Instructions for Creating an Engineering Worksheet in Mathcad Prime

Task 1: Familiarizing yourself with Mathcad Prime

Objective: To create a worksheet for calculating the force required to lower the ramp.

1. Click the Mathcad Prime icon to launch Mathcad.

***Note**: Mathcad Prime will open with a blank document. You will notice the Mathcad Grid. The Grid's primary purpose is to assist with the visual alignment of regions. You will find it very helpful as you work with Mathcad.*

2. Consider a design or engineering problem that needs to be solved.

"Placing two standard kit batteries a distance of 30 inches from the midline of the ramp will provide enough force to lower the ramp." (*FIRST* Rebound Rumble Game Manual)

Engineering Problem: How much force is required to lower the ramp?

3. Type the Given Information into the Worksheet using the tools on the Math ribbon.

Read and Follow the Instructions in Steps 1-8 to learn how to use Mathcad Prime Regions, Operators and Symbols, and Styles

1. The Blue (+) Crosshair identifies the current insertion point for a new region

2. Left-click on the Text Box icon to insert a text region in the worksheet. Notice that the Blue Crosshair disappears and it is replaced by a text region containing a black (|) insertion cursor.

Type: "Modeling the Force Required to Lower the Ramp"

3. Left-click beneath the Text Box. Notice that the Blue Crosshair identifies the new insertion point. Left-click in a

different position to relocate the insertion point.

4. Left-click on the Math icon. Notice that the Blue Crosshair disappears and is replaced by a Math region containing a blue (|) insertion cursor.

Type: "$W_{bat} := 14\ lb$" using the guide in the pink box below

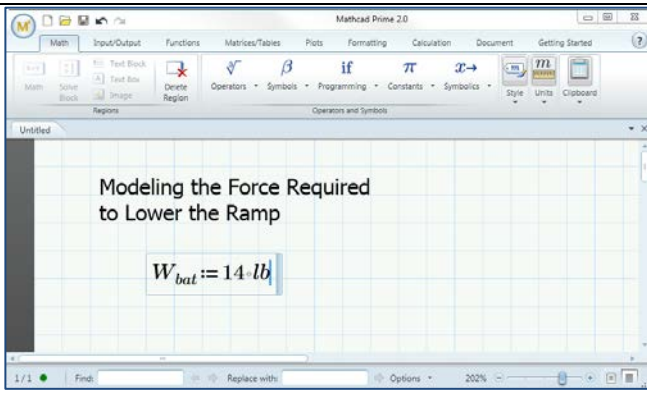
- To type W_{bat} you will use a variable subscript
- To add := you will use the Operators Icon on the Math Ribbon

Type	Select	Type	Select	Select	Type	Type
W	a_2 Subscript	bat	Operators	Definition (:) from Operators	14	lb

5. Observe the following in the screenshot below:

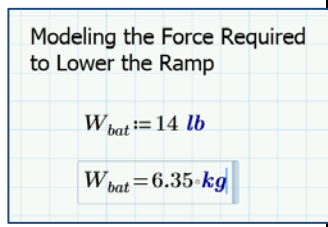
- The content of the text region and the math region appear in different fonts.
- When the insertion point is inside a region, the Regions Group of the Math Ribbon is grayed out -- it is not possible to insert a Mathcad Prime region into another region.
- When typing text in a math region after a numerical quantity, a gray circle appears to indicate implied multiplication. Mathcad

recognizes that "*lb*" will either be a variable or a unit. Since "*lb*" is a predefined Mathcad unit, in this case it will be converted to a unit when you click outside of the current Math Region.



6. Left-click below the Math Region defining W_{bat}, the weight of a battery

7. Type "W_{bat} =" and your worksheet should appear as shown at right



Note:

- ***lb*** *and* ***kg*** *appear in blue italics because they are standard Mathcad Prime units and blue italics is the default appearance for units*
- *Mathcad Prime automatically converts* W_{bat} *from units, pounds, to units, kilograms, the default Mathcad unit for mass*

- *Because Mathcad is unit aware, W_{bat} can be expressed with any standard unit of mass (**gm**, **oz**, **lb**, **kg**,…)*

8. Define the variables $Dist_{bat}$ and n_{bat} as shown below

$$W_{bat} := 14\ lb$$

$$Dist_{bat} := 30\ in$$

$$n_{bat} := 2$$

4. Defining a Formula in a Mathcad Worksheet

Read and Follow the Instructions in Steps 1-3 to define the simple formula below:

$$Moment := W_{bat} \cdot n_{bat} \cdot Dist_{bat}$$

1. Left-Click to place the insertion cursor beneath the definition of the 3 variables
2. Type: "Moment" and then select "Definition (:)" from Operators
3. Use the **Multiplication (*)** symbol from Operators to enter the multiplication symbol in between the variable names on the right side of the

equation.

