1. INTRODUCING THE DOCUMENT MODEL

Welcome to an exciting new world for teachers and students of mathematics and science!

In this section, you will be introduced to some of the key features of TI-Nspire™ learning technology, including:

1. understanding the structure of the TI-Nspire document model
2. using menus to create and navigate documents
3. using keyboard shortcuts for accessing menus and menu items

Introduction to Document Management: Quick Start

The TI-Nspire learning handhelds and computer software offer a new experience in teaching and learning technologies for the mathematics and science classrooms. Using these exciting new tools, teachers and students will be able to work seamlessly across representations, documents, and even computer platforms.

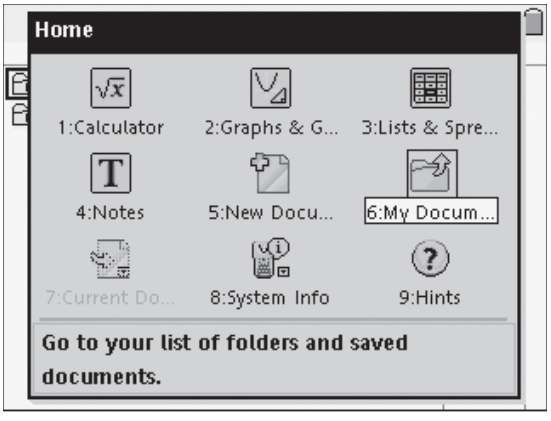


Figure 1.1: The Home Screen

It is recommended that you first work through the “Getting Started” tutorial so that you can become familiar with the management and navigation features of the TI-Nspire handheld.

The **HOME** (⌂) key at the top right of the keypad provides immediate access to the main features of the device, including **My Documents**, where documents are organized into folders as they would be on a computer.

Press ▼ on the circular NavPad to move down to the folder titled “GettingStarted.” Press the **ENTER** (enter) key or ► on the NavPad to open the folder.

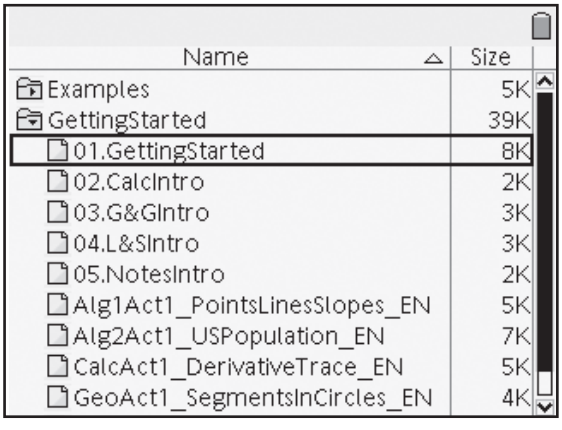


Figure 1.2: Opening a Folder

Use the cursor controls and (enter) to locate and open the file titled "01.Getting Started."

After opening the document, you will see a screen very much like the one shown in Figure 1.3. Working through this tutorial file will introduce you to many of the key features that define the TI-Nspire document model.

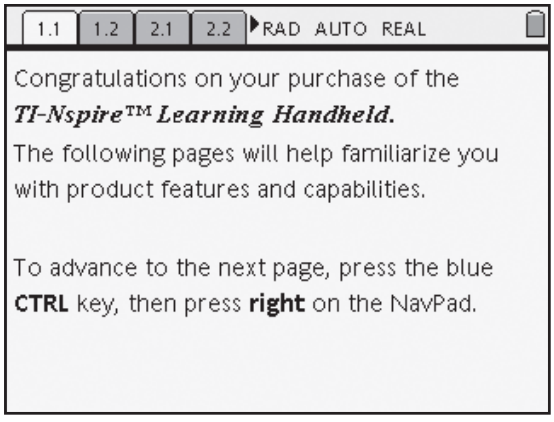


Figure 1.3: A Sample Document

Among these key features are useful and easy ways to *navigate* through documents. For example, pressing the **CTRL** ((ctrl)) key and ► on the NavPad will take you to the next page in a document. Similarly, pressing (ctrl) + ◄ returns you to the previous page. Pressing (ctrl) + ▲ will take you to the **Page Sorter**. Here, you can move quickly and easily through the pages of a document. Pressing (ctrl) + ▲ once more takes you to **My Documents**.

Figure 1.4 shows the information provided in the Page Sorter view: the name of the ***document*** (01.GettingStarted.tns), the number of the **problem** that you are currently working in (problem 1), and the total number of **pages** in the problem (for problem 1, 2 pages).

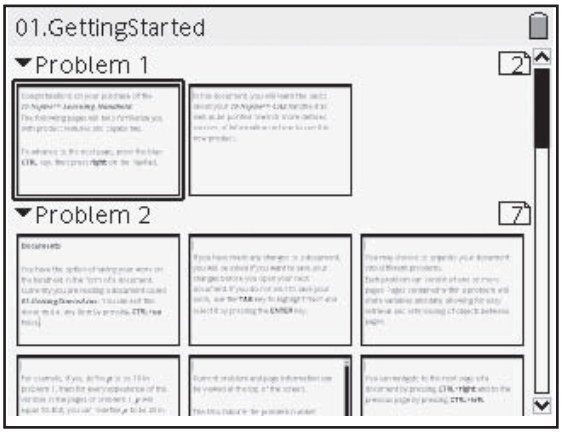


Figure 1.4: Page Sorter View

A TI-Nspire *document* may consist of multiple *problems* (each with their own set of *variables*) and each *problem* may consist of multiple *pages*. The document as shown in Figure 1.4 consists of at least two problems, with 2 and 7 pages, respectively.

From the Page Sorter, pressing (ctrl) + ▼ will return you to single page view, where you can find information at the top of the screen indicating your location in the document. For example, in Figure 1.5, the tab labeled 2.1 is highlighted to indicate that you are on page 1 of problem 2. Current system settings are shown to the right of the tabs.

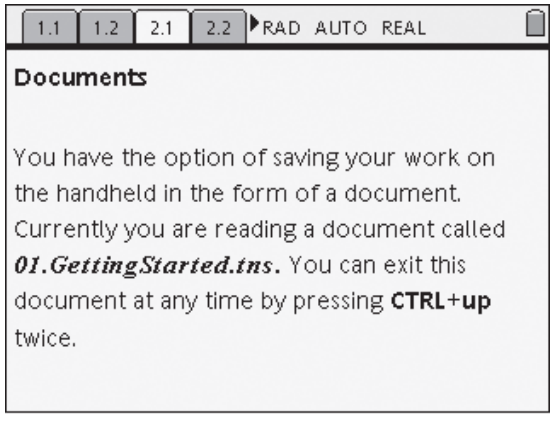


Figure 1.5: Keeping Track of Your Progress

Each page of a document can contain one or more of the core TI-Nspire applications. These applications are:

1. Calculator
2. Graphs & Geometry
3. Lists & Spreadsheet
4. Notes

A page can be divided into as many as four work areas, allowing up to four different applications to be used per page. Figure 1.6 shows a page which has the *Notes* application at the top, and the *Calculator* application at the bottom.

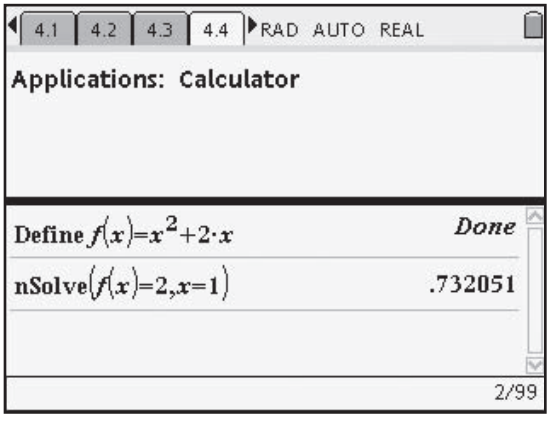


Figure 1.6: A Split Screen

You will learn much more about each of these applications and how they work together in the tutorials that follow. Although you may leave a document at any time, save it, and return to it later, you should continue to work through this *01.GettingStarted.tns* document to learn more.

