SMART Notebook™ Math Tools

User's Guide

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Contents

Chapter 1

Introduction to SMART Notebook™ Math Tools

If you install SMART Notebook Math Tools on your computer, SMART Notebook collaborative learning software includes mathematical features such as equation editing, handwriting recognition for mathematical terms, additional shape tools, graph generation and a launcher for Texas Instruments™ (TI) emulators.

Math Toolbar

The Math toolbar enables you to select and use a variety of math-specific commands and tools in the SMART Notebook window.

The following table describes the functions of each toolbar button in the Math toolbar.

Button	Command	Action
Σ	Equations	Insert equations.
	Irregular Polygons	Insert irregular polygons.
	Regular Polygons	Insert regular polygons.
	Graph Tables	Insert graph tables.
	Graphs	Insert Cartesian, quadrant or number line graphs.
	Launch Emulator	Launch the Texas Instruments (TI) emulator.

The Math Toolbar also includes a Measurement Tools button . This feature works the same way as the Measurement Tools button in SMART Notebook.

Hiding the Math Toolbar

If you want access to SMART Notebook Math Tools features, but you don't want a second toolbar in the SMART Notebook interface, you can add any of the buttons from the Math toolbar to the SMART Notebook toolbar, and then hide the Math toolbar.

To hide the Math toolbar

1. Customize the SMART Notebook toolbar to include the math tools you want to use.

2. Right-click the SMART Notebook toolbar.

   The *Customize Toolbar* dialog box appears.

3. Clear the **Show Secondary Toolbar** check box.

4. Press **Done**.

To restore the Math toolbar

1. Right-click the SMART Notebook toolbar.

   The *Customize Toolbar* dialog box appears.

2. Select **Show Secondary Toolbar**.

3. Press **Done**.

Chapter 2
Equations

Inserting Equations

You can insert equations into a page using the Equation Editor.

To insert equations

1. Press **Equations** Σ .

2. Press where you want to place the equation.

   The *Equation Editor* and a text box appear.

3. Type the numerals you want to add to your equation. Press the buttons in the *Equation Editor* for the mathematical terms you want to add to your equation.

4. After you finish creating your equation, press outside of the text object.

Writing Equations

You can write equations on the page using pen tray pens (on interactive whiteboards) or a tethered pen and pen tool buttons (on interactive pen displays).

To write equations

1. Press **Pen** , and then select an available line type.

   ☞ **IMPORTANT**
   Don't select a creative pen.

2. Write the equation on the interactive screen using the tips below.

3. Select the equation.

4. Press the equation's menu arrow, and then select **Recognize Math Ink**.

   The equation appears surrounded by a blue border. A green circle and a

   red circle appear below the equation.

5. If the equation appears correctly, press the green circle .

    SMART Notebook Math Tools recognizes many characters, including numbers, operators, Roman letters, Greek letters and other mathematical symbols. SMART Notebook Math Tools also recognizes many mathematical functions.

    NOTE

    If you write a mathematical expression, you can solve the expression. You can also generate a graph based on this equation.

If your equation appears incorrectly, press the red circle , erase the equation and write it again. Don't attempt to write over your original equation.

Tips for Writing Equations

Consider the following when you write equations:

- Write each symbol clearly and don't overlap symbols.

- Leave space between the characters, symbols, formulas and equations that you write.

- Draw a multiplication symbol as a six-pointed asterisk, for example, ✳✳.

- If your equation involves multiple lines, such as fractions, leave space between these lines. However, don't separate a single line equation over multiple lines.

- Align superscripts, such as exponents, to the right of and above the adjacent character or symbol. Don't allow a character and a superscript to overlap.

- Write problems sequentially from left to right and from top to bottom.

- Tap to make a decimal point. Don't draw a tiny ball or scribble a mark.

- Don't use *j* as a variable unless you're writing a trigonometric expression or a complex expression. Don't use *i* or *o* as variables unless you're writing a trigonometric expression.

- Don't use *e* as a variable unless you're writing an exponential expression.

Tips for Writing Trigonometric Equations

Consider the following when you write trigonometric equations:

- Enclose variables in parentheses, for example, sin (x).

- Separate multiple trigonometric expressions using a multiplication sign, for example, sin(A)*cos(A).

Tips for Writing Exponents, Logarithms and Geometric Series

Consider the following when you write exponents, logarithms and geometric series:

- SMART Notebook Math Tools recognizes log (N) as log10N.

