MT 135-56/8 **Limits with *Derive*™ *6*** **Fall, 2004**

In previous activities, you learned how to use Derive to do some basic algebraic manipulations and graphing. In this worksheet, you will begin learning some of the Calculus features of Derive.

Getting Started:
Run *Derive*™ *6* from any of the computer labs on campus. If the algebra window doesn't fill the entire Derive screen, click the "Maximize" button at the top right corner of the algebra window. Take your earlier Derive worksheets with you in case you need to refer to instructions for things like the absolute value function.

Computing Limits:
Highlight the expression whose limit you intend to find (you may have to author it first). Then select "Limit" from the Calculus menu at the top of the screen. If your expression contains more than one variable, choose the limit variable from the drop-down menu in the "Limit" dialog box (see Figure 1). In that dialog box, enter also the limit point, and indicate whether the limit is two-sided (approaching the limit point from both sides), or the variable is approaching the limit point from the left or from the right. If the "limit point" is ∞, or $-\infty$, it doesn't matter which direction you tell Derive to approach from. When all the settings are correct, click the "OK" button. Then do a "Basic" simplification from the Simplify menu.

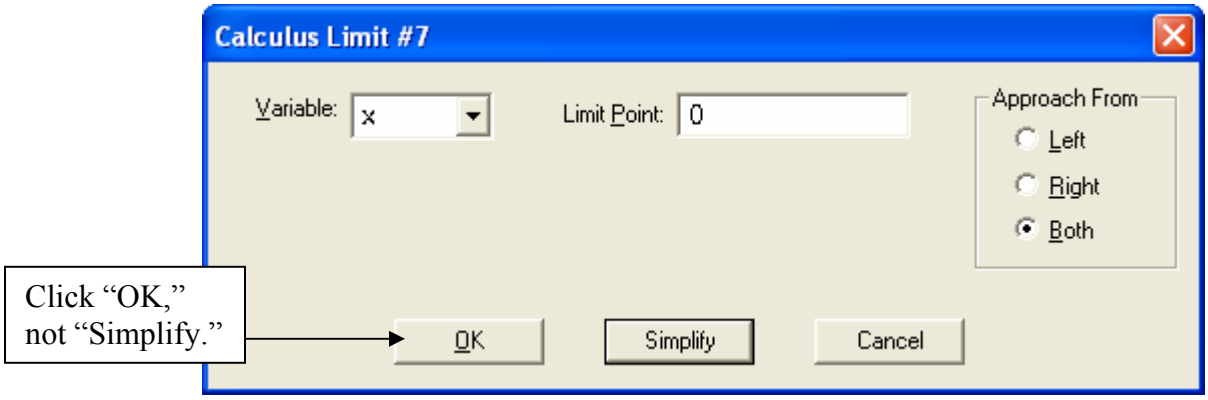

Figure 1: "Limit" Dialog Box

Try This:
Author the expression $\frac{|2x-4|}{x-2}$. In the "Limit" dialog box, set the limit point to 2 and the "Approach From" value to "Left." Click "OK" (not "Simplify"). You should see $\lim_{x\to 2-} \frac{|2x-4|}{x-2}$ in the algebra window. The purpose of using the "OK" button is so that you can review the command you're asking Derive to perform – in this case, the limit of $\frac{|2x-4|}{x-2}$ as x approaches 2 from the left. Now choose "Basic" from the Simplify menu to get the result of -2.

Compute $\lim_{x\to 2^+}\dfrac{|2x-4|}{x-2}$. You should see the result of 2. Finally, compute $\lim_{x\to 2}\dfrac{|2x-4|}{x-2}$ by choosing "Both" in the "Approach From" section of the "Limit" dialog box. After simplifying, Derive returns the result ± 2. Fortunately, we know that a limit can have only one value, so we conclude that $\lim_{x\to 2}\dfrac{|2x-4|}{x-2}$ doesn't exist. *Do not allow Derive to be a substitute for thinking!*

Copying Results from Derive onto Your Homework Paper:
Be sure to use subscripts and superscripts appropriately. For example, you should write "$\lim_{x\to 2^+}(x-3)$" instead of "$\lim_{x\to 2+}(x-3)$" (notice the position of the "+" symbol).

Exercises
Use *Derive*^{TM} *6* for the following exercises. Use standard mathematical notation to record the results ***on a separate sheet of notebook paper.*** Do not turn in a print-out of your Derive session. Note that "standard" notation is not always the same as Derive's notation. Remember that I should be able to tell what the question was, from the answer written on your paper.

1. Define $f(x)=\dfrac{x^3-42x^2+345x+2116}{2x^2-45x-23}$, and compute the following.

(a) $\lim_{x\to 23} f(x)$ (b) $f(23)$ (c) $\lim_{x\to(-\frac{1}{2})^-} f(x)$

(d) $\lim_{x\to(-\frac{1}{2})^+} f(x)$ (e) $\lim_{x\to-\frac{1}{2}} f(x)$

2. Write a sentence or two about what the values in Question 1 tell you about asymptotes, holes, and jumps in the graph of $y=\dfrac{x^3-42x^2+345x+2116}{2x^2-45x-23}$.

3. Define $g(x)=\dfrac{|x^2-3x+2|}{(x-1)\sqrt{4x^2+4}}$, and compute the following. Check to make sure that you have authored this expression correctly. Parentheses matter!

(a) $\lim_{x\to 1^+} g(x)$ (b) $\lim_{x\to 1^-} g(x)$ (c) $\lim_{x\to 1} g(x)$

(d) $\lim_{x\to\infty} g(x)$ (e) $\lim_{x\to-\infty} g(x)$

4. Write a sentence or two about what the values in Question 3 tell you about asymptotes, holes, and jumps in the graph of $y=\dfrac{|x^2-3x+2|}{(x-1)\sqrt{4x^2+4}}$.