Locate the **HOME** ((⌂)) key at the top right corner of the keypad. When pressed, it activates the Home screen: an icon-based view of common tasks as described below.

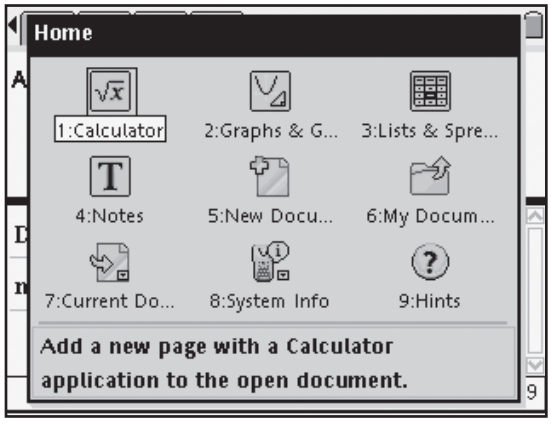


Figure 1.7: Home Screen Icon desktop

Selecting one of the TI-Nspire applications will insert that page into your current document. For example, selecting **1:Calculator** will insert a *Calculator* page.

Pressing **5:New Document** will prompt you to save or discard any changes made to the current document before opening a new one, while **6:My Documents** opens the document browser from which an existing document may be selected.

8:System Info is available here, and pressing **9:Hints** brings up a summary of shortcuts and navigation features as shown in Figure 1.8.

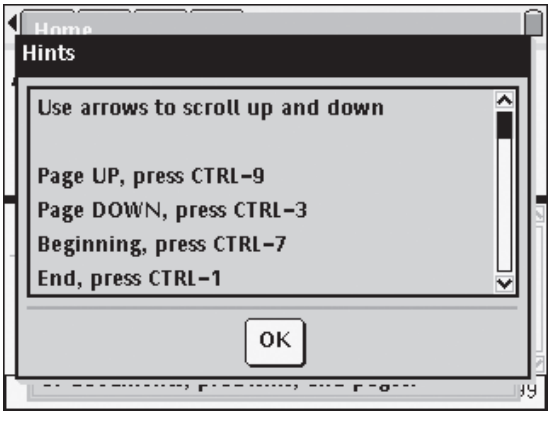


Figure 1.8: Helpful Hints

Return to the Home screen, and select **6:My Documents** to access the document browser. (The current document remains active until you choose to open another document or create a new document, at which time you will be prompted to save or discard any changes you have made.)

The **MENU** ((menu)) key, located below the **HOME** key, opens a drop-down menu which provides access to management features of the document browser as shown in Figure 1.9. This **MENU** key will always provide access to the features of the *current* environment. For example, within the *Notes* application, this menu offers only the available options for the *Notes* application.

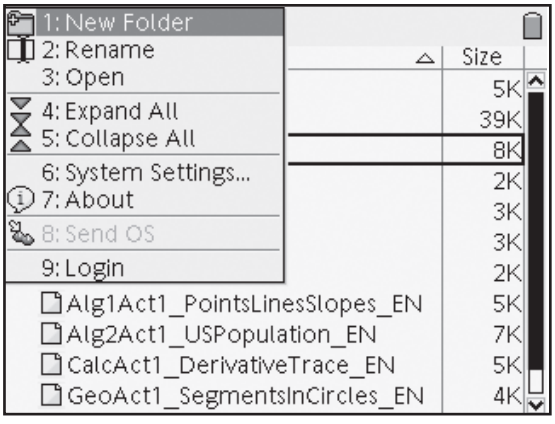


Figure 1.9: Document Browser—MENU

Press the **ESC** ((esc)) key at the top left of the keypad to close out of a menu or dialog box.

Pressing (ctrl) + (menu) from the document browser accesses a floating contextual menu with commonly-used features required for folder and document management (See Figure 1.10). This feature is context-specific and will offer useful options for the current working environment.

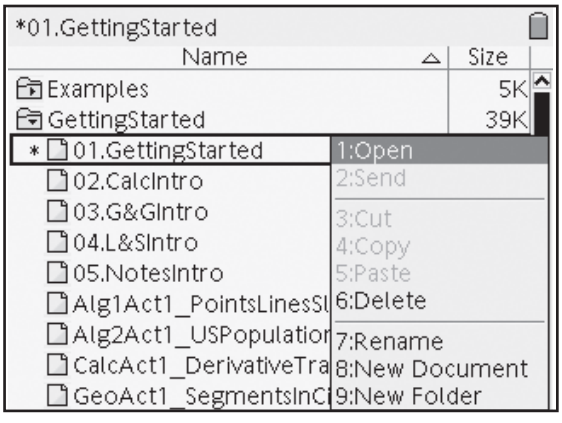


Figure 1.10: Document Browser—CTRL + MENU

More complete *document management* options are available through the **TOOLS** (🔧) menu. To access the **TOOLS** menu, press (ctrl) + (home). Within any application, this **TOOLS** menu retains the same features as shown in Figure 1.11. Most of the options that are unavailable within the document browser environment (shown in Figure 1.11 as "grayed out") will be active within an application page in a document.

Let's now to begin working with a new document and explore our first TI-Nspire application.

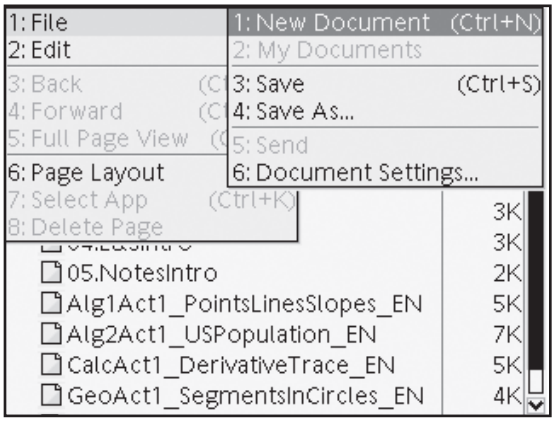


Figure 1.11: Document Browser—TOOLS (CTRL + HOME)

2. INTRODUCING THE CALCULATOR APPLICATION

In this section, you will be introduced to some of the key features of the TI-Nspire™ ***Calculator*** application, including:

1. using templates and the Catalog to create mathematical expressions
2. using menu items to carry out mathematical processes, both numeric and algebraic
3. defining functions, variables, and matrices
4. moving between exact and approximate modes of computation

At the heart of TI-Nspire learning technology lies the *Calculator* application, the workspace for both numeric operations and algebra. Create a new document and press (enter) to choose the *Calculator* application. Try recreating the examples shown in Figure 2.1. You can either directly type the commands or explore the menus.

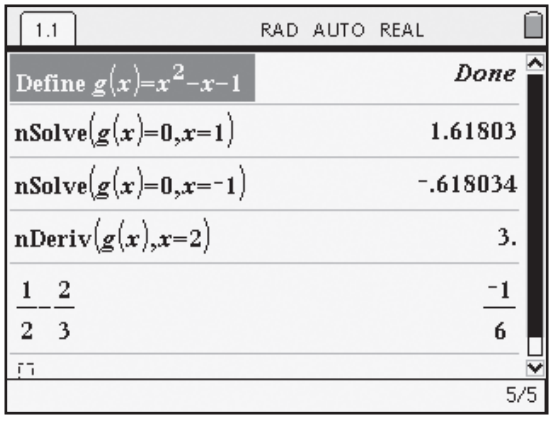


Figure 2.1: The Calculator Application

In this section, we will explore some of the properties of a most interesting number, the Golden Ratio, and in doing so, learn more about the TI-Nspire *Calculator* application.

