



MathCAD Fundamentals

Lecture 1

The logo graphic consists of a vertical black line on the left, a horizontal black line below the text, and three overlapping squares: a yellow one at the top left, a red one at the middle left, and a blue one at the bottom left. The word "MATHCAD" is written in a blue, sans-serif font to the right of the vertical line.

MATHCAD

- Mathematical problem solver
- Unit converter
- Communicator of results
- Design tool



MathCad as a Mathematical Problem Solver

- Numerical problems solutions
- Symbolic problem solutions
- Collection of Built-in-Functions
- Matrix operations
- Calculation of derivatives
- Evaluation of Integrals
- Laplace Transforms
- Iterative Solutions



MathCad as a Unit Converter

- Allows you to put units in your equations.!!

MathCad for Presenting Results



- MathCad spreadsheets show equations, calculations and results in a report format.



MathCad as a Design Tool

- Variable definitions
- Equations
- Text Regions
- Graphs



Objectives:

- The MathCAD workspace
- Four different EQUAL SIGNS
- Entering an equation
- Working with units
- Entering and Editing text
- Examples



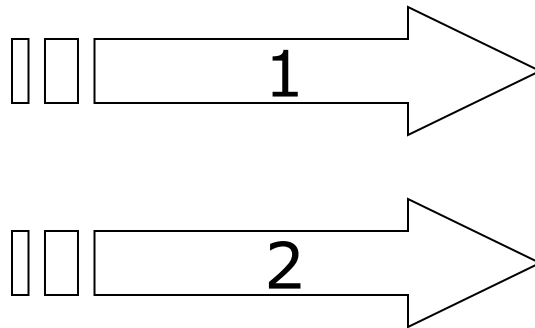
MathCad workspace

- Title bar
- Menu bar
- Math Toolbar: provides functions and mathematical symbols
- Matrix Toolbar: displays a collection of functions for performing matrix operations.
- Worksheet: area available to enter your equations, graphs, etc.



Order of equations

- Placement of your equations: controls the order of your solution
- Evaluates equations from *left to right* and *top to bottom*





Four Kinds of = Signs

- Assignment ($:=$)
 - Entered by using colon key [:]
- Display your result or the value of a variable ($=$)
 - Plain = sign
- Symbolic equality (\equiv)
 - Entered by pressing [Ctrl =]
- Global assignment (\equiv)
 - Entered by typing [\sim]



Entering an Equation

- Position the cursor (crosshair) where you want the equation to be written.
- The equation is displayed as you entered.
- MathCad creates an equation region and displays the equation.
- To see the results type =
- Be careful with exponents!!



Predefined values

- π [Ctrl-Shift-p]
- e [e]
- g [g]
- % [%]
- Exponent ^ [Shift-6]

```
r := 5
```

```
area :=  $\pi \cdot r^2$ 
```

```
area = 78.54
```

Text Subscripts and Index Subscripts



- Text Subscripts (.): as a part of a variable name. For exp: A_{circle} , A_{sphere}
- Index Subscripts ([]): indicate a particular element of an array. First element of an array in MathCad is zero.



Text Subscripts:

- Used to differentiate variables.
- Exp. Compute the areas of a circle and a square given $r = 5 \text{ cm}$ and $L = 1 \text{ cm}$
- $A_{\text{circle}} := \pi \bullet r^2$
- $A_{\text{square}} := L^2$

$$r := 5\text{cm}$$

$$A_{\text{circle}} := \pi \cdot r^2$$

$$A_{\text{circle}} = 7.854 \times 10^{-3} \text{ m}^2$$

$$L := 1\text{cm}$$

$$A_{\text{square}} := L^2$$

$$A_{\text{square}} = 1 \times 10^{-4} \text{ m}^2$$



Index Subscripts:

- Used to indicate a particular element of an array. First element in an array (matrix or vector) is element zero.

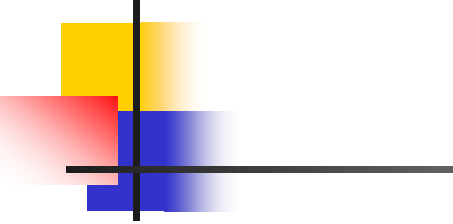
- Example:

$$t := \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix} \quad \begin{array}{l} t_0=2 \\ t_1=3 \\ t_2=4 \end{array}$$



Working with Units

- Default units: SI (meter, kilogram, second, Newton, etc)
- Also supports:
 - MKS
 - CGS
 - US
- MathCAD stores values in the base unit.
- Exp. $r := 100\text{cm} \longrightarrow r = 1\text{m}$



$$r := 5 \text{ cm}$$

$$A_{\text{circle}} := \pi \cdot r^2$$

$$A_{\text{circle}} = 7.854 \times 10^{-3} \cdot \text{m}^2$$

$$A_{\text{circle}} = 78.54 \text{ cm}^2$$



Working with Units

- Limitations:
 - Unit conversion must be multiplicative
 - Some Built-in-Functions don't support units (LINFITL)



MathCad Functions

- A function accepts inputs, performs calculations and returns a value or set of values.
- Inputs:
 - Scalars (trigonometric functions, mathematical functions and operators)
 - Arrays



MathCad Functions

- Elementary Mathematics Functions and Operators: Calculator Toolbar
- QuickPlot: produces a graph of a function. [Shift2] creates XY plot
- 3-D QuickPlots: allows you to visualize a function of 2 variables. For ex.:
 - $z(x,y)=2x^2-y$
- Trigonometric Functions: $\sin(z)$, $\cos(z)$, $\tan(z)$, $\cot(z)$, etc. z must be in radians.
- Hyperbolic Functions



Problem solutions:

- STEP 1: Use text to describe the problem
- STEP 2: Enter the given values with units
- STEP 3: Enter the equation or equations
- STEP 4: Display the answer with the appropriate units.



