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Math 2094 Lab #6 **Rates of Growth**

Recall the following definition:

Definition: (1) f grows faster than g as
$$x \to \infty$$
 if $\lim_{x \to \infty} \frac{f(x)}{g(x)} = \infty$ (or, equivalently, if $\lim_{x \to \infty} \frac{g(x)}{f(x)} = 0$).
(We will write $f >> g$.)
(2) f and g grow at the same rate as $x \to \infty$ if $\lim_{x \to \infty} \frac{f(x)}{g(x)} = L$ where $0 < L < \infty$. (We will write $f = g$.)

Use *Mathematica* to calculate $\lim_{x\to\infty} \frac{f(x)}{g(x)}$ to determine the relative rates of growth in the following exercises.

The proper syntax is $\text{Limit}[f(x)/g(x), x \rightarrow \text{Infinity}]$. You should first solve exercises 1., 3., and 5. You should be able to solve the other exercises outside of lab using the patterns found in your solutions on the three problems mentioned above.

- 1. Order the following functions from fastest growing to slowest growing. (Note: Be sure to indicate those that grow at the same rate.)
 - a) $v = e^x$
 - b) $y = 2^{x}$
 - e) $y = 2^{x^2}$ f) $y = 2^{x^3}$ g) $y = 2^{x+1}$ c) $y = 3^{x}$
 - d) $v = x^x$

2. Write down any function that will grow faster than the fastest growing function that you have listed. Write down any function that will grow slower than the slowest growing function that you have listed.

- Order the following functions from fastest growing to slowest growing. (Note: Be sure to indicate those 3. that grow at the same rate.)
 - e) $y = \sqrt{x}$ a) y = xf) $y = \sqrt{x^2 + 2x}$ b) $y = x^2$
 - g) $y = 2^{x}$
 - c) $y = x^{25,000}$
 - d) $y = x^2 + 2x$

- Write down any function that will grow faster than the fastest growing function that you have listed. Write 4. down any function that will grow slower than the slowest growing function that you have listed.
- Order the following functions from fastest growing to slowest growing. (Note: Be sure to indicate those 5. that grow at the same rate.)
 - e) $y = \ln(x^{\frac{1}{2}})$ a) $y = \ln(x)$
 - f) $y = \sqrt{x}$ b) $y = \ln(x^2)$
 - g) $y = x^{\frac{1}{25,000}}$ c) $y = (\ln(x))^2$
 - d) $y = (\ln(x))^{\frac{1}{2}}$

Write down any function that will grow faster than the fastest growing function that you have listed in the 6. previous problem. Write down any function that will grow slower than the slowest growing function that you have listed in the previous problem.

- 7. Order the following functions from fastest growing to slowest growing. (Note: Be sure to indicate those that grow at the same rate.)
 - g) $y = \sqrt{x^4 + 1}$ a) y = x
 - b) $y = x^{3}$ h) $y = \ln(x)$
 - c) $y = e^x$ i) $y = 2^x$
 - d) $y = x^{25,000}$ j) $y = (\ln(x))^2$
 - e) $y = x^{\frac{1}{25,000}}$ f) $y = x^2$ k) $y = 3^{x^2}$