Insert a new *Calculator* page by pressing (ctrl) + (I) (the letter I on the small green buttons) and then pressing (enter). Type "1" using the keypad, and press the **ENTER** key.

Now type "1 +" and press (ctrl) followed by the (÷) key to produce the fraction template.

Alternatively, the **Catalog** ((abc)) key or (ctrl) + (menu) (shown in Figure 2.2) will offer access to the templates menu, from which the fraction template may be chosen.

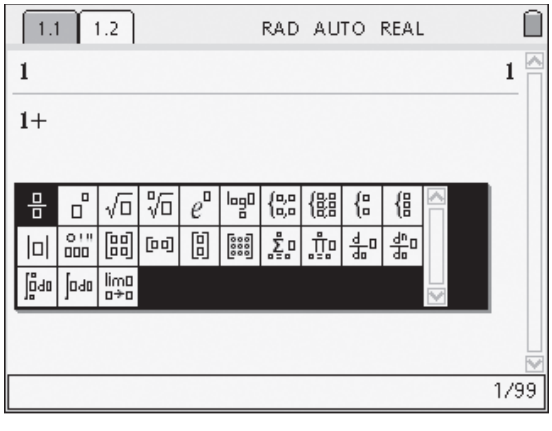


Figure 2.2: Choosing a Template

Enter “1” in the numerator position (top of the fraction), and then move to the denominator position (bottom of the fraction) by pressing ▼ on the NavPad or by pressing the **TAB** (tab) key—located below the **ESC** key.

For the denominator, enter “Ans” by pressing ctrl followed by ans (–)—the white key to the left of the **ENTER** key. Alternatively, you may type “Ans” using the green alphabet keys.

Press enter to evaluate the expression.

Pressing enter again instructs the device to repeat the last instruction—to find the sum of 1 and the reciprocal of the last answer.

Repeating this simple activity produces a series of fractions which have a very particular pattern. Each fraction is made up of successive terms of the famous Fibonacci Sequence, where each term is the sum of the two previous terms:

1, 1, 2, 3, 5, 8, 13, 21, …

Can you see these numbers emerging in your fraction calculations?

Something else is happening as this pattern unfolds, but it is not entirely obvious while the results are in exact form. Several options are available for producing approximate answers.

To change the settings for the entire document, press ctrl + home to access the **TOOLS** menu (🔧), and then press ► on the NavPad to expand the **File** menu, as shown in Figure 2.5. Arrow down to **6:Document Settings** (or simply press the number 6).

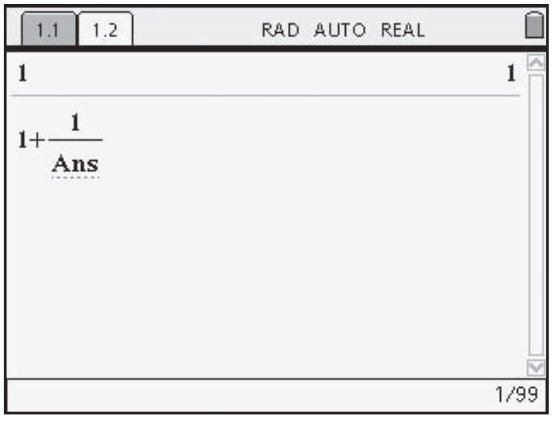


Figure 2.3: Working with Templates

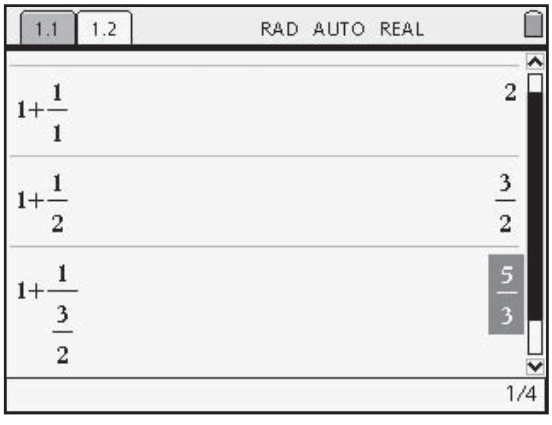


Figure 2.4: Building a Repeated Expression

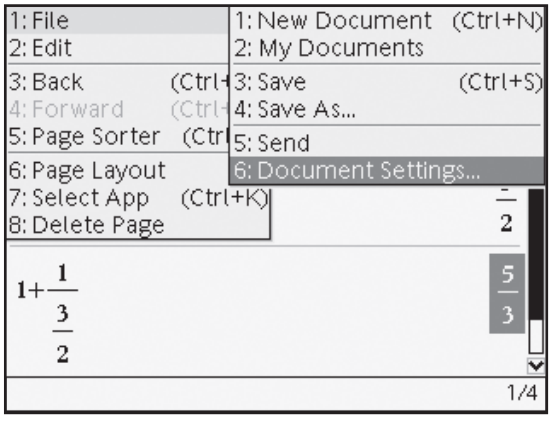


Figure 2.5: Accessing Document Settings

Press (tab) to move through the settings until the "Auto or Approx." setting is highlighted. The default setting for this is "Auto," which allows the device to choose the most appropriate form for an answer. Press ▼ to access the different options and select "Approximate." Then press (tab) again until the "OK" box is highlighted and press (enter) to confirm your choice.

This changes the setting for the document and subsequent calculations will remain in this mode until it is changed again.

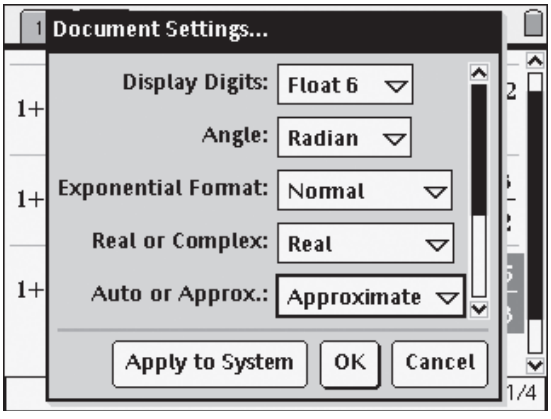


Figure 2.6: Configuring Document Settings

A less permanent option (and the one used in this activity) is to press (ctrl) before pressing (enter) to evaluate an expression. This will force an approximate result. Alternatively, entering any numeral in the expression in decimal form (e.g., 1.0 instead of 1) will also force an approximation.

Note that after forcing one approximation, subsequent calculations remain in approximate mode, due to the repeated nature of this calculation and since the *Ans* value is now in decimal form.

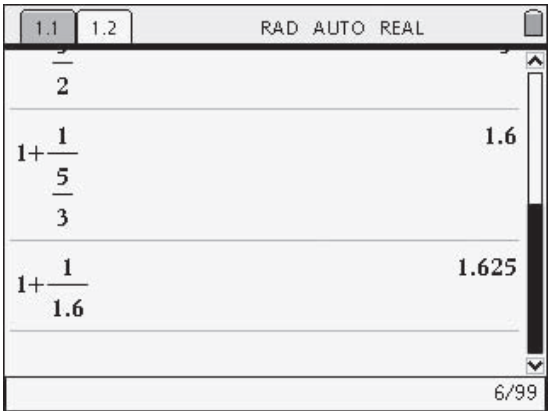


Figure 2.7: From Exact to Approximate

Continue pressing (enter) to produce a series of numbers which appear to converge to a single result—the famous Golden Ratio!

If a more or less exact result is required, return once more to the Document Settings and change the "Display Digits" menu option.

