eBook Sample Book

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Preface

In this Book

This sample book contains modified material from the **Maple User Manual**.

The source material for this book is found in the **data/eBookTools** directory of your Maple installation. The source material includes the following MW files:

- Legal.mw
- Preface.mw
- GettingStartedWithMaple.mw

Creating a Book using this Source Material

You can use the eBook Publisher to create a book from these files.

1. From the **Tools** menu, select **Assistants > eBook Publisher...**
2. Add the three files to the project.
3. Set the book title to "eBook Sample Book".
4. Set the book name to "eBookSample"
5. Specify an output folder.
6. Optionally, specify other settings.
7. Specify the format(s) to build.
8. Click **Build**.

The progress bar and log display the progress of the build. When the build is complete, the resulting book is saved to the output folder.

1 Getting Started with Maple

1.1 In This Chapter

Section	Topics
Introduction to Maple (page 1) - The main features of Maple's Standard Interface	• Starting the Standard Document Interface • Entering commands and mathematical expressions • Toolbars • Context menus • Copy and drag keys • Saving Maple documents
Entering Expressions (page 15) - Methods of entering expressions in 1-D and 2-D Math	• Execution groups • Math Mode and Text Mode
The Maple Help System (page 18) - Accessing help on commands, packages, point-and-click features, and more	• How to access help for Maple features

1.2 Introduction to Maple

Working in Maple

With Maple, you can create powerful interactive documents. The Maple environment lets you start solving problems right away by entering expressions in 2-D Math and solving these expressions using point-and-click interfaces. You can combine text and math in the same line, add tables to organize the content of your work, or insert images, sketch regions, and spreadsheets. You can visualize and animate problems in two and three dimensions, format text for academic papers or books, and insert hyperlinks to other Maple files, web sites, or email addresses. You can embed and program graphical user interface components, as well as devise custom solutions using the Maple programming language.

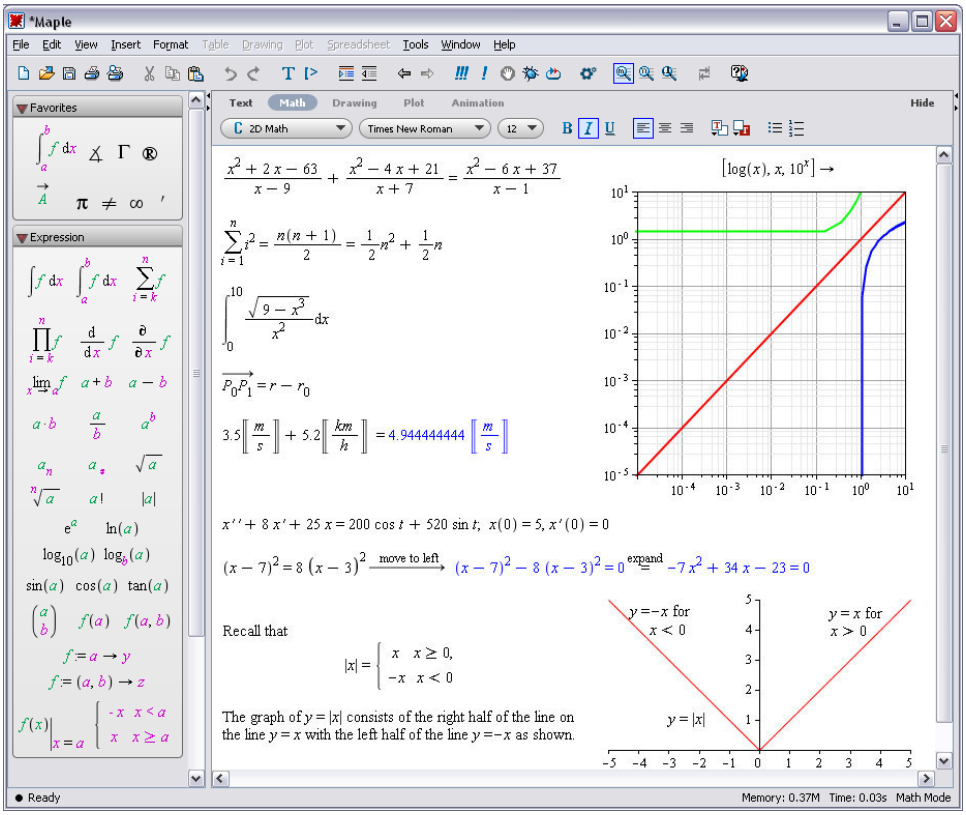


Figure 1.1: The Maple Environment

Starting the Standard Document Interface

To start Maple on:

Windows	From the **Start** menu, select **All Programs → Maple 16 → Maple 16**. **Alternatively:** Double-click the **Maple 16** desktop icon.
Macintosh	1. From the Finder, select **Applications** and **Maple 16**. 2. Double-click **Maple 16**.
UNIX	Enter the full path, for example, **/usr/local/maple/bin/xmaple** **Alternatively:** 1. Add the Maple directory (for example, **/usr/local/maple/bin)** to your command search path. 2. Enter **xmaple**.

