

1. For each of the following, circle YES if L'Hôpital's Rule can be applied, and NO if it cannot.

(a) YES NO $\lim_{x \rightarrow 0} \frac{\sin(x)}{1 - \cos(x)}$

(b) YES NO $\lim_{x \rightarrow \infty} \frac{e^x}{1 + x^2}$

(c) YES NO $\lim_{x \rightarrow \infty} \frac{\ln(x)}{e^{-x}}$

(d) YES NO $\lim_{x \rightarrow -\infty} \frac{x}{2^x}$

2. Use L'Hôpital's Rule to evaluate.

(a) $\lim_{x \rightarrow 2} \frac{x^2 - 4}{x^3 - 8} \stackrel{LR}{=} \lim_{x \rightarrow 2} \frac{2x}{3x^2} = \lim_{x \rightarrow 2} \frac{2}{3x}$
 $= \frac{2}{3 \cdot 2} = \frac{1}{3}$

(b) $\lim_{x \rightarrow -\infty} \frac{e^{-x}}{x^2 - 3} \stackrel{LR}{=} \lim_{x \rightarrow -\infty} \frac{-e^{-x}}{2x}$
 $\stackrel{LR}{=} \lim_{x \rightarrow -\infty} \frac{e^{-x}}{2} \quad DNE (+\infty)$

(c) $\lim_{x \rightarrow \infty} \frac{x}{5^x} \stackrel{LR}{=} \lim_{x \rightarrow \infty} \frac{1}{5^x \ln 5} = 0$

3. Find $\lim_{x \rightarrow \infty} x^2 e^{-3x}$. $= \lim_{x \rightarrow \infty} \frac{x^2}{e^{3x}} \stackrel{LR}{=} \lim_{x \rightarrow \infty} \frac{2x}{3e^{3x}}$

$\stackrel{LR}{=} \lim_{x \rightarrow \infty} \frac{2}{9e^{3x}} = 0$

4. Find $\lim_{x \rightarrow -\infty} \frac{7^x}{5^x}$. $= \lim_{x \rightarrow -\infty} \left(\frac{7}{5}\right)^x = 0$

5. Find $\frac{d}{dx} 3^{2+3x}$.

$f(x) = 3^x$

$f'(x) = 3^x \ln 3$

$g(x) = 2+3x$

$g'(x) = 3$

$f'(g(x)) g'(x) = 3^{g(x)} \ln 3 \cdot 3$

$= 3 \ln 3 \cdot 3^{2+3x}$

6. Find $\frac{d}{dx} \log_4(2+x^2)$.

$f(x) = \log_4(x)$

$f'(x) = \frac{1}{x \ln 4}$

$g(x) = 2+x^2$

$g'(x) = 2x$

$f'(g(x)) g'(x) = \frac{1}{g(x) \ln 4} \cdot 2x$

$= \frac{2x}{(\ln 4)(2+x^2)}$