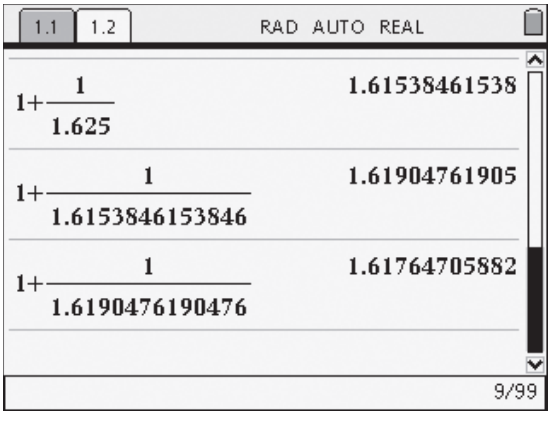


Figure 2.8: Decimal Forms

Interested students may wish to continue the computation until the decimal form remains unchanged, indicating that they have reached the limits of the device's visible accuracy. We say "visible" because, although it will not display more than 12 figure accuracy, another 6 decimal places are used to ensure accuracy of calculation "behind the scenes"!

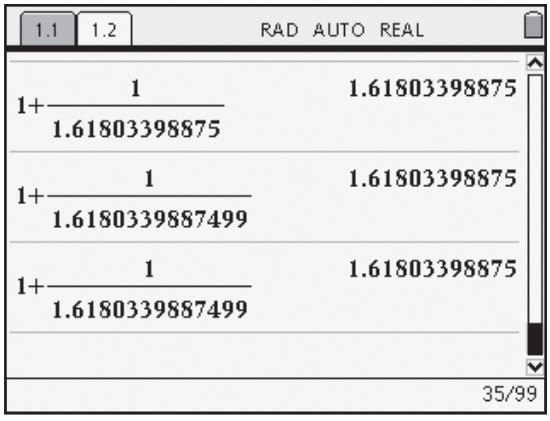


Figure 2.9: Better and Better Approximations

The Golden Ratio has many interesting properties, both numerical and algebraic. Define the last result as a variable, "*gold*." To do so, type "Define *gold* =" and press ▲ on the NavPad to highlight the last calculated answer. Press (enter) to copy the expression to the entry line, and press (enter) again to complete the definition.

Now take the reciprocal of *gold*. (You may like to use the keyboard shortcut for the fraction template, introduced earlier!) The result is exactly 1 less than *gold*—the "tail" of the decimal form remains unchanged!

Now find the square of *gold*. (The **SQUARE** ((x²)) key is halfway down the left-hand side of the keypad. The **CARET** ((^)) key moves the cursor into the raised exponent position for entering powers and is located above the **SQUARE** key.) The "tail" is again unchanged, and the result is exactly 1 more than *gold*!

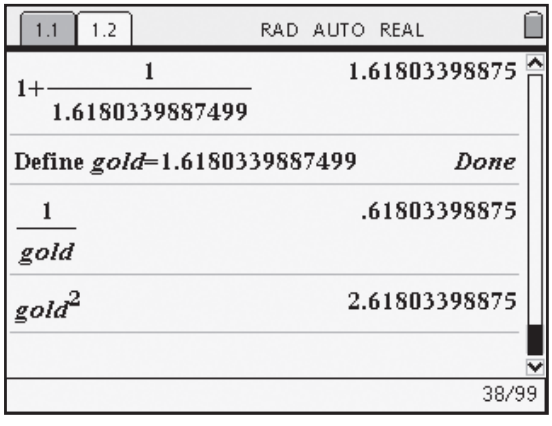


Figure 2.10: Special Properties of "gold"

Can you see how both these interesting results may be expressed algebraically? Two different equations can be written from these results and solved as shown in Figure 2.11.

Take some time to explore these interesting numbers further—the Fibonacci Sequence and the Golden Ratio tell us much about nature and art, and there is more yet to be discovered! Using the powerful features available within TI-Nspire learning technology, you have ideal tools for such an investigation!

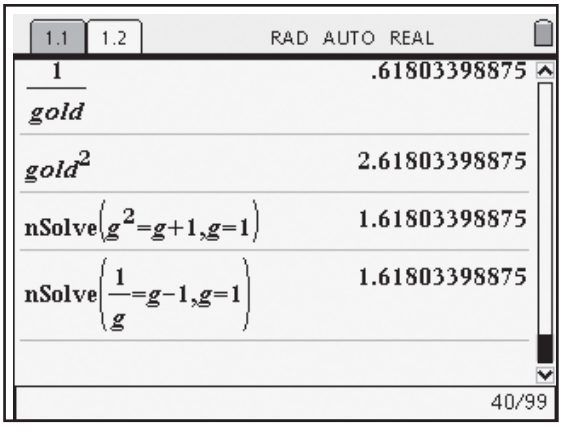


Figure 2.11: Using Numerical Solve

3. INTRODUCING THE GRAPHS & GEOMETRY APPLICATION

The ***Graphs & Geometry*** application is perhaps the most visually exciting of the TI-Nspire™ applications. In this activity, you will explore some of the functionality of the *Graphs & Geometry* application, including:

1. plotting function graphs
2. examining the graph as a geometric object
3. constructing tangents, perpendiculars, and loci
4. using templates to enter mathematical expressions

This activity was originally developed by Dr. Charles Vonder Embse from Central Michigan University.

Begin with a new TI-Nspire document, and create a *Graphs & Geometry* page. Throughout this activity, you will be pressing (menu) to access different tools. While using a tool, its icon will appear in the upper left corner of the screen. When you have finished using a tool, press (esc) to close out of it.

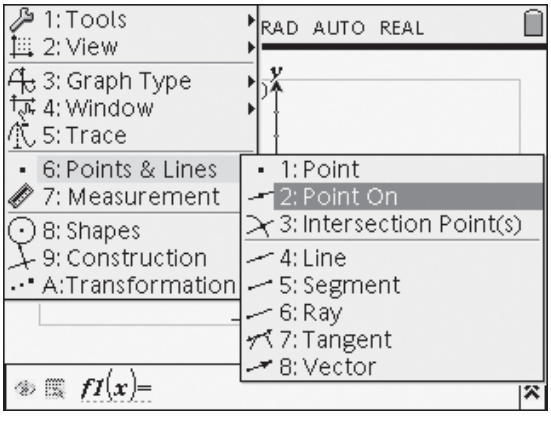


Figure 3.1: Accessing Tools through Menus

From the Points & Lines menu, select the **Point On** tool ( ) to create a point on the *x*-axis, and label this point *X*. Labeling can be achieved by typing the label immediately after placing the point, or afterwards by using the **Coordinates and Equations** tool ( ) (**MENU > Tools > Coordinates and Equations**). (Note: Unless otherwise directed, do not place points on tick marks; this will cause them to "jump" from mark to mark when dragged, rather than moving continuously along the axis.)

You may wish to use the **Attributes** tool ( ) (**MENU > Tools > Attributes**) to change the *style* of the point to increase its visibility.

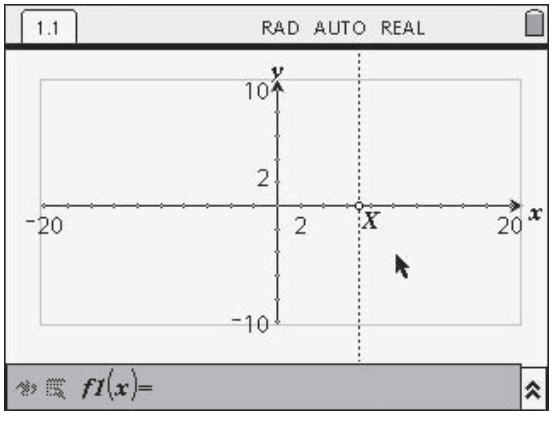


Figure 3.2: Point On an Axis and Perpendicular

Next, construct a line through this point that is perpendicular to the *x*-axis using the **Perpendicular** tool ( ) from the Construction menu—again you may use the **Attributes** tool to change the appearance of this line.

