Calculus

Name Examples

L'Hopital's Rule

$\lim_{x\to a} \frac{f(x)}{g(x)} = \lim_{x\to a} \frac{f'(x)}{g'(x)}$ ← for $\frac{0}{0}$ or $0\cdot\infty$ or $0\cdot$ undef

Date _____ Period ____

Evaluate each limit using L'Hôpital's Rule.

1) $\lim_{x\to\infty} \frac{x}{e^{2x}} = \frac{\infty}{\infty}$

$\lim_{x\to\infty} \frac{1}{2e^{2x}} = \frac{1}{\infty} = \boxed{0}$

2) $\lim_{x\to 0} \frac{\tan(3x)}{5x} = \frac{0}{0}$

$\lim_{x\to 0} \frac{3\sec^2(3x)}{5} = \frac{3(1)^2}{5} = \boxed{\frac{3}{5}}$

3) $\lim_{x\to 0^+} x^2 \ln x = 0\cdot(-\infty)$

* let $t = \frac{1}{x} \to x = \frac{1}{t}$ } trick

$x \to 0^+$ means $t \to \infty$

$\lim_{t\to\infty} \left(\frac{1}{t}\right)^2 \ln\left(\frac{1}{t}\right)$

$\lim_{t\to\infty} \frac{\ln(t^{-1})}{t^2}$

$\lim_{t\to\infty} \frac{-\ln(t)}{t^2} = \lim_{t\to\infty} \frac{-\frac{1}{t}}{2t} \overset{\lim_{t\to\infty}}{=} \frac{1}{2t^2} = \boxed{0}$

4) $\lim_{x\to 0} \frac{3(e^x - e^{-x})}{x} = \frac{0}{0}$

$\lim_{x\to 0} \frac{3(e^x + e^x)}{1} = \frac{3(1+1)}{1} = \boxed{6}$

5) $\lim_{x\to 0} 3x\cot x = 0\cdot$ und

$\lim_{x\to 0} \frac{3x\cos x}{\sin x}$

$= \lim_{x\to 0} \frac{3\cos x - 3x\sin x}{\cos x}$

$= \frac{3(1) - 0}{1} = \boxed{3}$

6) $\lim_{x\to 3} \frac{x-3}{\sqrt{x-2}-1} = \frac{0}{0}$

$= \lim_{x\to 3} \frac{1}{\frac{1}{2\sqrt{x-2}}} = \frac{1}{\frac{1}{2\sqrt{1}}} = \boxed{2}$

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L'Hopital's Rule

Date_____ Period____

Evaluate each limit using L'Hôpital's Rule.

1) $\lim_{x \to 0} \frac{5\left(e^{x} - e^{-x}\right)}{\sin x}$

2) $\lim_{x \to 1} \frac{(x-1)}{\ln x}$

3) $\lim_{x \to 1} \frac{2 \ln x}{x-1}$

4) $\lim_{x \to -2} \frac{x^2 + 3x + 2}{x+2}$

5) $\lim_{x \to 0^+} 4x \ln x$

6) $\lim_{x \to 1} \frac{4 \ln x^2}{x^2 - 1}$