Entering 2-D Math

In Maple, the default format for entering mathematical expressions is 2-D Math. This results in mathematical expressions that are equivalent to the quality of math found in textbooks. Entering 2-D Math in Maple is done using common key strokes or palette items. For more information on palettes, see *Palettes (page 17)*. An example of entering an expression using common key strokes is presented in the following section.

Common Operations

Entering mathematical expressions, such as $\frac{35}{99} + \frac{1}{9}$, $x^2 + x$, and $x \cdot y$ is natural in 2-D Math.

To enter a fraction:

1. Enter the numerator.
2. Press the forward slash (/) key.
3. Enter the denominator.
4. To leave the denominator, press the right arrow key.

To enter a power:

1. Enter the base.
2. Press the caret (^) key.
3. Enter the exponent, which displays in math as a superscript.
4. To leave the exponent, press the right arrow key.

To enter a product:

1. Enter the first factor.
2. Press the asterisk (*) key, which displays in 2-D Math as a dot, $\cdot$.
3. Enter the second factor.

Implied Multiplication:

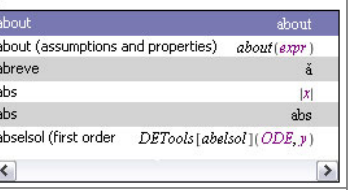
In most cases, you do not need to include the multiplication operator, $\cdot$. Insert a space character between two quantities to multiply them.

Note: In some cases, you do not need to enter the multiplication operator or a space character. For example, Maple interprets a number followed by a variable as multiplication.

Important: Maple interprets a sequence of letters, for example, *xy*, as a single variable. To specify the product of two variables, you must insert a space character (or multiplication operator), for example, $x\,y$ or $x \cdot y$. For more information, refer to the **2DMathDetails** help page.

Shortcuts for Entering Mathematical Expressions

Table 1.1: Common Keystrokes for Entering Symbols and Formats

Symbol/Formats	Key	Example
implicit multiplication	**Space** key	$(x^2 - 7xy + 3y^2)\,xy$
explicit multiplication[1]	* (asterisk)	$2 \cdot 3$
fraction[2]	/ (forward slash)	$\frac{1}{4}$
exponent (superscript)[2]	^ (**Shift** + **6** or caret key)	x^2
subscript[2]	_ (**Shift** + underscore)	x_a
navigating expressions	Arrow keys	
command / symbol completion	• **Esc**, Macintosh,Windows, and UNIX • **Ctrl** + **Space**, Windows • **Ctrl** + **Shift** + **Space**, UNIX	*ab* 
square root	*sqrt* and then command completion	$\sqrt{25}$
exponential function[2]	*exp* and then command completion	e^x
enter / exit 2-D Math	• **F5** key • **Math** and **Text** icons in the toolbar	$\frac{1}{4}$ versus 1/4

[1] required for products of numbers

[2] use the right arrow key to leave a denominator, superscript, or subscript region

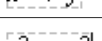
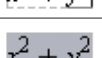
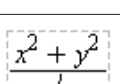
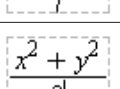
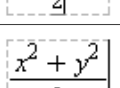
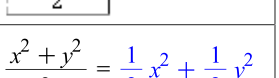
For a complete list of shortcut keys, refer to the **2-D Math Shortcut Keys and Hints** help page. For information on the Maple Help System, see *The Maple Help System (page 18)*.

Example 1 - Enter and Evaluate an Expression Using Keystrokes

Review the following example:

$$\frac{x^2+y^2}{2}$$

In this example, you will enter $\frac{x^2+y^2}{2}$ and evaluate the expression.