Move the cursor to the **Entry Line** and press the **CLICK** (⏺) key to activate it. Enter a cubic function, such as $x^3 - 5x + 2$ (as shown), press enter to graph it, and press esc to return to the work area. Now, grab and drag tick marks on the axes to gain a better viewing window for this function.

To grab an object, hover the cursor over it until the object pulses—the cursor should resemble an open hand (✋). Press and hold the **CLICK** key until the cursor changes to a closed hand (✊). Then simply use the NavPad to move the object as desired.

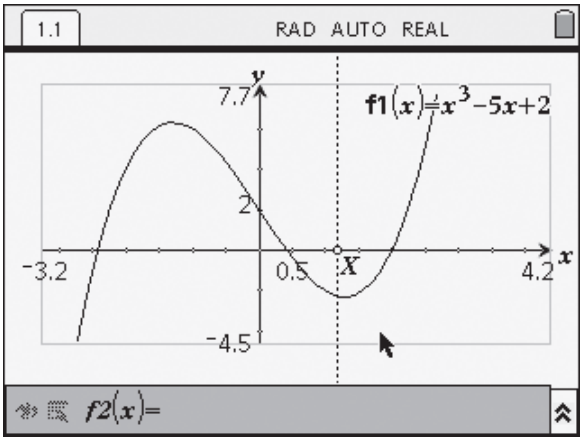


Figure 3.3: Function Graphing and Adjusting Axes

Note that pressing and releasing the **SHIFT** (caps) key, holding the **CLICK** key, and then dragging allows the axes to be scaled independently. You may also grab and drag the end points of the axes, or type directly into the values at the ends of each axis. **Window Settings** can also be adjusted from the **Window** menu.

From the Points & Lines menu, select the **Intersection Point(s)** tool (📍) to locate the point at which the line and curve intersect. Label this point *T*.

Pressing ctrl + G will hide the **Entry Line** at the bottom of the screen to free up some space. (Pressing ctrl + G again will bring it back.)

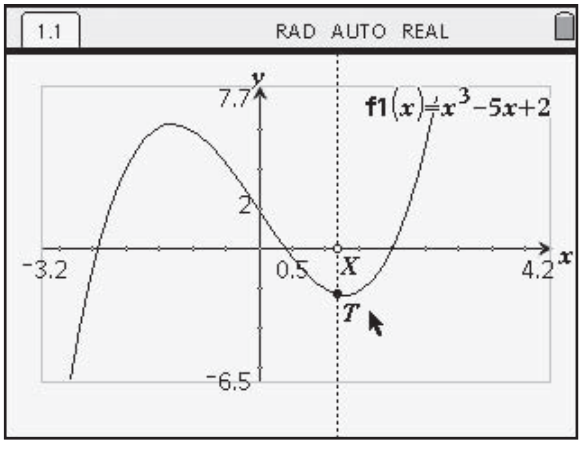


Figure 3.4: Intersection of Perpendicular and Curve

Next, create a dynamic tangent to the curve at point *T* by using the **Tangent** tool (📐) from the Points & Lines menu.

From the Measurement menu, select the **Slope** tool (📏) to measure the slope of the tangent line. You may wish to move the slope to a convenient place on the screen, such as the lower right corner. Because this value will, of course, dynamically change as point *X* is dragged, it is beneficial to have it in a fixed position so you know where to find it.

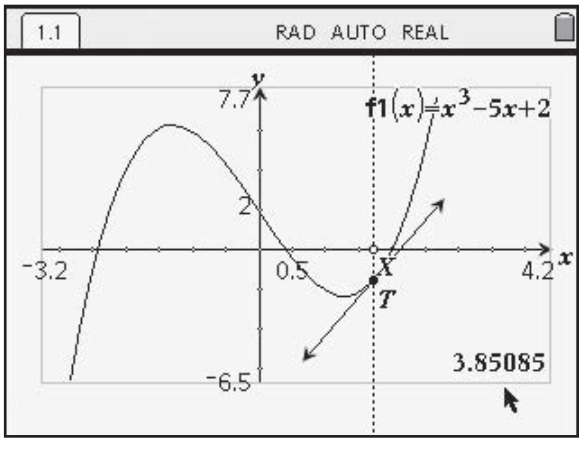


Figure 3.5: Adding a Dynamic Tangent

The **Measurement Transfer** tool (), available from the Construction menu, allows calculated measurements to be transferred to lines, segments, rays, and other geometric figures. Then, as the original figure's measurements change, so will the transferred measurement.

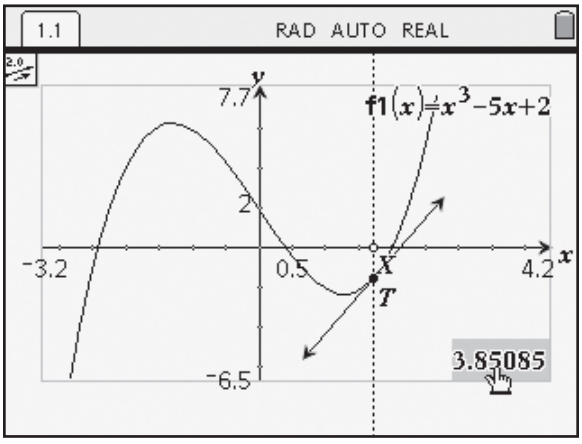


Figure 3.6: Measurement Transfer Tool

Select the **Measurement Transfer** tool and click on the slope measurement as shown in Figure 3.6. Then click on the *y*-axis. This creates a point on the *y*-axis such that the distance from the origin to the point is equal to the slope of the tangent line!

Press (esc) to close out of the **Measurement Transfer** tool, and use the **Perpendicular** tool to create a perpendicular line to the *y*-axis that passes through this newly constructed point. (Again, you may wish to use the **Attributes** tool to change this line's appearance.) Now use the **Intersection Point(s)** tool to find and label point *P*, the intersection of the two constructed perpendicular lines.

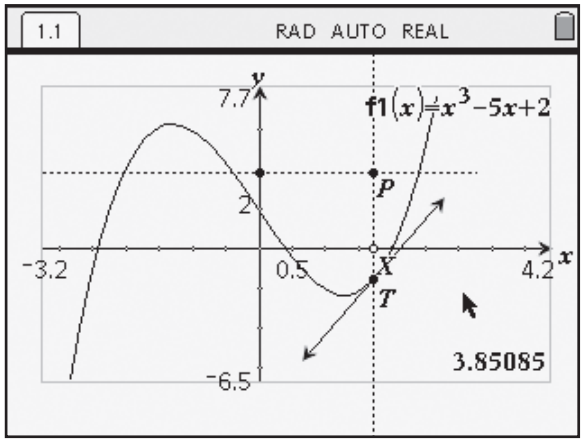


Figure 3.7: Intersection of Perpendiculars

As you drag point *X* along the *x*-axis, study the movement of point *P*, and try to describe the path it takes. Explain what point *P* represents in terms of the constructions.

After some discussion, select the **Locus** tool () from the Construction menu. Clicking on point *P* and then on point *X* will generate the path of the set of *all* points *P* as the point *X* is moved along the axis.

Further discussion should center on the nature of this new curve, which was *derived* from the original curve by graphing the slope at each point of the domain.

