# Lecture 18 - Introduction to MathCAD

Prayer/Spiritual Thought

### Outline

- 1. Accessing MathCAD
- 2. Mathematical Operations
- 3. Variables
- 4. Symbolic Math
- 5. Units

## 1. Accessing MathCAD

You have three options:

- Buy a copy from the Chem. Eng. Dept. Office (~\$20)
- Use a CAEDM lab computer
- Access the program remotely through Citrix: (web interface) https://citrix.et.byu.edu/Citrix/XenApp/clientDetection/downloadNative.aspx (CAEDM help site) https://caedm.et.byu.edu/wiki/index.php/Citrix

MathCAD help (quite useful):

https://help.ptc.com/mathcad/en/index.html

### 2. Mathematical Operations

A. Explanation

The crosshair indicates the insertion point on the worksheet where you can begin typing numbers and symbols. Some common math operations (see also Operators menu):

- + is the addition operator
- - is the subtraction operator
- / is the division operator
- \* is the multiplication operator
- = is the *evaluation* operator
- ^ is the power operator
- | is the absolute value operator
- \ is the nth root operator

Some other useful shortcut keys:

- <space bar> changes selection while typing
- <ctrl><shift><enter> adds a line break to a long expression
- <ctrl>T creates a text box
- <ctrl> F5 to recalculate the worksheet

(more shortcuts) https://cips.colorado.edu/mathcad/Mathcad\_Prime\_Keyboard\_Shortcuts.pdf

B. Example: Type:	5		
Туре			
	: 15-8/104.5=		Tips:
$15 - \frac{8}{104.5} = 14.923$ Type: 15-8 <space><space>/104.5= <math display="block">\frac{15-8}{104.5} = 0.067</math></space></space>		=14.923 pace>/104.5=	<ul> <li>Blue vertical line is insertion point.</li> <li>Can move insertion point with arrows.</li> <li>Change selection by pressing <space> (repeatedly)</space></li> <li>Grey box indicates selection</li> <li>Precision of output is controlled in</li> </ul>
		67	
Vario expre	us mathematical essions		the Math Formatting menu
	$5^2 = 25$	-2 =2	
	$\sqrt{36} = 6$	$\frac{(5\cdot 3)+2}{7} \downarrow = 6$	3.428571
		+(5-1)	
Assigning a	and Using Varia	ables	
A. Explanati	ion		
<ul><li>Variables</li><li>Variables</li></ul>	can be created to are assigned with	o store values. You the <i>assignment</i> op	can use letters or words to name a variable. Derator, : (shows control equals).
<ul> <li>Once def</li> <li>Global va equals).</li> <li>Global va</li> <li>There are</li> <li>MathCAD</li> </ul>	riables are define riables are define e menu options fo also has some pr	d with the global de d everywhere on th r these commands re-defined variables	equent calculations (below and to the right). efintion operator, <ctrl>+<shift>+~ (shows trip he sheet. too (Math -&gt; Operators) (e, pi, infinity, etc.)</shift></ctrl>
<ul> <li>Once def</li> <li>Global va equals).</li> <li>Global va</li> <li>There are</li> <li>MathCAD</li> <li>Some usefu</li> </ul>	ined, a variable ca iriables are define e menu options fo also has some pr I shortcuts:	d with the global de d everywhere on th r these commands re-defined variables	equent calculations (below and to the right). efintion operator, <ctrl>+<shift>+~ (shows trip ne sheet. too (Math -&gt; Operators) (e, pi, infinity, etc.)</shift></ctrl>
<ul> <li>Once def</li> <li>Global va equals).</li> <li>Global va</li> <li>There are</li> <li>MathCAD</li> <li>Some usefu</li> <li><ctrl><n< li=""> <li>latin lette</li> <li>B. Examples</li> </n<></ctrl></li></ul>	ined, a variable ca iriables are define e menu options fo also has some pr I shortcuts: ninus> to write a er then <ctrl> g fo</ctrl>	an be used in subset d with the global de d everywhere on th r these commands re-defined variables subscript or greek letters	equent calculations (below and to the right). efintion operator, <ctrl>+<shift>+~ (shows trip he sheet. too (Math -&gt; Operators) (e, pi, infinity, etc.)</shift></ctrl>
<ul> <li>Once def</li> <li>Global va equals).</li> <li>Global va</li> <li>There are</li> <li>MathCAD</li> <li>Some usefu</li> <li><ctrl><n< li=""> <li>latin lette</li> <li>B. Examples</li> <li>Local</li> </n<></ctrl></li></ul>	ined, a variable ca iriables are define e menu options fo also has some pr I shortcuts: ninus> to write a er then <ctrl> g fo s variables</ctrl>	d with the global de d everywhere on th r these commands re-defined variables subscript or greek letters	equent calculations (below and to the right). efintion operator, <ctrl>+<shift>+~ (shows trip he sheet. too (Math -&gt; Operators) (e, pi, infinity, etc.)</shift></ctrl>
<ul> <li>Once def</li> <li>Global va equals).</li> <li>Global va</li> <li>There are</li> <li>MathCAD</li> <li>Some usefu</li> <li><ctrl><n< li=""> <li>latin lette</li> <li>B. Examples</li> <li>Local</li> </n<></ctrl></li></ul>	ined, a variable ca iriables are define iriables are define e menu options fo also has some pr I shortcuts: ninus> to write a er then <ctrl> g fo variables a := 4 b := 3 <math>a^2 + b^2 = 25</math></ctrl>	d with the global de d everywhere on th r these commands re-defined variables subscript or greek letters	<pre>equent calculations (below and to the right). efintion operator, <ctrl>+<shift>+~ (shows trip ne sheet. too (Math -&gt; Operators)  (e, pi, infinity, etc.)  Tips:     Typing ":" gives a ":="</shift></ctrl></pre>
<ul> <li>Once def</li> <li>Global va equals).</li> <li>Global va</li> <li>There are</li> <li>MathCAD</li> <li>Some usefu</li> <li><ctrl><n< li=""> <li>latin lette</li> <li>B. Examples</li> <li>Local</li> </n<></ctrl></li></ul>	ined, a variable ca iriables are define riables are define e menu options fo also has some pr I shortcuts: ninus> to write a er then <ctrl> g fo variables a:=4 b:=3 <math>a^2 + b^2 = 25</math> x=5</ctrl>	d with the global de d everywhere on th r these commands re-defined variables subscript or greek letters	<pre>equent calculations (below and to the right). efintion operator, <ctrl>+<shift>+~ (shows trip ne sheet. too (Math -&gt; Operators)  (e, pi, infinity, etc.)  Tips:     Typing ":" gives a ":="    Watch out for the order of definition    (left to right, top to bottom)    Variables must be assigned before    used</shift></ctrl></pre>

