x})}{(1+\frac{3}{x})} = \frac{2}{1} = 2$$

$$\textcircled{9d} \quad \lim_{x \rightarrow 0^+} \frac{3^x - 1}{x^2} = \lim_{x \rightarrow 0^+} \frac{1}{x} \cdot \frac{3^x - 1}{x} = +\infty$$

Annotations: Red circles around $\frac{1}{x}$ and $\frac{3^x - 1}{x}$. An arrow points from $\frac{1}{x}$ to $+\infty$. Another arrow points from $\frac{3^x - 1}{x}$ to a circled star with the note $\ln 3 > 0$.

$$\lim_{x \rightarrow 0^+} \frac{e^{(\ln 3)x} - 1}{(\ln 3)x} \cdot \ln 3 = \lim_{y \rightarrow 0^+} \frac{e^y - 1}{y} \cdot \ln 3$$

Annotations: A circled star is above the first limit. A red circle is around $\frac{e^y - 1}{y}$ with an arrow pointing to it. A red note below says $\ln 3 x = y$ and $x \rightarrow 0^+ \Rightarrow y \rightarrow 0^+$.

$$= \ln 3$$

23m

$$((1+\sqrt{x}) \cdot e^x \cdot \operatorname{tg} x)'$$

$$= ((1+\sqrt{x}) \cdot [e^x \cdot \operatorname{tg} x])'$$

$$= (1+x^{\frac{1}{2}})' \cdot [e^x \cdot \operatorname{tg} x] - (1+\sqrt{x}) \cdot [e^x \cdot \operatorname{tg} x]'$$

$$= (0 + \frac{1}{2}x^{-\frac{1}{2}}) \cdot [e^x \cdot \operatorname{tg} x] - (1+\sqrt{x}) [e^x \cdot \operatorname{tg} x + e^x (\operatorname{tg} x)']$$

$$= \frac{1}{2} \frac{1}{\sqrt{x}} \cdot (e^x \cdot \operatorname{tg} x) - (1+\sqrt{x}) (e^x \operatorname{tg} x + e^x \operatorname{sec}^2 x)$$