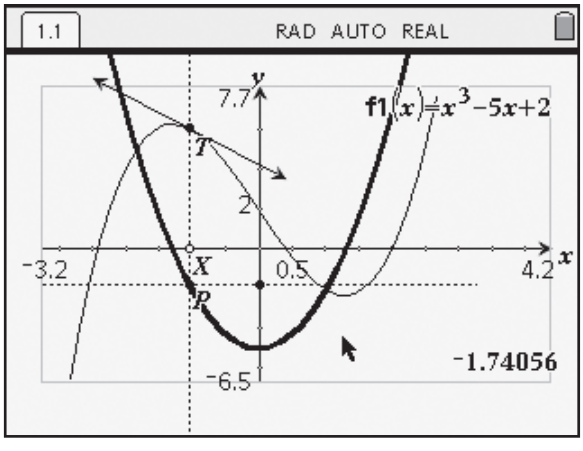


Figure 3.8: Locus of the Tangent Slope

Unhide the **Entry Line** and enter x^2 in for **f2(x)**. Grab the graph of this parabola near the origin (the cursor should look as shown in Figure 3.9: ✣) and drag its vertex to match that of the derived function you have created using the **Locus** tool. Note that the equation updates as the curve is translated.

You may also double-click the function label for **f2(x)** on the graph which opens the function in a text box, ready to edit.

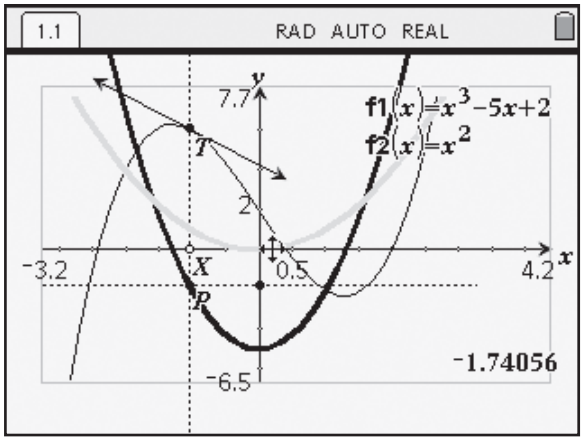


Figure 3.9: Translating a Function

Grab one of the arms of the parabola (now the cursor should look as shown in Figure 3.10: ⇲) and drag to stretch until it closely matches the curve. The equation again updates as the curve is stretched. Try adjusting the function equation to better match your curve!

After further discussion, the equation of the derived function may be recognized as $\mathbf{3}x^2 - \mathbf{5}$. How might this be found from the original function?

Now, you can alter the equation for **f1(x)** and observe how it affects the graph of the derived function. Then attempt to find the equation of the derived function by starting with a fundamental function and dragging and stretching.

Explore and enjoy!

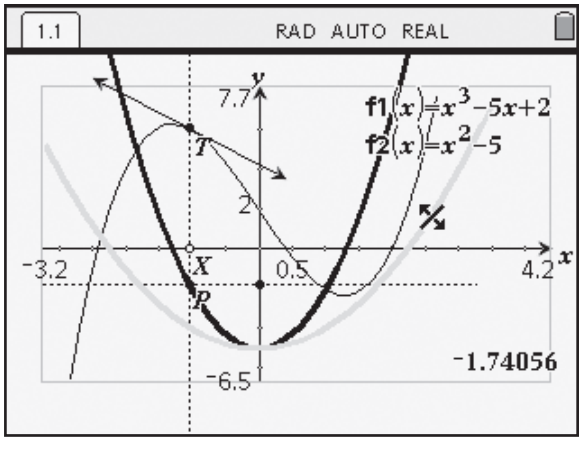


Figure 3.10: Stretching a Function

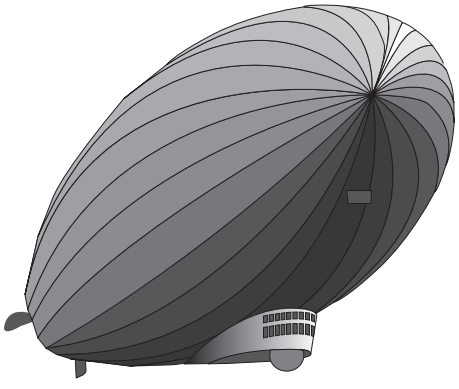
4. INTRODUCING THE LISTS & SPREADSHEET APPLICATION

The ***Lists & Spreadsheet*** application is one of the four core TI-Nspire™ applications. In this activity, you will analyze data using the some of the functionality of the *Lists & Spreadsheet* application, including:

1. entering data into lists
2. naming lists
3. using formulas
4. determining regression equations

Scenario

Although airships are still used for aviation including advertising blimps over sporting events, sightseeing rides, and heavy lifting, there are still concerns by the public about their safety. This is mostly due to the historic case of a Zeppelin exploding in 1937—known as the *Hindenburg disaster*. Currently a safer gas, helium, is used rather than hydrogen gas, which was the gas used in the early Zeppelin airships.



The table below shows how the volume of hydrogen gas affects the pressure when the temperature is kept at 27°C.

Volume (liters)	Pressure (atm)
1.25	20
0.84	30
0.63	40
0.51	50
0.26	100

It is clear from the above data and our own understanding that if the space (volume) of the gas is decreased the pressure will increase. We will investigate the mathematical relationship between the pressure and the volume of hydrogen gas.

Step-by-Step Instructions

Open a new document and insert the *Lists & Spreadsheet* application. From the Actions menu, select **Resize** and press ► on the NavPad to make each of the first three columns wider.

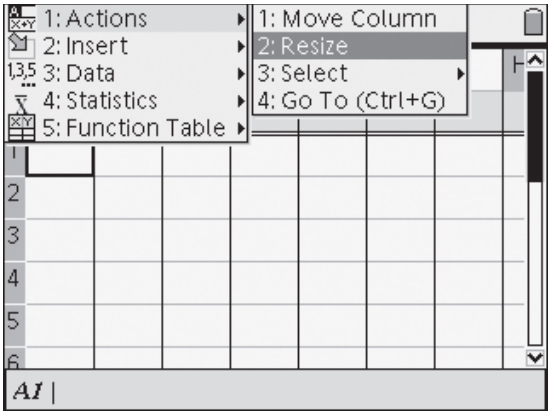


Figure 4.1: A New Lists & Spreadsheet Page

Move the cursor into the heading space of Column A and type in *volume* as the List name. Press (enter). Type in *pressure* as the List name for Column B. Press (enter).

In Column A, enter the *volume* readings from the table on page 17. In Column B, enter the *pressure* readings.

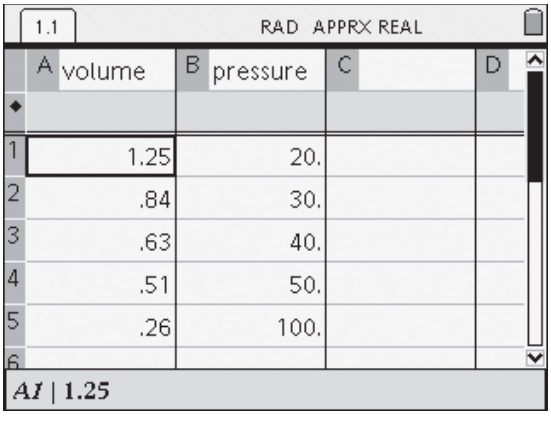


Figure 4.2: Entering Data

According to Boyle's Law for an ideal gas, pressure varies inversely with volume. That is, for a set amount of gas, the lesser the volume, the greater the pressure: $P \propto \frac{1}{V}$. This means that $P = \frac{k}{V}$ or $P \times V = k$ (where k is some constant).

Create a formula in Column C to multiply the two lists, *volume* and *pressure*, as follows. Move the cursor to the formula cell (in gray) in Column C and press (=). Then press the **VAR** (stoVar) key and **Link to** the *volume* variable. Insert the multiplication sign (press (×)) and use the **VAR** key again to **Link to** the *pressure* variable. Press (enter) to populate the column.

