

# Maple Introduction Session Instructions

## 1. Start the Maple program.

First, start the program: find the Maple V Release 4 leaf icon and double click on it to start the program. You will have a clear, untitled worksheet to begin with. **If you want to continue work on a file that has already been saved** , you can choose "Open" from the file menu (if you need help navigating the Windows or Mac file system, ask).

## 2. Do a few simple arithmetic problems.

Maple is quite a calculator -- you can type in expressions for Maple to compute (use +, -, \*, / for the four basic arithmetic operations, ^ for raising to powers). Be sure to end each statement with a semicolon. Some examples (you should make up your own):

```
> 3+88;
```

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```
> 4^50;
```

1267650600228229401496703205376

```
> 37444*4532/100;
```

$\frac{42424052}{25}$

## 3. Assign some values to variables and use them.

Use := for assignments. Names of variables can be fairly exotic -- there are a few "reserved words" to avoid. Variables can stand for expressions, equations, lists of

things, etc..

Also, Maple knows many standard functions:

`sin(x)`, `cos(x)`, `tan(x)`, `cot(x)`, `sec(x)`, `csc(x)`

-- the parentheses are **REQUIRED**

even though in standard math we sometimes omit them

`arcsin(x)`, `arccos(x)` , etc..

`ln(x)`, `log(x)` -- both are the natural log -- `log[10](x)`

`exp(x)` -- for "e to the x" -- note the parentheses, it is **WRONG** to say `exp^x`.

`abs(x)`, `sqrt(x)` --- also constants `E` or `exp(1)` , and `Pi`.

Use `evalf` to get decimal values of Maple output:

Here are some examples -- you try these and some of your own:

```
> z:=3+2*x;
```

```
z := 3 + 2 x
```

```
> a:=15;
```

```
a := 15
```

```
> sin(Pi*(z-a));
```

```
sin( $\pi(-12 + 2x)$ )
```

```
> sin(a);
```

```
sin(15)
```

```
> evalf(sin(a));
```

```
.6502878402
```

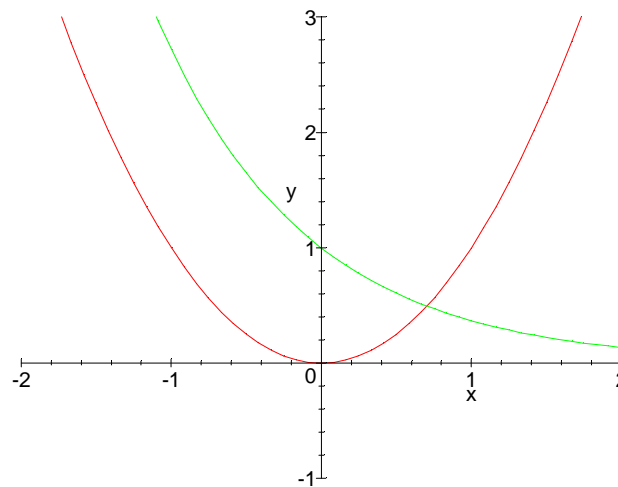
#### 4. Maple commands: solve, diff, int, subs, plot

These are how you get Maple to do real work -- `solve` is for solving equations or systems of equations (there is also `fsolve` for finding decimal approximations of solutions of equations), `diff` for taking derivatives (ordinary and partial), `int` for

integrals, subs for plugging values into expressions, and plot for drawing graphs.

All these commands have a basic `action(what,how);` syntax -- for example to use the `plot` command, you specify what to plot (i.e., which expression or expressions to graph) and how to plot it (i.e., what the domain is on the horizontal axis and range on the vertical one). For example

```
> plot({x^2,exp(-x)},x=-2..2,y=-1..3);
```



Notice that the two things being plotted were enclosed in braces `{ }` -- this is required when you are plotting more than one graph.

`Solve` is syntactically the same -- `solve(what,how)` -- "what" refers to the equation or equations being solved (again if there is more than one they must be enclosed in braces), and "how" refers to the name(s) of the variable(s) being solved for:

```
> solve(x^2-5=0,x);
```

$$\sqrt{5}, -\sqrt{5}$$

Note -- `solve` just tells you what the answer is -- it does NOT assign any value to the

variable.

Using the following examples, figure out the syntax of `subs`, `diff` and `int` (later you can read the sections of this Lab Manual on these commands to learn more):

```
> subs(x=3,x^2+8);
```

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```
> diff(3*x^2+2*x+5,x);
```

$6x + 2$

```
> int(6*x+2,x);
```

$3x^2 + 2x$

```
> int(6*x+2,x=0..1);
```

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Finally, `fsolve` is used to solve equations numerically for decimal approximations of the answer -- you can specify an interval in which you wish to find a solution. For example:

```
> fsolve(x^2-5=0,x,x=-3..-2);
```

-2.236067978

This is useful when a plot reveals that there are solutions which `solve` is unable to find algebraically.

