Indeterminate Forms and L'Hopital's Rule

W-up: Use your graphing calculator to evaluate the following limit graphically

$$\lim_{x\to 0}\frac{e^{2x}-1}{x}$$

L'Hopital's Rule : Method of using differentiation to find limits that cannot be solved algebraically. Use direct substitution to try and evaluate the limit. If the indeterminate forms of $\frac{0}{0}$ OR $\frac{\pm\infty}{\pm\infty}$ then the limit of the result of differentiating the numerator and denominator ***individually*** will be equivalent to the original expression. Note: We are NOT using the quotient rule to differentiate the rational expression.

L'Hopital's Rule

If $\lim_{x\to c}\frac{f(x)}{g(x)}=\frac{0}{0} or \frac{\pm\infty}{\pm\infty}$ **then** $\lim_{x\to c}\frac{f(x)}{g(x)}=\lim_{x\to c}\frac{f'(x)}{g'(x)}$

provided the limits exist!

EX) Use L'Hopital's Rule to evaluate $\lim_{x\to 0}\frac{e^{2x}-1}{x}$ to verify result from above.

EX) Use L'Hopital's Rule to evaluate each limit. Note: the rule may have to be applied more than one time to evaluate the limit.

A) $\lim_{x\to 0}\frac{e^{2x}-1}{x}$ B) $\lim_{x\to\infty}\frac{\ln x}{x}$ C) $\lim_{x\to-\infty}\frac{x^2}{e^{-x}}$

Note: L'Hopital's Rule is true ONLY for the indeterminate forms of $\frac{0}{0} or \frac{\pm\infty}{\pm\infty}$.

Any other indeterminate forms $\left(0\bullet\infty,\ 1^{\infty},\ 0^{0},\ \infty-\infty\right)$ must be rewritten so that $\frac{0}{0} or \frac{\pm\infty}{\pm\infty}$ are obtained.