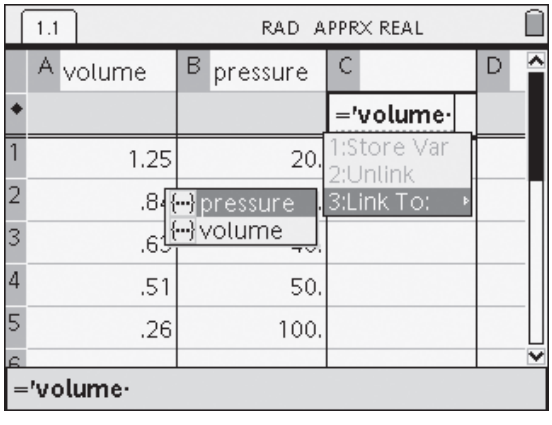


Figure 4.3: Entering a Formula

Does the data support Boyle's law? (Are the values in Column C constant?)

If the data is in fact related by $P = \frac{k}{V}$, then a power regression should show $P = kV^{-1}$.

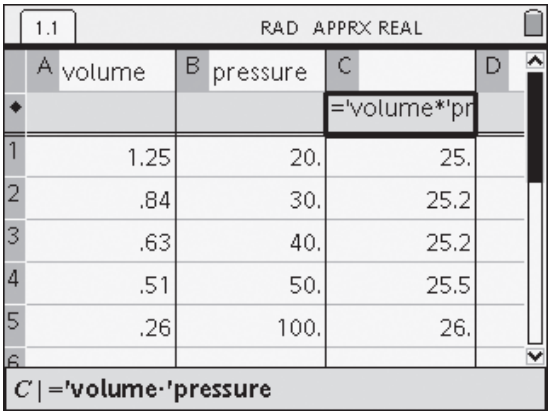


Figure 4.4: Interpreting Results

To perform a regression, highlight Columns A and B by choosing **MENU** > **Actions** > **Select** > **Select Column**, and then hold down the **SHIFT** (⇧) key and arrow over to select both columns. Alternatively, you can move the cursor to the top of Column A, press ▲ on the NavPad to select Column A, hold down the ⇧ key, and press ► to extend the selection to include Column B.

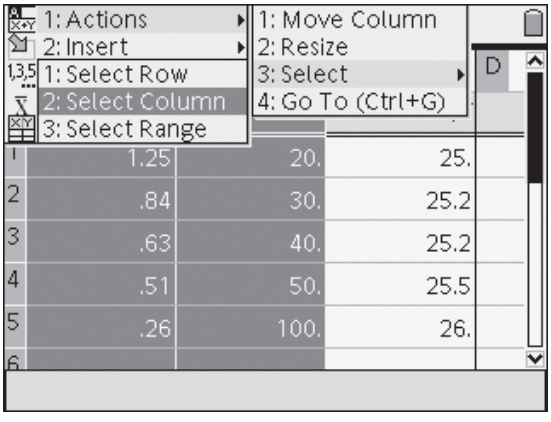


Figure 4.5: Selecting Columns

From the Statistics menu, select **Stat Calculations**. Note that there are numerous different regressions that may be performed on a set of data. For this activity, we wish to perform a **Power Regression**.

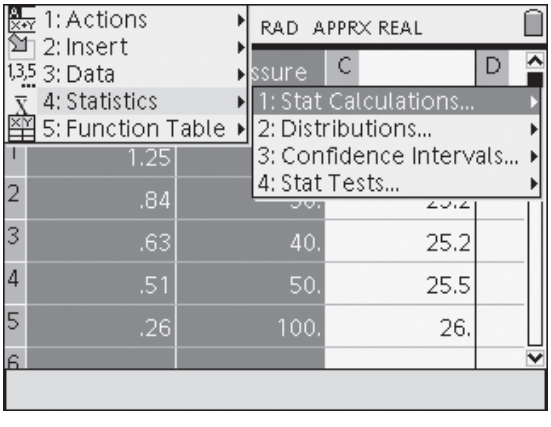


Figure 4.6: Performing Statistical Calculations

Note that the Column names a[] and b[] are shown rather than the List names. You can choose the List names if you prefer by pressing ▼ on the NavPad. Press (tab) to move down to the "1st Result Column" option. Because we have data in Column C, you need to direct the regression equation to fill Column D by changing "c[]" to "d[]". Notice that the options as they are set will save the regression equation to **f1**.

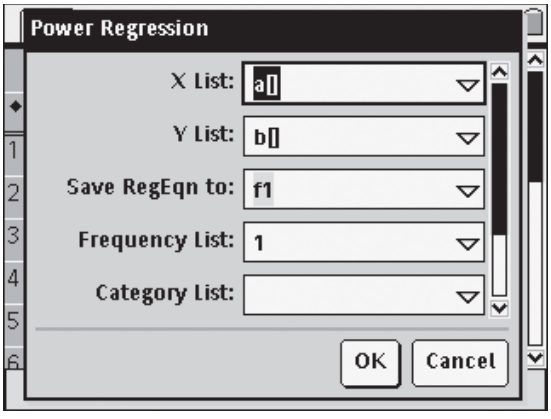


Figure 4.7: Setting Up a Regression

You may wish to resize Columns D and E to view the results of the regression. The regression equation of $P = 25.07V^{-1.03}$ is quite acceptable as an approximation of $P = kV^{-1}$ and thus the data supports Boyle's Law.

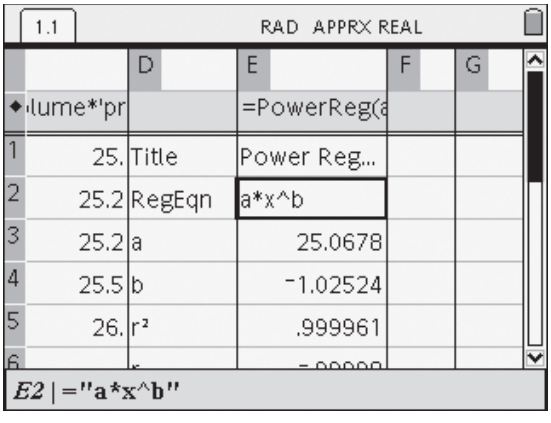


Figure 4.8: Results of a Power Regression

You can plot this data along with the regression function in the *Graphs & Geometry* application. Press (ctrl) + (I) and insert a new *Graphs & Geometry* page.

Draw a scatter plot of Volume vs. Pressure (**MENU > Graph Type > Scatter Plot**). Press (enter) to choose the *x*-variable (select **volume**), press (tab), then press (enter) to choose the *y*-variable (select **pressure**). Adjust the window (**MENU > Window > Zoom – Stat**), and plot the regression equation (**MENU > Graph Type > Function**)—press ▲ on the NavPad to access **f1(x)**, and press (enter) to draw its graph.

Hydrogen might be close to an "ideal gas" but is it *ideal* for an airship?

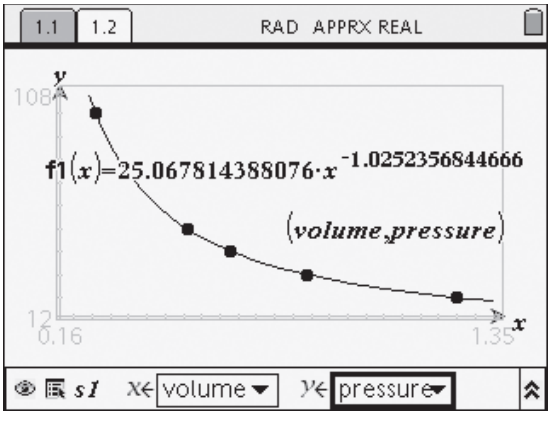


Figure 4.9: Graphical Results

5. INTRODUCING THE NOTES APPLICATION

In this section, you will be introduced to some of the key features of the TI-Nspire™ ***Notes*** application, including:

1. entering and accenting text
2. using templates for Questions/Answers and Proofs
3. using the Symbol Palette to enter mathematical terms
4. evaluating mathematical expressions

A unique feature of this new and exciting tool is the TI-Nspire **document model**. Previously when working with handheld devices, users would enter and perform calculations, and then record results and explanations elsewhere, in workbooks or even examination papers.