Action	Result in Document
To enter the expression: 1. Enter **x**.	
2. Press **Shift + 6** (the ^ or caret key). The cursor moves to the superscript position.	
3. Enter **2**.	
4. Press the right arrow key. The cursor moves right and out of the superscript position.	
5. Enter the + symbol.	
6. Enter **y**.	
7. Press **Shift + 6** to move to the superscript position.	
8. Enter **2** and press the right arrow key.	
9. With the mouse, select the expression that will be the numerator of the fraction.	
10.Enter the / symbol. The cursor moves to the denominator, with the entire expression in the numerator.	
11.Enter **2**.	
12.Press the right arrow key to move right and out of the denominator position.	
To evaluate the expression and display the result inline: 13.Press **Ctrl + =** (**Command + =**, Macintosh).	

To execute 2-D Math, you can use any of the following methods.

- Pressing **Ctrl** + = (**Command** + =, for Macintosh). That is, *press and hold* the **Ctrl** (or **Command**) key, and then press the equal sign (=) key. This evaluates and displays results inline.
- Pressing the **Enter** key. This evaluates and displays results on the next line and centered.
- Right-click (**Control**-click for Macintosh) the input to invoke a context menu item. From the context menu, select **Evaluate and Display Inline**.
- Using the **Edit** menu items **Evaluate** and **Evaluate and Display Inline**.

Toolbar Options

The Maple toolbar offers several buttons to assist you when interacting with Maple. See **Table 1.2**.

Table 1.2: Maple Toolbar Options

Basic Usage	Icon	Equivalent Menu Option or Command
Inserts plain text after the current execution group.		From the **Insert** menu, select **Text**.
Inserts Maple Input after the current execution group. For details, refer to *Execution Groups (page 15)*.		From the **Insert** menu, select **Execution Group** and then **After Cursor**.
Encloses the selection in a subsection.		From the **Format** menu, select **Indent**.
Removes any section enclosing the selection.		From the **Format** menu, select **Outdent**.
Executes all commands in the worksheet or document		From the **Edit** menu, select **Execute** and then **Worksheet**.
Executes a selected area.		From the **Edit** menu, select **Execute** and then **Selection**.
Clears Maple's internal memory. For details, refer to the **restart** help page.		Enter *restart*.
Add and edit Maple code that is executed each time the worksheet is opened. For details, refer to the **startupcode** help page.		From the **Edit** menu, select **Startup Code**.
Adjusts the display size of document content. **Note:** plots, spreadsheets, images, and sketches remain unchanged.		From the **View** menu, select **Zoom Factor** and then a zoom size.
Opens the Maple help system. For details, refer to *The Maple Help System (page 18)*.		From the **Help** menu, select **Maple Help**.

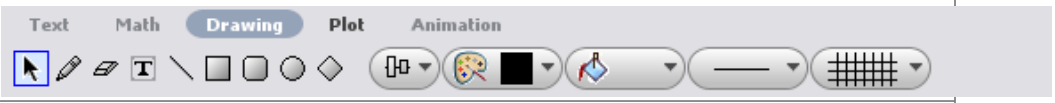
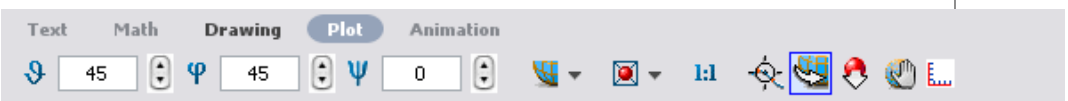
For 1-D Math and text regions, the **Tab** icon in the toolbar allows you to set the **Tab** key to move between placeholders (or cells in a table) or to indent text.

Table 1.3: Tab Icon Description

Tab Icon	Description
	Tab icon **off**. Allows you to move between placeholders using the **Tab** key.
	Tab icon **on**. Allows you to indent in the worksheet using the **Tab** key.
	The Tab icon is disabled when using 2-D Math (**Math** mode), and as such, the **Tab** key allows you to move between placeholders.

Toolbar icons are controlled by the location of the cursor in the document. For example, place the cursor at an input region and the **Text** and **Math** icons are accessible while the others are dimmed. See **Table 1.4** for a list of the tools available in each icon.

Table 1.4: Toolbar Icons and their Tools

Toolbar Icon Options
Text tools 
Math tools 
Drawing tools 
2-D Plot tools 
3-D Plot tools 

Toolbar Icon Options
Animation tools

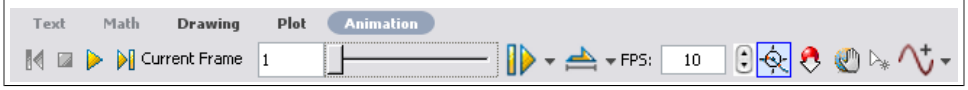


Table 1.5: Toolbar Icon Availability

Region	Available Tools
Input region\011	Text and Math icons
Plot region	Drawing and Plot icons
Animation region	Drawing, Plot, and Animation icons
Canvas and Image regions	Drawing icon

The **Text** and **Math** icons allow you to enter text and math in the same line by choosing the appropriate input style at each stage when entering the sentence.