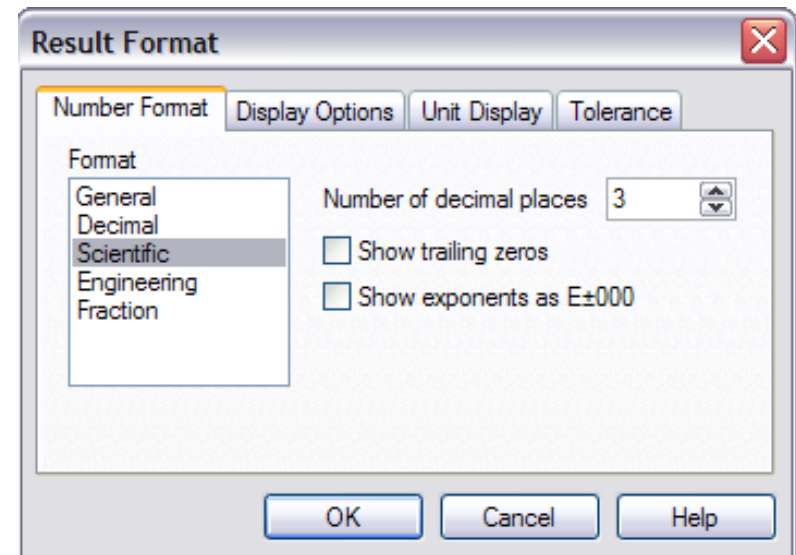
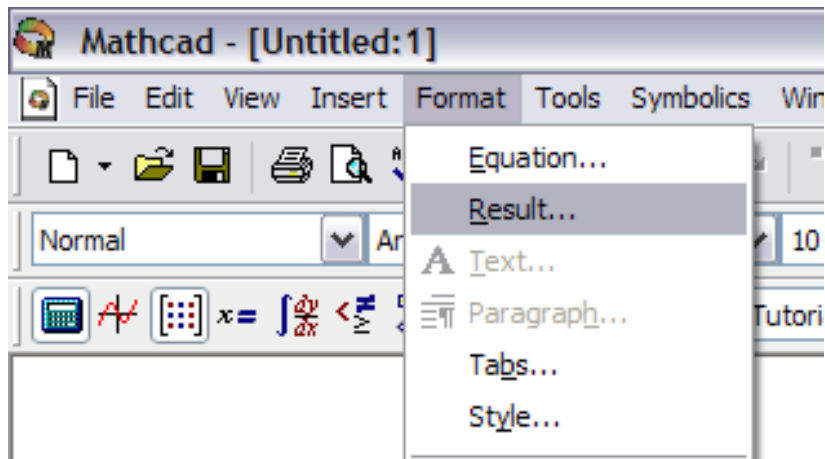
Entering Text

- Default mode is equation
- Type a series of letters and then space, MathCad will recognize it as text
- Or use ["`] to tell MathCad that you are entering text



Controlling how results displayed

- Use **Format/Result** from **Menu**
- Or double click the displayed result



Unit Conversions

■ Page 33, Problem 1 (a)

Step 1

$$\text{speed} := 2.998 \cdot 10^8 \frac{\text{m}}{\text{s}}$$

$$\text{speed} = 2.998 \times 10^8 \cdot \frac{\text{m}}{\text{s}}$$

Step 2

$$\text{speed} = 2.998 \times 10^8 \cdot \frac{\text{m}}{\text{s}}$$

Step 3

$$\text{speed} = \text{mph}$$

Step 4

$$\text{speed} = 6.706 \times 10^8 \text{ mph}$$

The screenshot shows a software interface with a toolbar at the top containing icons for undo, redo, equals, copy, paste, and a zoom dropdown set to 100%. Below the toolbar is a text input field containing "10" and a dropdown menu. To the right of the input field are buttons for bold (B), italic (I), and "Insert Unit". Below the input field is a "Tutorials" dropdown and a "Go" button with a green arrow icon.

The "Insert Unit" dialog box is open, showing a list of dimensions on the left and a list of units on the right. The "Dimension" dropdown is set to "Dimensionless". The "System" dropdown is set to "SI". The "Unit" dropdown is set to "Accel. due to gravity [g]". The dialog box has "OK", "Insert", and "Cancel" buttons.

Dimension	System
Dimensionless	SI
Acceleration	
Activity	
Angular	
Area	
Capacitance	

Unit
Accel. due to gravity [g]
Acres [acre]
Ampere [A]
Amps (amp)
Atmospheres [atm]
Becquerel [Bq]
BTU's - 15 C (BTU15)