Info...

Test 3 review videos are posted!

Note the due date on Homework 10.

We will have an ONLINE review for Test 3 Friday from 4-6pm.
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<td>EMCF28 due at 9am</td>
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<td>Quiz 10 closes (10.4-10.5)</td>
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Popper 20

1. \( \lim_{x \to \infty} \frac{100x^2}{e^x} = \)

2. \( \lim_{x \to \infty} \frac{100 \ln(x)}{x^2} = \)

3. \( \lim_{x \to \infty} x \sin \left( \frac{1}{x} \right) = \)

4. \( \lim_{x \to 0} \frac{x - \tan(x)}{x - \sin(x)} = \)

5. \( \lim_{x \to 0} \frac{1 - \sec(x)}{x^2} = \)

\( \text{DNE} = 999 \)
3. \[ \lim_{x \to \infty} x \sin \left( \frac{1}{x} \right) = \lim_{x \to \infty} \frac{\sin \left( \frac{1}{x} \right)}{\frac{1}{x}} = \lim_{u \to 0} \frac{\sin (u)}{u} = 1 \]

\[ \lim_{x \to \infty} \frac{17 x \cdot \frac{1}{x}}{\infty} = 17 \]
4. \[ \lim_{{x \to 0}} \frac{x - \tan(x)}{x - \sin(x)} = \frac{0}{0} \text{ ind. form} \]

Try L'Hopital's Rule:

\[ \lim_{{x \to 0}} \frac{1 - \sec^2(x)}{1 - \cos(x)} = \frac{0}{0} \text{ ind. form} \]

Think or Use L'Hopital rule 2 more times.

Note: \( \sec^2(x) = \frac{1}{\cos^2(x)} \)

\[ = \lim_{{x \to 0}} \frac{\cos^2(x)}{\cos^2(x)} \cdot \frac{1 - \sec^2(x)}{1 - \cos(x)} \]

\[ = \lim_{{x \to 0}} \frac{\cos^2(x) - 1}{\cos^2(x) (1 - \cos(x))} \]

\[ = \lim_{{x \to 0}} \frac{(\cos(x) - 1)(\cos(x) + 1)(-1)}{\cos^2(x) (1 - \cos(x))} \]

\[ = -\frac{2}{1} = -2 \]
Recall:

L’Hospital’s Rule: \((0/0)\) Case.

**Theorem** Suppose that \(f\) and \(g\) are differentiable functions with \(g'(x) \neq 0\), and suppose

\[
f(x) \to 0 \text{ and } g(x) \to 0
\]
as \(x \to c^+, c^-, c, \infty, -\infty\). Let \(L\) be a real number or \(\pm \infty\).

If \(\frac{f'(x)}{g'(x)} \to L\) then \(\frac{f(x)}{g(x)} \to L\).
L'Hospital’s Rule: \((\infty/\infty)\) Case.

**Theorem** Suppose that \(f\) and \(g\) are differentiable functions with \(g'(x) \neq 0\), and suppose

\[f(x) \to \pm \infty \text{ and } g(x) \to \pm \infty\]

as \(x \to c^+, c^-, c, \infty, -\infty\). Let \(L\) be a real number or \(\pm \infty\).

If \(\frac{f'(x)}{g'(x)} \to L\) then \(\frac{f(x)}{g(x)} \to L\).
Recall: \[
\lim_{x \to 0^+} \left( e^x + 2x \right)^{1/x} \to \infty = e^3
\]

There is no way we would have ever guessed this.

"\(\infty \) \(\infty \)" ind. form.

Example: \[
\lim_{x \to \infty} \left( e^x + 2x \right)^{1/x} = e \quad \text{"}\left(\infty \right)^{1/\infty} \text{" ind. form}
\]

Note: \[
\ln\left(\left( e^x + 2x \right)^{1/x}\right) = \frac{\ln(e^x + 2x)}{x}
\]

\[
\lim_{x \to \infty} \frac{\ln(e^x + 2x)}{x} = \frac{e^x + 2}{e^x + 2x} \quad \text{"}\infty \text{" ind. form}
\]

\[
\lim_{x \to \infty} \frac{e^x + 2}{e^x + 2x} = \lim_{x \to \infty} \frac{\frac{e^x + 2}{e^x}}{\frac{e^x + 2x}{e^x}} = \frac{1 + \frac{2}{e^x}}{1 + \frac{2x}{e^x}} = 1
\]
Example: \( \lim_{x \to \infty} \left( x^2 + 2x \right)^{1/x} = 1 \), "\( \infty^0 \)" ind. form

Note: \( (x^2 + 2x)^{1/x} = e \)

\[
\ln \left( (x^2 + 2x)^{1/x} \right) = \frac{\ln(x^2 + 2x)}{x} = e
\]

\[
\lim_{x \to \infty} \frac{\ln(x^2 + 2x)}{x} = \frac{\infty}{\infty}, \text{ind. form}
\]

Try L'Hôpital's Rule: \( \lim_{x \to \infty} \frac{2x + 2}{x^2 + 2x} = \lim_{x \to \infty} \frac{2x + 2}{x^2 + 2x} = 0 \)