The derivative of $\sin(x)$ is $\cos(x)$.

Using the tools available in these icons, you can customize the input style of the text and 2-D Math. For the **Text** and **Math** icons, the icon that is selected remains in that state until prompted otherwise; therefore, if the **Text** icon is selected and you press the **Enter** key, the new input region remains a Text region.

The **Text** and **Math** icons differ while at a Maple input prompt. The Math icon displays input as 2-D Math, whereas the Text icon displays Maple input. For details, refer to *Math Mode vs. Text Mode (page 16)*.

$$> \frac{x^2}{2}$$

```
> x^2/2;
```

To access the tools available in the **Plot** and **Drawing** icons, click a plot region. These tools allow you to manipulate the plot or draw shapes and enter text on the plot region. By clicking an animation region, you have the same features available for a plot region, in addition to tools for playing the animation in the **Animation** icon.

For the remaining icons, hover the mouse over the icon to display the icon description.

Context Menus and Copy & Drag

Context Menus

Maple dynamically generates a context menu of applicable options when you right-click an object, expression, or region. The options available in the context menu depend on the

selected input region. For example, you can manipulate and graph expressions, enhance plots, format text, manage palettes, structure tables, and more. When using context menus to perform an action on an expression, the input and output are connected with a self-documenting arrow or equal sign indicating the action that had taken place.

Copy & Drag

With Maple, you can drag input, output, or curves in a plot region into a new input region. This is done by highlighting the input or selecting the curve and dragging it with your mouse into a new input region. Dragging the highlighted region will cut or delete the original input. To prevent this, use the copy and drag feature.

- **Ctrl** + drag, Windows and UNIX
- **Command** + drag, Macintosh

That is, highlight the region you want to copy. Press and hold the **Ctrl** key while you drag the input to the new region using the mouse. The steps are the same for Macintosh with the exception of pressing the **Command** key.

Example 2 - Solve and Plot an Equation Using Context Menus and Copy & Drag

Review the following example:

$$5x - 7 = 3x + 2$$

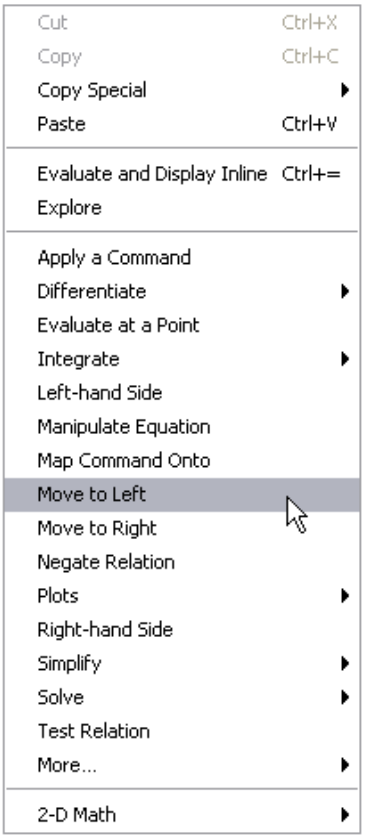
In this example, we will enter the equation and then solve and plot the equation using context menus and Maple's copy & drag feature. This example will only refer to the keystrokes needed on a Windows operating system to invoke the context menus and the copy & drag feature. The shortcut keys for your operating system can be viewed from the **Help** menu (**Help → Manuals, Resources, and more → Shortcut Keys**).