- SMART Notebook Math Tools recognizes logM as logm or logM (natural log).

- SMART Notebook Math Tools supports log2M and log10M only.

- Write the natural logarithm (ln) as log.

- SMART Notebook Math Tools doesn't support subscripts.

- Enclose exponents in parentheses.

Tips for Solving Multiple Line Equations

SMART Notebook Math Tools can solve some multiple lined equations if you select all the equations, press the equation's menu arrow, and then select **Recognize Math Ink**.

Recognized Mathematical Symbols

You can write equations on the page. SMART Notebook Math Tools recognizes the mathematical symbols and functions within your equation and converts them into typed text. SMART Notebook Math recognizes many symbols, including numbers, operators, Roman letters, Greek letters, and other mathematical symbols.

Numbers

Operators

Roman Letters

Greek Letters

$$\alpha \ \beta \ \gamma \ \delta \ \varepsilon \ \mu \ \nabla \ \lambda \ \eta \ \rho \ \sigma \ \pi \ \psi \ \tau$$

Other Mathematical Symbols

$$(\ ) \quad z^2 \quad e \quad (0..1) \quad \dot{x}(t) \quad \int \quad \infty$$

Recognized Mathematical Functions

You can write equations on the page. SMART Notebook Math Tools recognizes the mathematical symbols and functions in your equation and converts them into typed text. SMART Notebook Math Tools recognizes many mathematical functions, including functions in the following categories:

- Basic mathematical functions

- Trigonometric functions

- Statistical functions

- Advanced mathematical functions

> **i** **NOTE**
> SMART Notebook Math Tools doesn't support matrix variables or vector variable inputs.

Basic Mathematical Functions

abs (a)	absolute value
angle (a)	phase angle of complex numbers
ceil (a)	rounds toward +inf
exp (a)	exponential function
factor (a)	generates a list of factors
factorial (a)	n!
fix (a)	rounds toward 0
floor (a)	rounds toward -inf
gcd (a;b)	greatest common divisor
imag (a)	imaginary part

lcm (a;b)	least common multiple
log (a)	natural logarithm
log10 (a)	base 10 logarithm
log2 (a)	base 2 logarithm
max (a)	largest element
min (a)	smallest element
mod (a;b)	modulo
real (a)	real part
rem (a;b)	integer quotient and remainder
rot90 (a) and rot90 (a;b)	90 degree rotation of matrices
round (a)	rounds to nearest number
sign (a)	sign of matrix elements
sqrt (a)	square root function

Trigonometric Functions

acos (a)	inverse cos function
asin (a)	inverse sin function
atan (a)	inverse tan function
cos (a)	cos function
cosh (a)	hyperbolic cos function
cot (a)	cot function
coth (a)	hyperbolic cot function
csc (a)	cosecant function
sec (a)	secant function
sin (a)	sin function
sinc (a)	sinc function
sinh (a)	sinh function
tan (a)	tan function
tanh (a)	tanh function

Statistical Functions

cov (a)	covariance matrix
hist (a) or hist (a;b)	histogram
mean (a)	mean value
median (a)	median value
nchoosek (a;b)	binomial coefficient
rand (a) or rand (a;b)	uniformly distributed pseudorandom numbers
randn (a) or randn (a;b)	normally distributed pseudorandom numbers
std (a)	standard deviation
var (a)	variance

Advanced Mathematical Functions

beta (a;b)	beta function
erf (a)	error function
erfc (a)	complementary error function
erfcinv (a)	inverse complementary error function
erfcx (a)	scaled complementary error function
erfinv (a)	inverse error function

Solving Mathematical Expressions

If you insert or write a mathematical expression into a page, you can solve this expression and display the complete equation using the available menu options.

NOTE

SMART Notebook Math Tools can solve some equations numerically but not symbolically, and it can solve some equations symbolically but not numerically. If a solution type isn't available, you're unable to select it in the menu.

To solve an expression numerically

1. Select the equation.

2. Press the equation's menu arrow, and then select **Math Actions > Solve Numerically**.

To solve an expression symbolically

1. Select the equation.

2. Press the equation's menu arrow, and then select **Math Actions > Solve Symbolically**.

To find an equation's zero value

1. Select the equation.

2. Press the equation's menu arrow, and then select **Math Actions > Find Zeroes**.

To find an equation's minimum and maximum values

1. Select the equation.

2. Press the equation's menu arrow, and then select **Math Actions > Find Extrema**.

Chapter 3

Advanced Shape Creation and Manipulation

Inserting Regular Polygons

You can insert regular polygons with between 3 and 15 sides using the Regular Polygon tool.

