Math 126 Calculus I Derive Lab 2 Block 3 Tinsley

Directions: Work in the same groups you did in lab 1. Turn in only one lab but include all names.

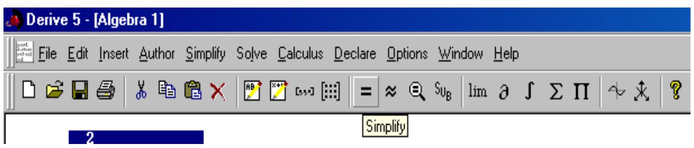
Have your first lab handy for reference. This lab assumes knowledge of the first. The work that you turn in related to this lab is due at 9:00 am on Monday of the 3rd week of the block. Turn in exercises 1 and 2. You will turn in your work electronically. I will give instructions in class on Thursday.

In this lab we intend to have you:

a. Learn to utilize some additional features of Derive;
b. Enhance the appearance of the outputs from Derive;
c. Incorporate Derive into your written work.

You need to be familiar with Microsoft Word. If not, you will need some additional assistance. The general idea is to let Derive do the hard work for you and then copy and paste your solutions including graphs into a word processing document. Pasting the objects as *Device Independent Bitmaps* will allow easy resizing and rearranging of the Derive objects within the document. However, performance seems to vary quite a bit.

Not surprisingly (☺), Derive does calculate derivatives. The Find Derivative (button along with the Simply (=)) button does the trick. Two new expressions will appear including the desired answer.



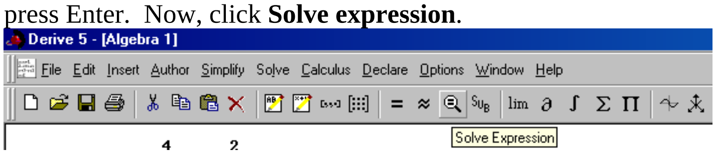
A. Author the expression f(x) := x^4-3x^2+2x – 1 (see lab 1, if you have forgotten how). The previous statement is assigns the expression x^4-3x^2+2x – 1 to the function f. You now can use *f(x)* in place of the more complicated expression. So, author the expression, *f(x)*, and plot it. Being sure that *f(x)* still is highlighted in the algebra window. Differentiate and simplify (see above). Note: Derive will automatically highlight the derivative. Now, plot the derivative; Derive's plot routine keeps track of previous graph; you will see both on the same set of coordinates.

What you are now seeing is the graph of a function along with the graph of its derivative function, i.e. *f(x)* and $f'(x)$ graphed together. Recall the relationships between these functions. When f' is negative, you see *f* has negative slope, when f' is positive, you see f has positive slope, etc. You can label the graphs using the **Insert annotation** option. Derive allows you to insert text wherever the + is located. Once text is inserted, you can move it around with a left-click and hold. Try labeling the graphs with *f(x)* and $f'(x)$ respectively. Return to the algebra window.

Exercise 1: Plot $f''(x)$ on the same axes with $f'(x)$ and *f(x)*. Label each using the **Insert annotation** option. Place this graph in your Word document.

You can find where *f(x)* has 0 slope by setting $f'(x)$ equal to zero and having Derive solve the equation. Derive makes it easy to use expressions to build more complicated expressions. One feature is that you may use an expression label in place of an expression. If your $f'(x)$ is currently expression number three, you can author: **#3=0**. The result will be the equation obtained by setting the expression for $f'(x)$ equal to 0.

Alternatively, you can use any expression (or part of any expression) in the algebra window in the entry line below. First, delete any text in the entry line below. Now, highlight the expression for $f'(x)$ above, then click on the entry line below, then right click, and finally select **Insert expression**. Now, add **=0** at the end of the expression and press Enter. Now, click **Solve expression**.