To solve the equation:

1. Enter the equation.
2. Right-click the equation and select **Move to Left**.

Input:

$5x - 7 = 3x + 2$



Result:

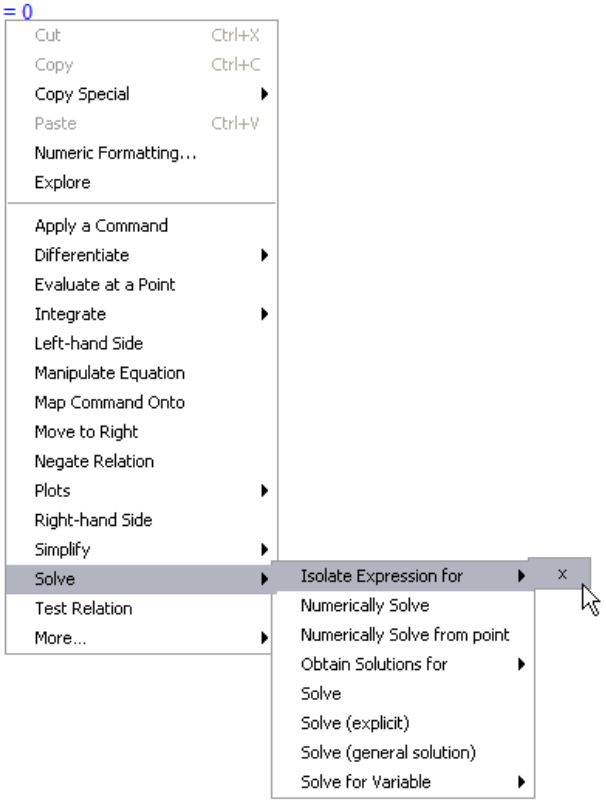
$5x - 7 = 3x + 2 \xrightarrow{\text{move to left}} 2x - 9 = 0$

A brief description, "move to left" is displayed above the arrow that connects the input and output.

3. Right-click the output from the previous action, $2x - 9 = 0$, and select **Solve → Isolate Expression for → x**.

Input:

$5x - 7 = 3x + 2 \xrightarrow{\text{move to left}} 2x - 9 = 0$



Result:

$5x - 7 = 3x + 2 \xrightarrow{\text{move to left}} 2x - 9 = 0 \xrightarrow{\text{isolate for x}} x = \frac{9}{2}$

Now that we have solved the equation, we can plot it. To do this, we will copy the equation $2x - 9 = 0$ to a new document block and use context menus again.

4. From the **Format** menu, select **Create Document Block**.
5. To copy the expression $2x - 9 = 0$, highlight only this expression from the previous result. Press and hold the **Ctrl** key and drag the expression to the new document block region.

Result:

$5x - 7 = 3x + 2 \xrightarrow{\text{move to left}} 2x - 9 = 0 \xrightarrow{\text{isolate for x}} x = \frac{9}{2}$

$5x - 7 = 3x + 2 \xrightarrow{\text{move to left}} 2x - 9 = 0 \xrightarrow{\text{isolate for x}} x = \frac{9}{2}$

$5x - 7 = 3x + 2 \xrightarrow{\text{move to left}} 2x - 9 = 0 \xrightarrow{\text{isolate for x}} x = \frac{9}{2}$

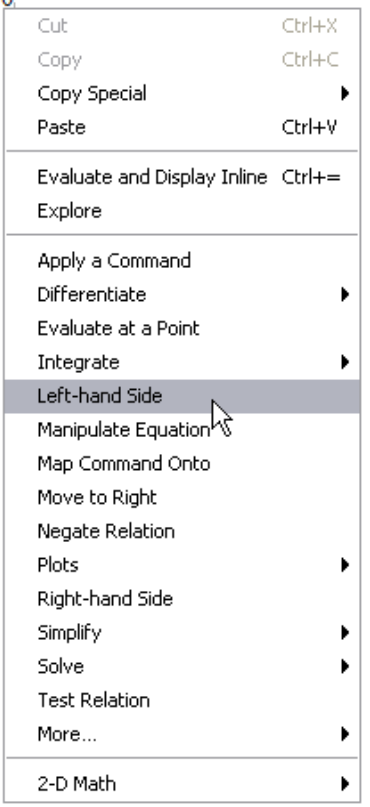
$2x - 9 = 0$

To plot the expression:

6. Right-click the equation, and select **Left-hand Side**.

Input:

