MTH 1120 – MAPLE TUTORIAL PROBLEMS  
August 1, 2009

Use the tutorial to learn how to solve these problems using MAPLE mathematical software. These problems will not be collected or graded.

1. \(\frac{2 + 5}{3} - \frac{1}{7} - \frac{4}{4}\)

2. \((4x)(3y)(1+1)(x)\)

3. \(\sqrt{64} \text{ and } \sqrt{64}\)

4. \(|-3| + |-4| + |-5 - 2|\)

5a. Multiply \((3x - 5)(2x + 7)\)

5b. Factor \(6x^2 + 11x - 35\)

5c. Factor \(8x^3 - 27y^6\)

5d. Factor \(2x^2 - 18\)

5e. Factor \(x^2 - 7\)

5f. Factor \(x^2 + 7\) over the complex numbers

6a. Simplify \(\frac{2x^2 + 11x - 21}{3x^2 + 23x + 14}\)

6b. Simplify \(6i^5 - 5i^4 + 3i^3 + i^2 - 12i + 2\)

6c. Simplify \(\frac{5 - i}{4 + 2i}\)

7. Rationalize the denominator and simplify your answer. \(\frac{4 + 3\sqrt{2}}{5 - 7\sqrt{2}}\)

8. Graph the functions \(f(x) = 2x + 1\) and \(g(x) = -\frac{1}{2}x + 7\) on separate axes and on the same axes.

9. Graph the relation \((x + 3)^2 + (y - 1)^2 = 16\)

   Adjust the graph to make this circle look like a circle.

10a. Solve the equation \(2x + 1 = -\frac{1}{2}x + 7\)

10b. Let \(f(x) = x^4 - 9x^3 + 13x^2 + 37x - 66\)

   - Solve the equation \(f(x) = 0\). Give the exact solution (with the square roots in the answer).
   - Solve the equation \(f(x) = 0\). Give the solution with the decimal approximations in the answer
   - Graph the function. Adjust the axes so that you can see all the roots

11a. Find the equation of the line through \((3, 4)\) and \((7, 13)\).

11b. Find the equation of the line that passes through \((-1, 3)\) and is perpendicular to the line in problem 11a.

12. Let \(f(x) = 3x - 12\) and \(g(x) = 2x^3 - 7x + 1\).

   Evaluate: \(f(5)\) \(g(5)\) \((f+g)(x)\) \(f(g(x))\)

   Evaluate: \(g(f(x))\) \(f(g(5))\) \(g(f(5))\)

   Evaluate the difference quotient for \(g(x)\)

13. Complete the square on \(f(x) = 3x^2 + 24x - 53\)

14. Draw the graph of \(f(x) = \frac{2x - 3}{x + 1}\). Show all the horizontal and vertical asymptotes.

15. Draw the graphs of \(f(t) = 8e^{-4t}\) and \(f(x) = 8e^{-1x}\)

   Adjust the axes to show the characteristic shapes of the two functions.
MTH 1120 - Introduction to MAPLE Mathematical Software
(Save this handout for future use. You will need it later in the semester.)

This handout will introduce MAPLE software and show you how to use a few of the commands. Throughout the semester you will have MAPLE problems to submit for a grade. **Note:** The problems in this handout will **not** be collected or graded.

**Two Important Prompts at the Top of the Screen:**

The symbol "[>" is the MAPLE prompt.
This symbol means the software is expecting some **mathematical input** in the MAPLE language.

The "T" is the **text** prompt.
If you want to type some **text**, such as problem labels or your name, click the "T" icon on the menu bar at the top of the screen. When you have finished typing text, click the "[>" icon to return to the "mathematics" mode.

You **must always** put your name and the date on the top line of your output.

**Fred Russell**
**September 15, 2009**

**Punctuation is Important in MAPLE.**
Every MAPLE command must end with either:
- a **semi-colon** (;) if you want MAPLE to **show** the output  **OR**
- a **colon** (:) if you want MAPLE to **suppress** the output.

**Keep your output neat and orderly.** Get in the habit of labeling **every part of every problem** as you do it. Correct your errors and **delete unwanted output** immediately. If you make an error, go back and edit the command. Then move the cursor to the end of the line and hit the **ENTER** key to re-execute the command.

Sometimes you may wish to delete a whole block of output. Put the cursor at the beginning of the stuff that you want to delete. Hold down the left mouse button and **drag** the mouse across the block of text. Then use the **delete** key to erase the highlighted block.