## 5. Formatting, etc..

You have control over the fonts Maple uses for text -- when you are in Text mode (you can get to text mode by clicking on the "T" button at the top of the Maple window) you can choose a font from the pull-down menu. You can also use **boldface**, *italics*, or underlined characters by clicking on the B, I or U buttons (it's a lot like a word processor). More importantly, you can control the **size** of the characters in your worksheet -- there are three  $x$  buttons at the top of the page --

small, medium and large. We use the large setting for demonstrations in class because it's easier to read, but you should use the small one for something you're going to print out. Groups of statements will be bracketed in your worksheet unless you de-select "Show group ranges" in the "View" menu at the top of the window.

Text in your worksheet: It is important that you insert explanatory text into your homework papers -- to explain what your variables stand for, to interpret answers and to answer some of the essay-type questions we will ask, and to explain what went wrong if the answer doesn't come out right. To insert text at any point in your Maple Worksheet, position the cursor at the point you want to put the text, then click on the "T" button at the top of the window - or just put the cursor at the beginning of a line and press the F5 key. Maple will probably display your text in a different font, and will not attempt to execute your text as Maple statements. To get out of text mode and back into input mode, click on the [ $\>$ ] button at the top of the page, or press return followed by F5.

When you make plots in your worksheets, you can resize them or delete them by selecting them first -- just click the mouse anywhere in the plot to select the plot, use the little squares along the sides of the plot to resize it, or the delete key to delete it.

Finally, you can print and save from the File menu -- **MAKE SURE YOU SAVE YOUR WORK OFTEN! In most computer labs, this will require you to have a floppy disk with you.** -- Maple is a large complicated program and will occasionally crash -- you don't want to lose too much of your work by not backing up once in a while.

### **TASKS TO COMPLETE:**

A. Define the two variables  $y := \exp(-x)$  and  $z := \sin(x)$  -- don't forget the semi-colons.

B. Plot the graphs of  $y$  and  $z$  on the same axes --choose the horizontal domain so that at least two points of intersection of the two curves are visible (there are infinitely many and they all have positive  $x$  coordinates). Insert the graph into your worksheet. The statement you use to do the plot should be something like:

```
> plot({y,z},x=-2..5);
```

C. Use `fsolve` to find the  $x$ -coordinates of the two intersection points. You will have to specify the two intervals Maple should look in (in two different statements). Take advantage of the definitions of  $y$  and  $z$  by using a statement of the form:

```
> fsolve(y=z,x,x=0..3);
```

D. Insert text into your worksheet telling why you picked the intervals you did.

E. Have Maple compute the derivative of  $x^x \cos(\sqrt{1+x^5})$  .

F. Print out your work (if the printer in your lab is working).

G. Save your file on the hard disk (choose "Save" or "Save As" from the File menu) -- it is ABSOLUTELY ESSENTIAL that the filename be of the form `xxxxx.mws` -- Maple will fill in the `".mws"` if you don't specify a file extension, but if you specify a different one, the file may behave strangely when it is reloaded. Then quit Maple (Exit under the File menu). Restart Maple, and load your file back in -- and execute all its statements again (position the cursor on the first one, then keep pressing "enter").

H. Quit Maple again.

## World-Wide Web

Exploring the World-Wide Web can be a fascinating way to learn about Penn as well as the outside world. It is easy to use, and even if you've never tried it before, you can quickly begin to "surf the Net". To begin, find the "Netscape" icon (it may be hidden in a folder labelled "Networking" or "Communications" or something similar). When you double-click on the icon, you will enter the Infobahn at some location (usually a Penn location). Addresses on the Web are called "URLs", the general Penn URL is

`http://www.upenn.edu`

and the Math Department's URL is

`http://www.math.upenn.edu`

Information on the undergraduate mathematics program (including info on calculus courses and Maple) is at the URL

`http://www.math.upenn.edu/ugrad/Undergrad.html`

You can enter a URL in the box labelled "URL" on the screen and press enter in order to jump immediately to a place you know the address of. But it is more interesting to follow "links" in "Web-space" -- you do this by finding highlighted text (it is usually a different color than most of the text on the screen, often blue or purple) and clicking on it. You will see the "URL" change automatically and the files from the new location will be displayed. You can use buttons on the screen to navigate "Back" (to the last thing you looked at), or "Forward" (if you have gone back).

## **TASKS TO COMPLETE:**

- A. Get the Penn Math Department "Home Page" at the URL given above.
  
- B. Find the link (it will have a picture of a famous mathematician on it) to the "Home Page" of your course, and click on it to view this page.
  
- C. On your course home page, there will be links to the home pages of the professors and TAs teaching the course -- follow these links. Then go back to the course home page.
  
- D. On the Home Page of your course, there are links to Maple demonstrations (examples). Go to the page that lists these examples. Click on one of them -- this will (should) cause your computer to "download" the Maple file for the demonstration from the Math Department computer. Your computer may ask you where to save the file (or what to do with the file). Be sure to remember where you saved it. Or (better), your computer may already be configured to open Maple and load the downloaded worksheet.
  
- E. Quit Netscape if Maple didn't open automatically. Then, open the file you just downloaded in Maple and execute its statements.

If time permits, you may wish to use Netscape to explore other parts of the Math Department Web, the Penn Web, or the World-Wide Web in general.