***Mathematica* Practice**

(Note - Make sure the Basic Math Assistant palette is visible, go to the Palettes menu)

I. NUMERICAL STUFF

Remember that in *Mathematica* you must press *Enter* or *Shift-Return* to get an answer. Hitting *Return* merely wraps you to a new line in the same input cell. It is often convenient to put several commands in the same input cell. Try each of the following

1. $3+6\times5$ (Note that merely putting a space between the 6 and the 5 denotes multiplication. You can use an $\times$ from the palette. There are also keyboard shortcuts than can be handy. What order does *Mathematica* use? Can you use parentheses to get a different result? Use only ( ) parentheses. Don't use {} or [ ] they have other uses.
2. 274/3 (Try this again with a decimal point after one of the numbers)
3. $((3.24 \times 6.791) - 14.7)/(4.5 + 82/3)$ (Remember, you can use a space for multiplication.)
4. 2.6^2.99 (note that ^ means power. Can you make it look like $2.6^{2.99}$ instead? Hint: look at the palette, in the *Calculator...Basic* or the *Typesetting* section.)

II. SIMPLE COMMANDS

All commands in *Mathematica* start with a capital letter and use square brackets, [ ] to enclose the entity they operate on.

1. Log[13.5] (What base is this in? Can you figure out how to get any base you want?)
2. E^2.5 (or try $E^{2.5}$)
3. Log[E, 12.7]
4. Log[10, 12.7] (This is the common log, base 10. See how it works now?)
5. Sqrt[25.0]
6. Abs[-3.8]
7. I×I (I is the square root of -1. Try esc-i-i-esc to get a fancier version of i)

III. MORE BUILT-IN NUMBERS

Type the following and hit *enter*

1. E
2. N[E]
3. Pi
4. N[Pi]

   The function N will only display 6 digits. To get more use N[ ], and a specifier for the number of places.

5. N[E, 10] (try esc-e-e-esc to get a fancier version of e)
6. N[Pi, 20] (try esc-p-esc to get a fancier version of π)

IV. PALETTES

There are several handy palettes available in the File...Palettes... menu. Especially the Basic Math Assistant palette. It facilitates some prettier typography. Use the palette to make the following, and evaluate them.

1. $3^{2.7}$
2. $\sqrt{18.7}$
3. $\frac{41.38}{7.2}$
4. Sin[25.5 Degree] (Notice how I snuck a special symbol in there, "Degree" is a conversion factor necessary, otherwise *Mathematica* would assume you mean radians. You can also use the degree symbol ^{o}, from the *Calculator* section of the Basic Math Assistant palette.)

V. REFERRING TO PREVIOUS OUTPUT

The % symbol allows you to refer to previous outputs. % refers to the previous output. %% to the one before that, etc. %12 refers to output number 12, even if you have erased it! Try it out.

VI. ALGEBRA

Basic symbolic algebra stuff.

1. Expand[(x+2)^5]
2. Simplify[$\frac{1}{x+1} - \frac{2x-1}{x^2-x+1}$]
3. Factor[4x^4 -1]
4. Together[2/(x - 5) + 3/(x + 2)]
5. Apart[3/((x-2)(x+3))]
6. Cancel[(x^2-2x-3)/(x^2-9)]

VII. SIMPLE PLOTS

Try each of the following

1. Plot[x Sin[1/x], {x,-1,1}] (Look over the syntax, the capitalization of the built-in commands and functions, and the use of square [ ] and curly { } brackets.)
2. Change the domain to something other than {-1,1}. Zoom to successively smaller and larger ranges.
3. Change the function in some simple way and plot it again.

VIII. SLIGHTLY FANCIER 2-D PLOTS

1. Plot[Tan[x], {x,-1,1}]

2. Change the domain to {-Pi,Pi}, then use esc-p-esc to replace the Pi with the cooler looking Greek letter.

3. Now alter it to change the vertical resolution: Plot[Tan[x], {x,-1,1}, PlotRange→{-3,5}] . Mess around with the ranges. Try PlotRange→All. (To make the arrow, just use the two keys " - " and ">", and keep typing, it magically turns into an arrow.)

4. Plot two functions on the same plot: Plot[{x Sin[x],Tan[x]}, {x,-1,1}]. Note that we just make a list of functions, inside curly braces, separated by commas.

5. Try "Frame→True" just stick in with a leading comma before the ending].

6. Definitely try out "FrameLabel". Look it up in the Documentation Center to see what it does. If you want good, readable plots you will probably use it a lot.

IX. SIMPLE 3-D PLOTS

Type the following and hit *enter*

1. Plot3D[Sin[x y], {x,-Pi,Pi}, {y,-Pi,Pi}]. (It is critical to have a space between x and y, so they are considered a product of two variables. If there is no space, it will be interpreted as a single variable named xy.)

2. Go to the Help menu and select Wolfram Documentation. Then type in Plot3D and hit enter. This takes you to information and examples for that command. The examples can be executed, altered, and played with.

X. SLIDERS AND ANIMATIONS

1. In *Help... Wolfram Documentation* search for "Animate". Play with the examples. Look how easy you can make a movie, and let the user interact with variables by including sliders.

2. Look at the two "Neat Examples"

3. Also check out the command "Manipulate" as you did "Animate"

XI. FANCY PLOTTING TRICKS

There are other kinds of plots. Look up DensityPlot, ListPlot, StreamPlot, ListPointPlot3D... If the documentation has "Neat Examples" they are almost always worth looking at.

XII. DERIVATIVES–D[ ] AND ∂_x

Remember that in *Mathematica* you must press *Enter* or *Shift-Return* to get an answer. Hitting *Return* merely wraps you to a new line. Try each of the following

1. Find the derivative with respect to θ of $(\cos\theta)^{\sin\theta}$. (To make a pretty θ enter esc-th-esc)
2. Find $\dfrac{\partial^2}{\partial x \partial y}\,(3x^2y^3 + \sin 2xy)$

XIII. INTEGRALS–INTEGRATE[ ] AND NINTEGRATE[ ]

1. $\int \sqrt{1-t^2}\,dt$. Then plot the function and its integral from -1 to 1.

2. Numerically integrate $(\cos\theta)^{\sin\theta}$ from 0 to 1.

XIV. MULTIPLE TASKS IN ONE CELL

1. Put two (or more) calculus tasks in the same input cell, by entering one, then *Return*, and another. Evaluate them to get both outputs by pressing *Enter*.