To insert regular polygons

1. Press **Regular Polygons** , and then select the number of sides (the number in the polygon represents the number of sides).

2. Create a shape by pressing where you want to place the shape and dragging until the shape is the size you want.

3. To customize it, select the shape, and then edit its properties.

Inserting Irregular Polygons

In addition to creating shapes using SMART Notebook's Shapes tool, you can insert irregular polygons using the Irregular Polygon tool.

To insert irregular polygons

1. Press **Irregular Polygons** .

2. Press where you want to place the shape's first vertex.

   The first vertex appears as a small red circle.

3. Press where you want to place the next vertex.

   A line appears between the two vertices.

4. Repeat step 3 to add more vertices.

5. To stop adding vertices and complete the shape, press the first vertex's red circle.

6. To customize the shape, select the shape, and then edit its properties.

Displaying Interior Angles

You can display the interior angles of a shape.

> **ℹ NOTE**
> If you display these angles and then edit the vertices of the shape, SMART Notebook Math Tools updates the labels and displays the new interior angles.

To display interior angles

1. Select the shape.

2. Press the shape's menu arrow, and then select **Show/Hide Interior Angles**.

To stop displaying interior angles

1. Select the shape.

2. Press the shape's menu arrow, and then select **Show/Hide Interior Angles** again.

Displaying Side Lengths

You can display the side lengths of a shape.

> **ℹ NOTE**
> If you display these lengths and then edit the vertices of the shape, SMART Notebook Math Tools updates the labels and displays the new side lengths.

To display side lengths

1. Select the shape.

2. Press the shape's menu arrow, and then select **Show/Hide Side Lengths**.

To stop displaying side lengths.

1. Select the shape.

2. Press the shape's menu arrow, and then select **Show/Hide Side Lengths** again.

Displaying and Editing the Vertices of a Shape

You can edit the position of a shape's vertices. If you're displaying the shape's interior angles or side lengths, SMART Notebook Math Tools updates the labels and displays the new interior angles or side lengths automatically.

To edit the vertices of a shape

1. Press one of the shape's vertices.

   A red circle replaces each of the shape's vertices.

2. Press and drag a red circle to move that vertex.

3. When you finish editing the shape's vertices, press anywhere else on the page.

Dividing Shapes

You can divide a circle, square or rectangle into separate pieces of equal area. You can then edit and manipulate these pieces as individual objects.

i NOTE
You're unable to divide other shape types in this way.

To divide a shape

1. Select the circle, square or rectangle you want to divide.

2. Press the shape's menu arrow, and then select **Shape Division**.

   The *Shape Division* dialog box appears.

3. Select the number of pieces you want to divide the shape into from the **Divide shape into** drop down list.

4. Press **OK**.

   The shape divides into separate objects.

Chapter 4
Graphs

Inserting Cartesian Graphs

You can insert a Cartesian graph into a page. You can include the default Cartesian graph or create a graph with customized axes and insert this instead. After you insert the graph, you can add points to it.

To insert the default Cartesian graph

Press **Graphs**, and then press **Cartesian**.

A Cartesian Graph appears.

To insert a customized Cartesian graph

1. Press **Graphs**, and then press **Wizard**.

    The *Insert Graph* dialog box appears.

2. Select **Cartesian**, and then press **Next**.

    The customization fields appear.

3. If you want to change the increments of the numbers along either of the graph's axes, type a different **Step** value or increase it using the up and down arrows.

4. Type numbers to define the **Start** and **End** points of the x (horizontal) axis and y (vertical) axis or change these numbers using the up and down arrows.

5. To display a graph without horizontal lines, clear the **Horizontal Lines** check box.

6. To display a graph without vertical lines, clear the **Vertical Lines** check box.

7. To display a graph without numbers on the axes, clear the **Show Numbers** check box.

8. Press **Finish**.

To insert points in the graph

1. Double-press the position in the graph where you want to place a point.

2. Repeat step 1 until you've placed all the points you want to add to the graph.

To remove points from the graph

1. Double-press the point you want to remove.

2. Repeat step 1 until you've removed all the points you want to remove from the graph.

Inserting Quadrant Graphs

You can insert a quadrant graph into a page. You can include the default quadrant graph or create a graph with customized axes and insert this instead. After you've inserted the graph, you can add points to it.