**Problem 1:**
The addition, subtraction, and division signs are illustrated below.
Because the command ends in a semi-colon MAPLE will show a result.
Use the **right arrow** key to move the cursor out of the denominator.

\[
\frac{\frac{2}{3} + \frac{5}{7} - \frac{1}{4}}{95} = \frac{84}{95}
\]
If we end the command with a colon, **MAPLE** will perform the operation but not show the result.

\[
\frac{2}{3} + \frac{5}{7} - \frac{1}{4} : 
\]

**Problem 2:**
The multiplication symbol is the **star** (*).
On the screen the multiplication symbol appears as a dot.
Use the star between **every** two terms that you wish to multiply.
Try the multiplication \((4x) \, (3y) \, (1+1) \, (x)\)

\[
4 \cdot x \cdot 3 \cdot y \cdot (1 + 1) \cdot x ; \\
24 \ x^2 \ y . \quad (2)
\]

**Problem 3:**
**MAPLE** gives only the **positive** square root.
To take the square root of a number we use the following command:

\[
sqrt{t}(64); \\
8 \quad (3)
\]

To raise a number to a power we use the **carat** symbol.
For example, the cube root of a number is the power \((1/3)\).
Use the **right arrow key** to move the cursor out of the exponent.

\[
64^{\left(\frac{1}{3}\right)} ; \\
64^{1/3} \quad (4)
\]

What happened? **MAPLE** did not give us "4" as an answer!

The **percent sign** (%) refers to the **last answer** that **MAPLE** computed.
The **simplify** command will give us a different form of that answer.

\[
simplify(\%); \\
4 \quad (5)
\]

**Problem 4:**
To find absolute values we use the **abs** command.

\[
abs(-3) + abs(-4) + abs(-5 - 2) ; \\
14 \quad (6)
\]
Problem 5:
The `expand` and `factor` commands can be used to perform the multiplication and factoring operations.

**Notice:** The parentheses around the **whole expression** are **required**.

\[
\text{expand}((3x - 5) \cdot (2x + 7)); \\
6x^2 + 11x - 35 \tag{7}
\]

\[
\text{factor}(6x^2 + 11x - 35); \\
(2x + 7)(3x - 5) \tag{8}
\]

Here is an example with the difference of cubes:

\[
\text{factor}(8x^3 - 27y^6); \\
(2x - 3y^2)(4x^2 + 6x y^2 + 9y^4) \tag{9}
\]

**MAPLE** removes the greatest common factor (gcf) when factoring the expression.

\[
\text{factor}(2x^2 - 18); \\
2(x - 3)(x + 3) \tag{10}
\]

**MAPLE** will factor over the **irrational numbers**, but you must specify "complex" in the command. Again, use the **right arrow** key to move the cursor out of the exponent.

\[
\text{factor}(x^2 - 7); \\
x^2 - 7 \tag{11}
\]

\[
\text{factor}(x^2 - 7, \text{complex}); \\
(x + 2.645751311)(x - 2.645751311) \tag{12}
\]

**MAPLE** will factor over the **complex numbers** if you specify "complex" in the command. **Notice:** The complex number "I" appears in the factors.

\[
\text{factor}(x^2 + 7, \text{complex}); \\
(x + 2.645751311 I)(x - 2.645751311 I) \tag{13}
\]

Problem 6:
We can use the `simplify` command to remove common factors. Again, use the **right arrow** key to move out of the denominator.

\[
\text{simplify}\left(\frac{2x^2 + 11x - 21}{3x^2 + 23x + 14}\right); \\
\]

\[
\]
\[
\frac{2x - 3}{3x + 2}
\]

(14)

The `simplify` command also works with **complex numbers**. The **complex number** is the capital letter "I".

\[
simplify(6I^5 - 5I^4 + 3I^3 + I^2 - 12I + 2);
-4 - 9I
\]

(15)

\[
simplify(\frac{5 - I}{4 + 2I});
\frac{9}{10} - \frac{7}{10}I
\]

(16)

**Problem 7:**
The `rationalize` command can be used to rationalize the denominator. If we want, we can use the `expand` command to multiply the factors. Notice how the "%" sign refers to the last result.

\[
rationalize(\frac{4 + 3 \sqrt{2}}{(5 - 7 \sqrt{2})});
-\frac{1}{73} \left(4 + 3 \sqrt{2}\right) \left(5 + 7 \sqrt{2}\right)
\]

(17)

\[
expand(\%);
-\frac{62}{73} - \frac{43}{73} \sqrt{2}
\]

(18)

**Problem 8:**
Before we use MAPLE to graph an equation we store it as an **expression**. The name of this expression will be `e2`.
The **colon** and **equal sign** after the name `e2` are both **required**. Here is the correctly formatted command:

\[
e2 := 2 \cdot x + 1;
e2 := 2x + 1
\]

(19)

The expression `e2` is a **function** because every `x` has only one `y` associated with it. The expression can be written in "y=" form.

We use the `plot` command to draw the graph of a **function**.

You **must** specify the **expression name** and the **plotting range** for at least one of the variables. Your graph must CLEARLY show all the roots and turning points.

If you are lazy and use **inappropriate plotting ranges** you will **DISTORT** the shape of your graph. **THIS IS UNACCEPTABLE.** It is **IMPORTANT** to choose plotting ranges which are **APPROPRIATE** for your function. You must show all the important features of the function without wasting space on the graph. Sometimes you must execute the `plot` command several times with