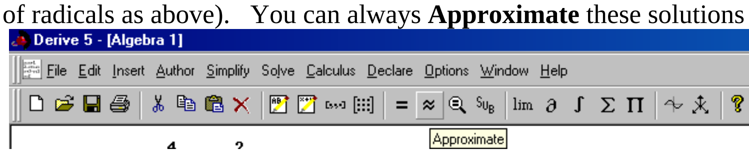


Derive allows you to choose the solution variable, the solution method, and the solution domain. Click **Solve**; two

$$x = -\frac{\sqrt{3}}{2} - \frac{1}{2} \vee x = \frac{\sqrt{3}}{2} - \frac{1}{2} \vee x = 1$$

new expressions appear above.

If **Algebraically** was selected as the solution method, then Derive will try to find the exact solutions (i.e., in terms of radicals as above). You can always **Approximate** these solutions with decimal fractions.



You should obtain: (the **v** symbol means "or") and after approximating

$$x = -1.366025403 \vee x = 0.3660254037 \vee x = 1$$

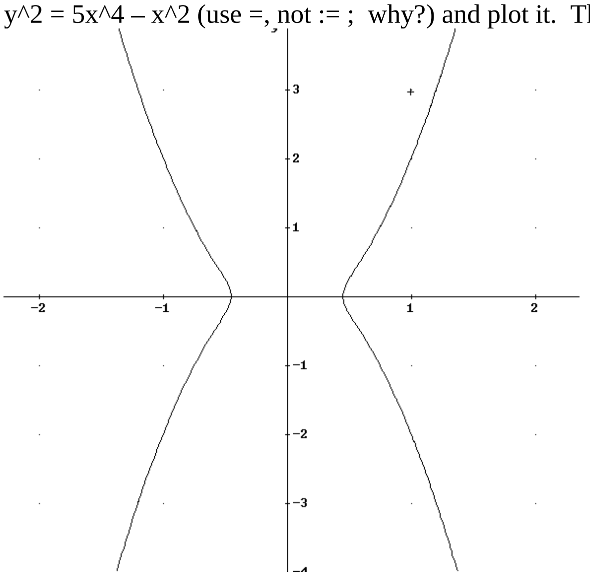
Derive will find the equations of tangent lines to curves at points you specify. A description of the command follows:

tangent(y, x, x_0) simplifies to the line tangent to expression *y(x)* at $x=x_0$. The result will be linear in variable x.

Author TANGENT(*f(x)*,*x*,1) and then simplify. Derive remembers that you defined *f(x)* above using := . You will see the linear equation for the tangent line at x=1. If you wish, you can plot *f(x)* and the tangent line on the same axes. Experiment.

B. As an illustration, we now will work an exercise similar to those you have been doing in your homework. Before proceeding, exit and reenter Derive.

Derive is happy to plot and differentiate non-functional (implicit) expressions. Author the expression y^2 = 5x^4 – x^2 (use =, not := ; why?) and plot it. The result is:



You now know what the curve looks like. Does the symmetry surprise you?

To compute the implicit derivative, we use the **imp_dif** command.

IMP_DIF(u, x, y, n) simplifies to the nth implicit derivative of y with respect to x. n must be a positive integer, and it defaults to 1. **u** is the expression in x and y **<u>with all terms on one side of the implicit equation</u>**. Derive automatically adds the **=0**. In most cases the result depends on both x and y rather than x or y alone.

For our exercise, we author **imp_dif(y^2 – 5x^4 + x^2,x,y,1)** .

Of course, you can use the expression label instead of the expression itself. We choose **1** since want the first derivative. After simplification, the result is

$$\frac{x\cdot(10\cdot x^2 - 1)}{y}$$

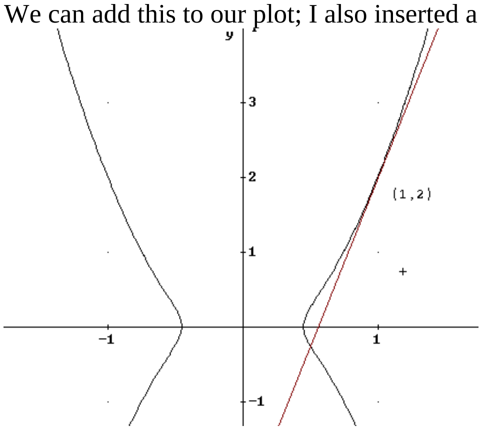
Derive also can find the equations of tangent lines to implicit curves using the **imp_tangent** command.