$2x - 9 = 0$

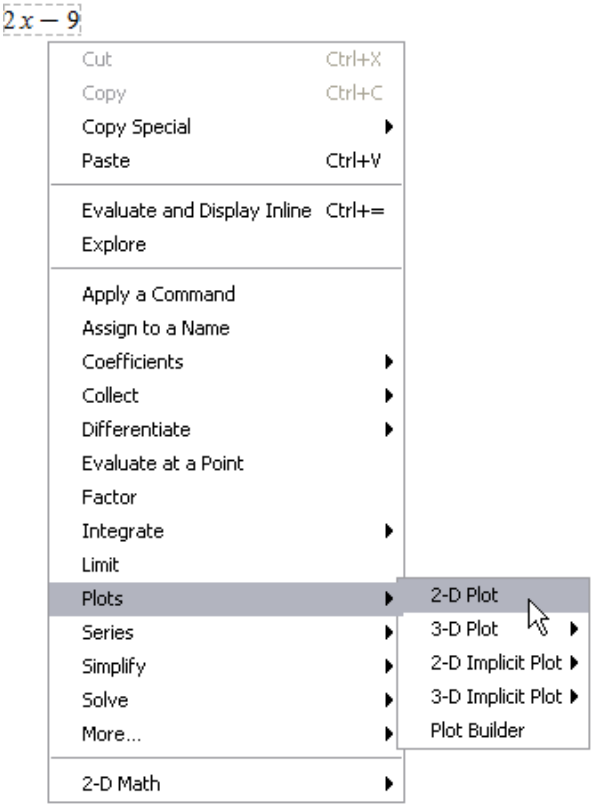


Result:

$2x - 9 = 0 \xrightarrow{\text{left hand side}} 2x - 9$

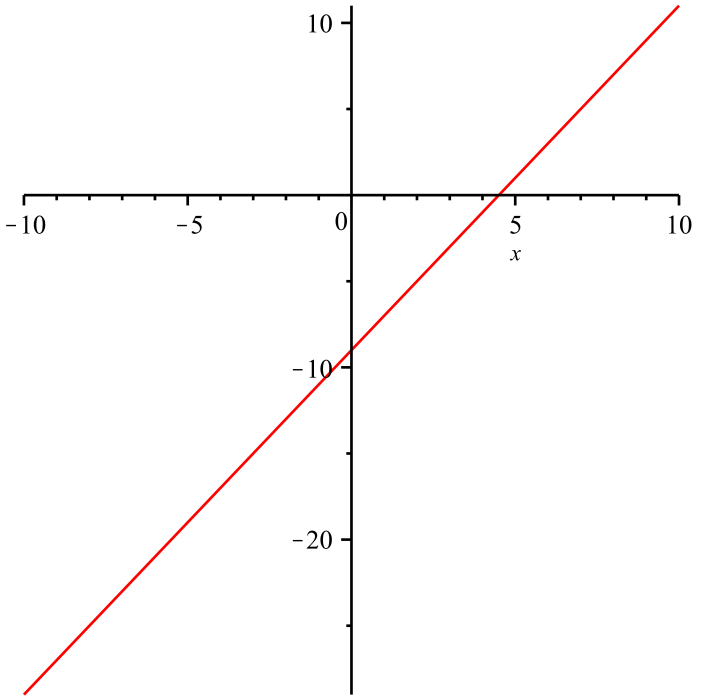
7. Right-click the expression and select **Plots → 2-D Plot**.

Input:


2 x − 9
Cut Ctrl+X
Copy Ctrl+C
Copy Special
Paste Ctrl+V
Evaluate and Display Inline Ctrl+=
Explore
Apply a Command
Assign to a Name
Coefficients
Collect
Differentiate
Evaluate at a Point
Factor
Integrate
Limit
Plots
Series
Simplify
Solve
More...
2-D Math
2-D Plot
3-D Plot
2-D Implicit Plot
3-D Implicit Plot
Plot Builder

Result:

$2x - 9 \rightarrow$



Saving a Maple Document

To save these examples you created, from the **File** menu, select **Save**. Maple documents are saved as **.mw** files.

1.3 Entering Expressions

Execution Groups

An execution group is a grouping of Maple input with its corresponding Maple output. It is distinguished by a large square bracket, called a *group boundary*, at the left. An execution group may also contain any or all of the following: a plot, a spreadsheet, text, embedded components, and a drawing canvas.

Execution groups are the fundamental computation and documentation elements in the document. If you place the cursor in an input command and press the **Enter** or **Return** key, Maple executes all of the input commands in the current execution group.

Math Mode vs. Text Mode

The default mode of entry in Document or Worksheet mode is Math Mode, which displays input in 2-D Math. In earlier releases of Maple, commands and expressions were entered using Maple Input or 1-D Math.