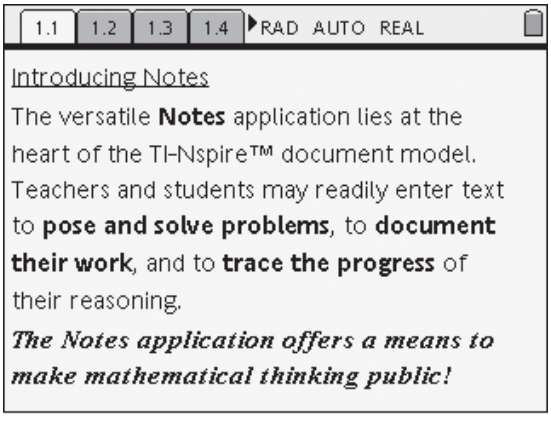


Figure 5.1: Introducing Notes

With TI-Nspire learning technology, the user can begin by creating a new document, and directly record all work in the same electronic file, providing a complete documentation of their mathematical activities. Using the *Notes* application, problems may be posed and solved, reasoning may be recorded, and mathematical thinking may be made public!

There are a variety of ways that users can format text to accentuate important aspects of their documents and to produce text that is richly presented. Bold (**Keyword**), underline (Title), and italics (*Sub-heading*) options are available via the Format menu, as are superscript and subscript options.

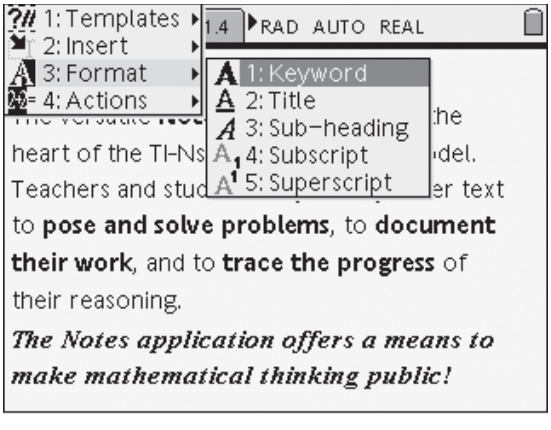


Figure 5.2: Accenting Text

These documents may be readily shared with others—teachers or other students, whether in handheld or computer-based environments. *TI-Nspire* documents may be transferred seamlessly across platforms!

The *Notes* application offers templates for presenting and organizing these documents. In addition to free-text pages as shown in Figure 5.1, users may choose the **Q&A** format as shown in Figure 5.3. This format allows teachers (or students) to pose questions, and record answers. Of course, these answers may be hidden if desired!

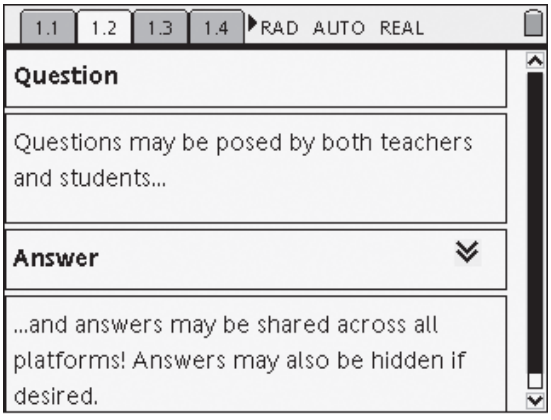


Figure 5.3: Q&A Template

The **PROOF** format is ideally designed, not only for geometric proof, but for all manner of logical argument. Choosing **Shape** from the Insert menu (or using the **Catalog** (⌘) key) offers a range of geometric symbols which satisfy a long-recognized need for a simple and convenient way for entering and representing geometric proofs.

This format supports and encourages students to make mathematical statements of all kinds, and to develop arguments to justify their ideas.

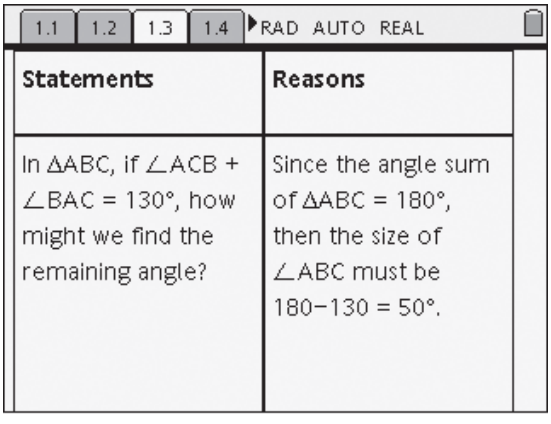


Figure 5.4: Proof Template

Perhaps the most remarkable feature of this apparently simple application is that, like all other TI-Nspire working environments, *Notes* is ***mathematically active***!

Mathematical expressions and equations may be entered using the **Catalog** (⌘) key and symbol palette (or simply typed), highlighted, and then evaluated using **MENU** > **Actions** > **Evaluate Selection**.

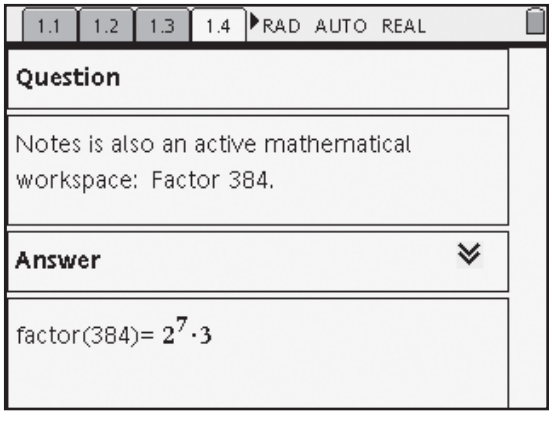


Figure 5.5: Mathematically Active Documents

One way in which this powerful feature may be used involves entering a mathematical expression (as shown in Figure 5.6), highlighting, and then *copying* the expression (using the shortcut ctrl + c). This may be pasted on the next line (using the shortcut ctrl + v), and then evaluated, displaying both input and output for each computation.

Using **MENU > Insert > Expression box**, correct mathematical formatting is available, in addition to a range of geometric shapes.

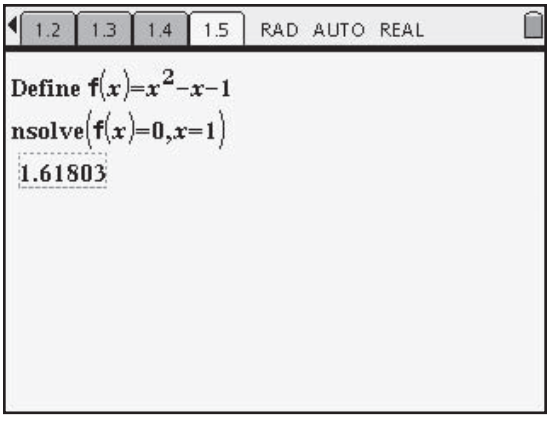


Figure 5.6: Correct Mathematical Formatting

Finally, the *Notes* application offers the option for users to take on different roles, distinguishing, if desired, between the role of "Teacher" and "Reviewer" (**MENU > Insert > Comment**). In this way, documents may be developed in a collaborative manner between student peers and teachers!

The *Notes* application offers teachers and students a simple and yet powerful means of annotating their mathematical documents to produce, not only a professional appearance, but a true record of their mathematical thinking and activities.