IMP_TANGENT(u, x, y, x0, y0) simplifies to an expression linear in variable x. The result is the y coordinate of the line tangent at x=x0 and y=y0 to the curve implicitly defined by u=0.

For our exercise, we author **imp_tangent(y^2 – 5x^4 + x^2,x,y,1,2)** and simplify. The result is

$$\frac{9\cdot x - 5}{2}$$

We can add this to our plot; I also inserted a label for the point (1,2) (see lab 1):



C. As you may have noticed, I have embedded and resized Derive expressions and Derive plots in this Word document. You can do so as well and, thus, construct visually pleasing Derivel documents.

To copy the entire active Derive plotting window, simply click **Edit|Copy Plot Window**. Now, move to your Word document, click **Edit|Paste Special**, and choose **Device Independent Bitmap**. Your graph will appear in the Word document. You may resize it and move it around in the usual way. If you are unfamiliar with Word, then ask for help or use a word processor with which you are familiar.

You can also copy a rectangular piece from the Derive plotting window to your document. To begin, click **Edit|Mark and Copy**. Now, you will draw a box around the part of the graph you wish to copy. Left click and hold the cursor at the top left corner of the box and then move the cursor to the bottom right corner of the box so that the section of graph is inside. As before move to your Word document, click **Edit|Paste Special**, and choose **Device Independent Bitmap**.

Copying an expression from an active Derive algebra window requires a similar effort. Highlight an expression ***other than the one you wish to copy to the Word document***. (Otherwise, the dark highlighting will be copied along with the expression.) As with your graph, click **Edit|Mark and Copy**. Draw a box around the expression you wish to copy. For example:

#1:	$y^2 = 5\cdot x^4 - x^2$	
#2:	$\text{IMP\_DIF}(y^2 - 5\cdot x^4 + x^2,\ x,\ y,\ 1)$	
#3:		$\frac{x\cdot(10\cdot x^2 - 1)}{y}$
#4:	$\text{IMP\_TANGENT}(y^2 - 5\cdot x^4 + x^2,\ x,\ y,\ 1,\ 2)$	
#5:		$\frac{9\cdot x - 5}{2}$

Transfer your selection to the word document as above. It can be resized and moved.

$$\frac{9\cdot x - 5}{2}$$

BEWARE: A simple copy and paste of an expression from the Algebra Window will **not** yield a nice-looking expression. You must use **Edit|Mark and Copy.**

Finally, Derive 6 has a new feature that creates a rich text format (.rtf) file consisting of all your algebraic expressions. Click **File|Write|Rich Text Format File** and proceed as with any file-save sequence.

D. As you might guess, some of the graphs that incorporate lighter colors may not show up well when printed, particularly on a black and white printer. You can choose which colors Derive uses. First, click **Options** and uncheck **Change Plot Colors**. Then, click **Options|Display Plot Color** and click **Next Color** button. Now, you can select your choice of plot color.

E. You save your Derive algebraic expressions on your h:-drive. Click **File|Save As** and then follow the usual regimen.   You can also save a plot, but you first must embed it in the algebra screen. Construct your plot; then click **File|Embed**. Now move to and save the algebraic expressions as before.

Exercise 2: Use Derive and a word processor to construct a practice exam and solutions to help you prepare for the final. Embed appropriate expressions and graphs from Derive into your document. Your practice exam is to consist of 4 problems. You should place the solutions on a separate page(s) of the document. One problem should deal with an inverse trig function; another should be calculation of a derivative directly from the limit definition; and the final two should require the application of the derivative rules of various types. I include an example; notice how I mix in output from Derive:

Problem: Let $f(x) := x^2 \cdot SIN(x)$; calculate $\frac{d}{dx} f(x)$.

Solution: $x^2 \cdot COS(x) + 2 \cdot x \cdot SIN(x)$ (by the product rule)

Note: In the course of doing this lab, also be sure the printer in Tutt Science 213 is installed on your user number for future use. Turn in this lab electronically (to be discussed on Monday).