5. Evaluating the result of a formula definition in a Mathcad Worksheet

Read and Follow the Instructions in Steps 1-2 to evaluate the definition of Moment:

1. Place the insertion cursor beneath the definition of Moment
2. Type: Moment = to evaluate the definition

$$W_{bat} := 14\ lb$$

$$W_{bat} = 6.35\ kg$$

$$Dist_{bat} := 30\ in$$

$$n_{bat} := 2$$

$$Moment := W_{bat} \cdot n_{bat} \cdot Dist_{bat}$$

$$Moment = 9.678\ kg \cdot m$$

Note:

- *Mathcad Prime uses several different equality symbols. This example employs the Definition (:) and Evaluation (=) symbols.*
- *Most Ribbon icons have keyboard shortcuts – it is efficient to learn to the shortcuts for common operators*
- *Definitions in a Mathcad Prime worksheet are sequential – Mathcad reads and evaluates definitions across (right) and down the worksheet.*
- *Mathcad Prime automatically calculates a correct unit for the result of the formula*
- *It is possible to change the unit label on a mathematical quantity. For instance, we can change the unit on Moment to **lb*in** by deleting the existing unit and typing the desired unit*

6. Defining a Function in a Mathcad Worksheet

Read and Follow the Instructions in Steps 1-4 to define a function relating Moment to the Distance from the Center of the Ramp for the information given in this worksheet:

1. Place the insertion cursor beneath the definition of the variable Moment

2. Use the keyboard and the Operators on the Math Ribbon to define the function shown below:

$$Force(D) := \frac{Moment}{D}$$

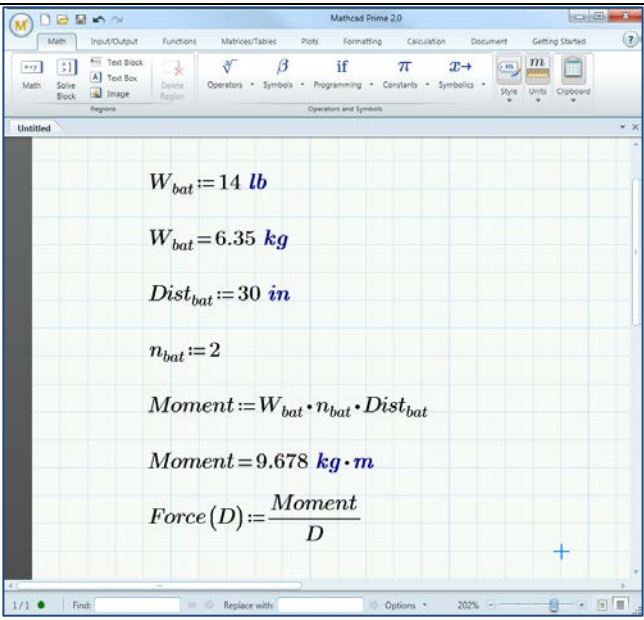
Note:

- *All Regions float on a Mathcad worksheet. When selected they can be dragged with the mouse or moved with the 4 directional arrow keys*

3. Drag Select or Ctrl-click the Math Region containing the definition of Force. Then, practice relocating the region.

Observe what happens when you move the definition of Force to the top of the worksheet and then click in a blank space on the worksheet to deselect the Force region.

4. Place the definition of Force beneath all of the other definitions on the worksheet.



5. Evaluate the function for the Distance 36 inches from the center.

Type: Force(36 in)=

$$Force(D) := \frac{Moment}{D}$$

$$Force(36\ in) = 10.584\ kg$$

7. Understanding and Defining a Range Variable

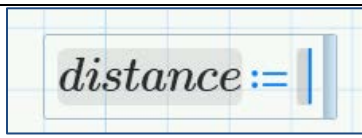
In Mathcad Prime a **range variable** is a special variable type that can be used to

quickly assign a range of values to a single variable name. It is an efficient, but less powerful, alternative to creating a vector of data values.

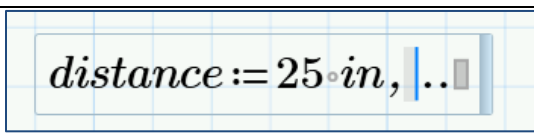
Read and Follow the Instructions in Steps 1-4 to define a range variable called distance:

1. Place the insertion cursor below the definition of Force.

2. Begin a Definition statement.
   Type: distance:



3. Begin to assign a range to the variable distance.
   Type: 25in,



Note: The "," signifies the definition of a range variable. Mathcad automatically creates placeholders for the next term and the last in the range of values represented by the label distance.

4. Complete the definition of the range variable as shown.

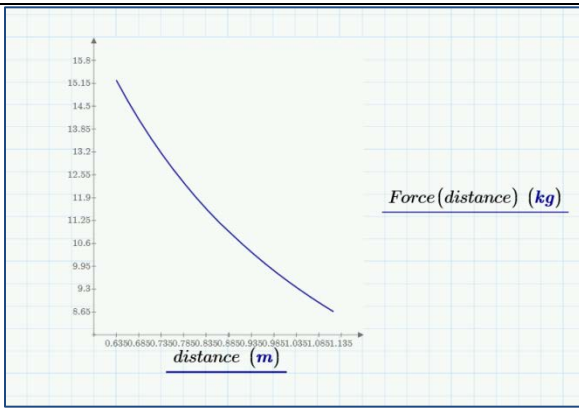
$$distance := 25\ in, 26\ in .. 44\ in$$

8. Creating a Plot using a Range Variable and a Function

Read and Follow the Instructions in Steps 1-4 to create a plot of F(distance):

1. Place the insertion cursor in the space below the definitions of Force and distance
2. Select the Plots Tab on the Mathcad Ribbon
3. Select Insert Plot
4. Select X-Y Plot and a blank X-Y plot will appear

Note: The blank plot will have a placeholder for the y-axis variables on the right and the x-axis variables beneath the plot. Many people find these locations confusing at first.



5. Click in the x-axis placeholder beneath the plot.

   Type: distance

6. Click in the y-axis placeholder to the right of the plot.

   Type: Force(distance

7. Click outside the plot to see the result

9. Using a Text Box to record observations and report conclusions

1. Locate the insertion cursor beneath the x-y plot

2. Use the Math Ribbon to insert a Text Box

3. Describe the relationship between distance (from the center line) and the

amount of force required to lower the ramp

Congratulations! You have completed the Mathcad Worksheet.