Important: With Maple input, you must terminate commands with a semicolon or colon.

```
> cos(alpha)^2+sin(alpha)^2;
```

$$\cos(\alpha)^2 + \sin(\alpha)^2$$

```
> a*int(exp(sqrt(2)*x),x);
```

$$\frac{1}{2}\, a \sqrt{2}\, e^{\sqrt{2}\, x}$$

```
> limit(f(x),x=infinity);
```

$$\lim_{x \to \infty} f(x)$$

```
> sum(a[k]*x^k, k=0..m)=product(b[j]*x^j, j=0..n);
```

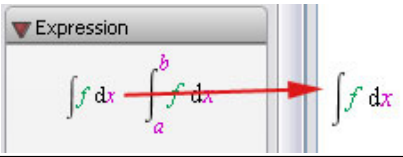
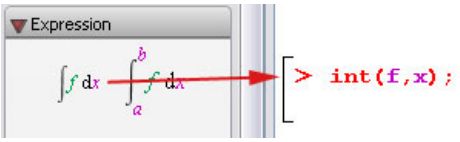
$$\sum_{k=0}^{m} a_k x^k = \prod_{j=0}^{n} \left(b_j x^j \right)$$

In Document Mode, to enter input using Maple Input mode, insert a Maple prompt by clicking [> in the toolbar, and then click the **Text** button in the toolbar. In Worksheet Mode, simply click the **Text** button. See **Figure 1.2**.

Figure 1.2: Text and Math Buttons on the Toolbar

Table 1.6: Math Mode vs. Text Mode

Math Mode	Text Mode
Maple's default setting. Executable standard math notation. This is also referred to as **2-D Math Input**. $> \int x^2 + 2x + 1 \, dx$ $\frac{1}{3} x^3 + x^2 + x$	Executable Maple notation. This is also referred to as **1-D Math Input** or **Maple Input**. `> int(x^2+2*x+1, x);` $\frac{1}{3} x^3 + x^2 + x$

Math Mode	Text Mode
Access from the **Insert → 2-D Math** menu.	Access from the **Insert → Maple Input** menu.
When using 2-D Math, the **Math** mode icon is highlighted in the toolbar, Text Math.	When entering Maple Input or text in a text region, the **Text** mode icon is highlighted in the toolbar, Text Math.
In Document Mode (or a document block), input is entered in a document block with a slanted cursor, .	In Document Mode (or a document block), input is entered with a vertical cursor, as plain text, Enter some text.
In Worksheet Mode, input is made at an input prompt with a slanted cursor, > .	In Worksheet Mode, input is made at an input prompt with a vertical cursor, > .
To convert a 2-D Math expression to 1-D Math, right-click the expression (**Command**-click, Macintosh) and select **2-D Math → Convert To → 1-D Math Input**.	To convert a 1-D Math expression to 2-D Math, right-click the expression (**Command-click,** Macintosh) and select **Convert To → 2-D Math Input**.
No termination symbol is required.	All input must end with a semi-colon (;) or a colon (:).
Palettes make entering expressions in familiar notation easier than entering foreign syntax and reduces the possibility of introducing typing errors. 	Using palettes while in 1-D Math teaches you the related Maple command syntax. 

If you prefer 1-D Math input, you can change the default math input notation.

To change math input notation for a session or globally across all documents:

1. From the **Tools** menu, select **Options**. The **Options Dialog** opens.
2. Click the **Display** tab.
3. In the **Input Display** drop-down list, select **Maple Notation**.
4. Click the **Apply to Session** or **Apply Globally** button.

Important: The new input display becomes the default setting *after* pressing the **Enter** key.

Palettes

Palettes are collections of related items that you can insert into a document by clicking or drag-and-dropping. The Maple environment provides access to over 20 palettes

containing items such as symbols (∞), layouts (A^b), mathematical operations ($\int_a^b f\,dx$), and much more.

By default, palettes are displayed in the left pane of the Maple environment when you launch Maple. If the palettes are not displayed,

1. From the **View** menu, select **Palettes**.
2. Select **Expand Docks**.
3. Right-click (**Control**-click, Macintosh) the palette dock. From the context menu, select **Show All Palettes**.

Alternatively, from the main menu, select **View** → **Palettes** → **Arrange Palettes** to display specific palettes.

You can create a **Favorites** palette of the expressions and entities you use often by right-clicking (**Control**-click, Macintosh) the palette template you want to add and selecting **Add To Favorites Palette** from the context menu.

1.4 The Maple Help System

The Maple program provides a custom help system consisting of almost 5000 reference pages. The help system is a convenient resource for determining the syntax of Maple commands and for learning about Maple features.