Globa	al variables		
	z + 1 = 5	Tips:	
		Notice the order here	
	$z \equiv 4$	<ul> <li>Be careful with global variables!</li> <li>There are three different equals signs (evaluation, assignment, global assignment). Be careful to keep these straight!</li> <li>You can highlight text or math using the Text Formatting or Math</li> </ul>	
	$k_B\!\equiv\!1.380610^{-23}$		
Pre-d	Pre-defined variables $kg \cdot m^2$		
		Formatting menus	
	$R=8.314 \frac{1}{s^2 \cdot K \cdot mol}$		
	e - 2.718		
	e - 2.718		
	$\pi = 3.142$		
	$\infty = 1 \cdot 10^{307}$		
	a = 2	Tip:	
	e=2	<ul> <li>You can re-define MathCAD variables if you want. Be careful with this too.</li> </ul>	
Symbolic	Math		
A. Explanat	ion		
<ul> <li>Symbolic a right ar</li> </ul>	expressions can be evaluated row)	d using the symbolic evaluation operator, <ctrl>. (looks li</ctrl>	
• You can a	also use the Symbolics menu.	hlas a g cimplify avpand	
<ul> <li>The symbol</li> </ul>	polic math solver will use you	r previously defined numeric variables	
B. Examples	S		
5 <i>x</i> -	$\rightarrow 25 \qquad \alpha + 4 \ \alpha \rightarrow 5 \cdot \epsilon$	lpha Tip:	
		<ul> <li>x was defined above</li> </ul>	

$$\frac{\sin(\alpha+\gamma) \xrightarrow{expand}}{\longrightarrow} \cos(\gamma) \cdot \sin(\alpha) + \sin(\gamma) \cdot \cos(\alpha)$$

$$\frac{n^2 - 2n + 1}{n^2 - 1} \xrightarrow{factor} (n-1)^2 \qquad \frac{n^2 - 2n + 1}{n-1} \xrightarrow{simplify} n-1$$

# 5. Units

## A. Explanation

- MathCAD defines units. This makes it very easy to convert units.
- You can add quantities with consistent units and multiply units in intuitive ways.
  Input units by either typing or by using the Math -> Units menu.

#### B. Examples

$1 \frac{m}{s^{2}} \cdot kg = 1 N$ 1 $atm = 14.696 \ psi$ 1 $slug = 14.594 \ kg$ 32 °F = 491.67 R	<ul> <li>Tip:</li> <li>Units appear in dark blue. Make sure they turn this color or it isn't treating it like a unit.</li> <li>MathCAD seems to work better using absolute units (R and K) instead of Celsius and Farenheit.</li> </ul>