To insert the default quadrant graph

Press **Graphs** , and then press **Quadrant**

A quadrant graph appears.

To insert a customized quadrant graph

1. Press **Graphs** , and then press **Wizard** .

   The *Insert Graph* dialog box appears.

2. Select **Quadrant**, and then press **Next**.

   The customization fields appear.

3. If you want to change the increments of the numbers along either of the graph's axes, type a different **Step** value or increase it using the up and down arrows .

4. Type numbers to define the **Start** and **End** points of the x (horizontal) axis and y (vertical) axis or change these numbers using the up and down arrows .

5. To display a graph without horizontal lines, clear the **Horizontal Lines** check box.

6. To display a graph without vertical lines, clear the **Vertical Lines** check box.

7. To display a graph without numbers on the axes, clear the **Show Numbers** check box.

8. Press **Finish**.

To insert points in the graph

1. Double-press the position in the graph where you want to place a point.

2. Repeat step 1 until you've placed all the points you want to add to the graph.

To remove points from the graph

1. Double-press the point you want to remove.

2. Repeat step 1 until you've removed all the points you want to remove from the graph.

Inserting Number Line Graphs

You can insert a number line graph into a page. You can include the default number line or create a customized axis and insert this instead.

To insert the default number line graph

Press **Graphs** , and then press **Number Line** .

A number line graph appears.

To insert a customized number line graph

1. Press **Graphs** , and then press **Wizard** .

   The *Insert Graph* dialog box appears.

2. Select **Number Line**, and then press **Next**.

   The customization fields appear.

3. If you want to change the increments of the numbers along the axis, type a different **Step** value or increase it using the up and down arrows .

4. Type numbers to define the **Start** and **End** points of the axis or change these numbers using the up and down arrows .

5. To display a graph without numbers on the axes, clear the **Show Numbers** check box.

6. Press **Finish**.

Selecting Graphs

Before you can manipulate a graph or access its menu options, you must select it.

After you select the graph, you can:

- Move the graph.

- Customize the graph.

- Generate a table from the graph.

To select the graph

1. Press **Select** ▲ .

2. Press outside, but near to, the top right corner of the graph, and then drag a rectangle to the opposite corner.

    A selection rectangle appears around the graph.

    The white circle in the graph's lower right corner is a resize handle.

    The downward arrow in the graph's top right corner is a menu arrow.

Manipulating Graphs

You can insert a Cartesian graph, quadrant graph or number line graph into a page or generate a graph from an equation or a table of values. After you insert the graph, you can move or magnify this graph.

To move the graph

1. Select the graph.

    A selection rectangle appears around the graph.

2. Press somewhere inside the border but outside of the graph, and then drag to a different position on the page.

To change the graph's magnification

1. Select the graph.

    A selection rectangle appears around the graph.

2. If no icons appear below the graph, press the two downward arrows ⌄ in the graph's bottom right corner.

    Seven icons appear below the graph.

3. Press to zoom in.

   OR

   Press to zoom out.

To display a different part of the graph

1. Select the graph.

   A selection rectangle appears around the graph.

2. If no icons appear below the graph, press the two downward arrows in the graph's bottom right corner.

   Seven icons appear below the graph.

3. Press the hand icon .

4. Press and drag the graph.

5. When SMART Notebook Math Tools displays the part of the graph you want to view, press the hand icon again.

Customizing Graphs

You can insert a Cartesian graph, quadrant graph or number line graph into a page or generate a graph from an equation or a table of values. After you insert the graph, you can customize the title of the graph and edit the start point, end point, labels and grid lines of its axes. You can also add a line of best fit based on the points in the graph.

To customize a graph using the hidden menu

1. Select the graph.

   A selection rectangle appears around the graph.

2. If no icons appear below the graph, press the two downward arrows in the graph's bottom right corner.

   Seven icons appear below the graph.

3. Press **Show/Hide Lines** to display horizontal and vertical lines on the graph. Press again to remove them.

4. Press **Show/Hide Point Labels** to display point labels. Press again to remove them.

5. Press **Show/Hide Line of Best Fit** to display a line of best fit, based on the points you add to the graph. Press again to remove it.