Accessing the Help System

There are several ways to access the Maple help system:

- From the **Help** menu, select **Maple Help**
- Click  in the toolbar

To get help on a specific word:

- In a document, place the insertion point in a word for which you want to obtain help. From the **Help** menu, select **Help on ...**. Alternatively, press **F2** (**Control** + **?**, for Macintosh) to access context-sensitive help.
- In a document, execute the command **?topic**, for example, enter **?LinearAlgebra** and press **Enter**

The Maple help system opens in a separate window with two panes. The left pane contains the Help Navigator where you initiate searches and browse the table of contents, and the right pane displays the final search result, such as a specific help page.

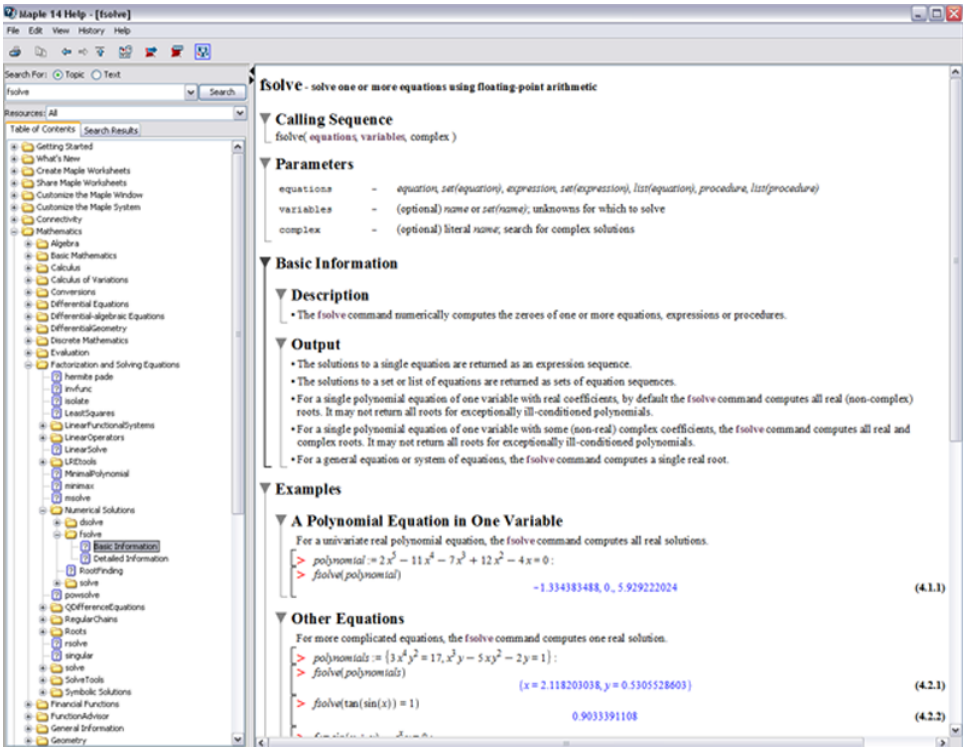


Figure 1.3: Sample Help Page

Every help page in Maple lists the command's calling sequence, parameters, and a description, with examples of the command at the end of the page. Some help pages also contain hyperlinks to related help pages and hyperlinks to dictionary definitions. Hyperlinks to help pages display in green, while hyperlinks to dictionary definitions display in dark red.

Using the Help Navigator

The Help Navigator contains a field for topic or text-based searches. The **Table of Contents** tab provides a structured list of all topics in the help system.

To search the help system:

1. In the left pane, enter a string in the search field.
2. By default, a topic search is performed. To perform a text search, select the **Text** radio button.
3. Enter the term and click **Search**.

- **Topic** searches reveal a list of matching topics sorted by the precision of the match.
- **Text** searches reveal a list of topics based on keyword frequency.
- You can search all of the help system or specific Resources such as Help Pages, Tasks, Tutorials, and Manuals by selecting the **Resources** drop-down menu.

Search results are displayed as a list in the **Search Results** tab of the left pane. Click the **Table of Contents** tab to view a structured list of all topics in the help system.

To display potential matches in the right pane, click a topic preceded by an icon. **Table 1.7** describes the different icons.

Table 1.7: Help Page Icons

Icon	Description
	A folder icon in the **Table of Contents** tab indicates that a topic can be expanded into subtopics.
	Question mark icon indicates a help page and displays the associated help page in the right pane when selected.
	**WS** icon indicates an example worksheet. Example worksheets open in a new tab in the Maple document.
	**D** icon indicates a definition and displays the associated dictionary definition in the right pane when selected.
	**T** icon indicates a Task template and displays the associated Task Template in the right pane when selected.
	**M** icon indicates a manual. Manuals open in a new tab in the Maple document.

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