Names: ________________________

____

____

Lab #11
Math 120 Lab
Thursday
April 3, 2014
Prof. Ron Buckmire

Limits and Exotic Indeterminate Forms: ∞^0, 1^∞, 0^∞ and 0^0

Introduction

Indeterminate forms like $0 \cdot \infty$ and $\infty - \infty$ can often be handled by reducing them algebraically to $0/0$ or ∞/∞. Then L'Hopital's Rule can be applied. However there are more complicated expressions which require a little bit more work before you can apply L'Hopital's Rule.

Consider the folowing indeterminate forms: ∞^0, 1^∞, 0^∞ and 0^0

These indeterminate forms are considered "exotic" and require another approach. The following proposition is often helpful.

PROPOSITION:

If $f(x) > 0$, then $f(x)^{g(x)} = e^{\ln(f(x)^{g(x)})} = e^{g(x)\ln(f(x))}$.

In this case, $\lim_{x\to a} f(x)^{g(x)} = \lim_{x\to a} e^{g(x)\ln(f(x))} = e^{\lim_{x\to a} g(x)\ln(f(x))}$.

Examples

Evaluate $\lim_{k\to\infty} k^{1/k}$

Evaluate $\lim_{k\to\infty} k^{1/k^2}$

Using techniques you have learned in this course, find the following limits if they exist. Decide first if an expression is an indeterminate form, and if so, of what kind. Check your work carefully. (You may also wish to use graphing or *Derive* to check your work.)

1. $\lim_{x \to 0} \frac{\sin(5x)}{\sin(7x)}$

2. $\lim_{x \to \infty} x \sin(1/x)$

3. $\lim_{x \to 0^+} (\cos x)^{1/x}$

4. $\lim_{x \to +\infty} \left(1 + \frac{1}{x}\right)^x$.

5. $\lim_{x \to \infty} \frac{\ln(1+x)}{x}$

6. $\lim_{x \to 0^+} x^x$

7. $\lim_{x \to 0^+} x^{(x^2)}$

8. $\lim_{x \to 0^+} \left(\frac{1+x}{1-x}\right)^{\frac{1}{x}}$