6. Press **Show/Hide Numbers** to display labels on the axes. Press again to remove them.

To customize a graph using the Properties tab

1. Select the graph.

   A selection rectangle appears around the graph.

2. Press the graph's menu arrow, and then select **Properties**.

3. If you want to include a label above the graph, type a **Title**.

4. To display numbers on the axes, select **Show Numbers** or clear this check box to remove them.

5. To display vertical lines, select **Vertical Lines** or clear this check box to remove them.

6. To display horizontal lines, select **Horizontal Lines** or clear this check box to remove them.

7. To display point labels, select **Show Point Labels** or clear this check box to remove them.

8. To change the labels on the axes, the range of the axes or the increments of the numerical labels on the axes, type new values for the **Label**, **Start**, **End** and **Step**.

Generating Graphs from Equations

If you insert or write an equation, you can generate and display a graph based on the equation.

To generate a graph from an equation

1. Select the equation.

2. Press the equation's menu arrow, and then select **Math Actions > Generate Graph**.

    The graph appears.

    If you update the information in the equation, SMART Notebook Math Tools updates the graph.

To break the connection between an equation and a graph

1. Select the equation or select the graph.

    A blue highlight appears around both the equation and the graph. An X in a blue circle appears between them.

2. Press the X symbol .

    If you update the information in the equation and the connection is broken, SMART Notebook Math Tools doesn't update the graph.

Generating Graphs from Tables

You can create a table of values and then generate a graph based on these values.

To generate a graph from a table

1. Press **Graph Tables** .

    A grid appears.

2. Move the pointer over the grid to select the number of rows that you want in the table. The cells of the grid correspond to the cells of your table.

    The table appears on the page.

3. Type values into the table's cells.

4. Select the table.

5. Press the table's menu arrow, and then select **Math Actions > Generate Graph**.

    If you update the information in the table, SMART Notebook Math updates the graph and vice versa.

To break the connection between a graph and a table

1. Select the table or select the graph.

   A blue highlight appears around both the table and the graph. An X in a blue circle appears between them.

2. Press the X symbol .

   If you update the information in the table and the connection is broken, SMART Notebook Math Tools doesn't update the graph and vice versa.

To reconnect a graph and a table

1. Select the table.

   A blue highlight appears around the table and a small blue square appears alongside it.

2. Select the blue square and drag it over the graph.

Generating Tables From Graphs

If you insert a Cartesian or quadrant graph, and then insert points into it, you can generate a table of values based on these points.

To generate a table from a graph

1. Select the graph.

2. Press the graph's menu arrow, and then select **Math Actions > Generate Table**.

   If you add or remove the points in the graph, SMART Notebook Math updates the table and vice versa.

To break the connection between a table and a graph

1. Select the table or select the graph.

   A blue highlight appears around both the table and the graph. An X in a blue circle appears between them.

2. Press the X symbol .

   If you update the information in the graph and the connection is broken, SMART Notebook Math Tools doesn't update the table and vice versa.

To reconnect a table and a graph	1. Select the table. A blue highlight appears around the table and a small blue square appears alongside it. 2. Select the blue square and drag it over the graph.

Adding Shapes To Graphs

You can add a shape to a graph and then display the coordinates of its vertices.

To add a shape to a graph	1. Create a shape, draw a shape, insert a regular polygon or insert an irregular polygon. 2. Press the shape and drag it over the graph.
To display the coordinates of the shape's vertices	1. Select the shape. 2. Press the shape's menu arrow, and then select **Show/Hide Vertices**.
To hide the coordinates	1. Select the shape. 2. Press the shape's menu arrow, and then select **Show/Hide Vertices** again.

Chapter 5

Texas Instruments Emulators

If you install TI-Nspire, TI-SmartView 84 or TI-SmartView 73 software on your computer, you can launch it from the Math toolbar.

NOTE
- A Texas Instruments (TI) emulator isn't included with SMART Notebook Math Tools software and this feature works only if TI software is already installed on your computer.

- You can download software from the Internet that describes itself as a TI emulator or includes features similar to a TI emulator. However, pressing the **Launch Emulator** button launches only fully licensed versions of TI emulators.

To launch the Texas Instruments emulator

1. Press **Launch Emulator** .

   If TI-Nspire, TI-SmartView 84 or TI-SmartView 73 software is installed on your computer, an icon appears with the name of your software.

2. Press this icon.