Teacher Notes

It is an expectation in Portland Public Schools that all teachers are using the TI-83 graphing calculator in meaningful ways in Algebra 1-2. This does not mean that students use a graphing calculator on every problem in the book, but all students deserve to have the opportunity to gain a deeper understanding of algebraic concepts which a graphing calculator can provide. The purpose of this set of activities is to provide teachers and students calculator keystrokes for specific problems in the McDougal Littell *Algebra 1 Explorations and Applications* textbook.

The activities are designed with the idea that teachers can use them for notes as they perform demonstrations/lectures for students, or students can use the sheets directly with a partner or in small groups as a classroom activity, or even as homework if students have access to a TI-83 calculator for homework. Some of the activities help students visualize concepts. Many of the activities model the use of multiple representations. Some of the activities model using the calculator to check predictions. Just as success in geometry often depends on a student’s previous exposure to geometric concepts, if students are to successfully use graphing calculators to investigate concepts in Advanced Algebra 3-4, it is helpful for them to have prior experience with the calculator.

For your convenience, a Table of Contents is provided. Information on the section, the actual problems, examples, or exploration activities being used, and a short description of how the calculator is being used is listed in the Table of Contents.
1.3  **Mean, Median, Mode**  
Example 2, CKC(2)  
Calculator: One variable statistics (mean, median), sorting data to determine the mode. Students practice on small sets of data so they have confidence in keystrokes when using for large sets of data.

1.8  **Organizing Data**  
Example 2  
Calculator: Using lists to make calculations. This can often replace spreadsheet problems if no spreadsheet is available.

2.6  **Using Graphs to Solve Problems**  
Example 2, T&C (1)  
Calculator: Finding a solution graphically. The goal is to have students understand how to use graphs to solve linear equations so their understanding will transfer to other situations later.

3.2  **Direct Variation**  
Example 1, CKC(3,4)  
Calculator: Shows how to use the calculator to make repeated calculations simultaneously.

3.3  **Finding Equations of Lines**  
Exploration  
Calculator: Visualize the y-intercepts and slopes of linear equations.

3.6  **Modeling Linear Data**  
E&A(8)  
Calculator: Plot scatter plots of data, calculate line of best fit, graph line of best fit with scatter plot.

4.1  **Solving Problems Using Tables and Graphs**  
Exploration  
Calculator: Tables and graphs are used to find the intersection of two linear equations and to visualize when one situation give a better price than another.

6.3  **Calculating with Radicals**  
CKC(1,5)  
Calculator: Simplification of expressions with radicals. Check predictions.
7.2 Solving Systems of Equations
Example 2
Calculator: Visualizing solutions to systems of linear equations graphically and numerically.

7.3 Solving Linear Equations by Adding or Subtracting
Example 2
Calculator: Graphs are used to visualize why you can find a solution by adding or subtracting two linear equations.

8.2 Exploring Parabolas
Exploration
Calculator: Graphs are used to visualize the effect on the graph of a quadratic equation by changing the values of $a$.

8.3 Solving Quadratic Equations
Example 2
Calculator: Tables and graphs are used to visualize solutions to quadratic equations.

8.4 Applying Quadratic Equations
Example 1
Calculator: Determine the x-intercepts of a quadratic equation.

9.2 Exponential Growth
E&A(22,23,28)
Calculator: Graphs and tables are used to compare growth of linear, quadratic, and exponential curves.
Lesson 1.3 Mean, Median, and Mode
Example 2, CKC(2)

Page 15 Example 2:
Step 1: To enter the numbers in the TI-83, press STAT.

Press ENTER to select 1:Edit… under the EDIT menu.

Be sure the lists are cleared. If you have numbers in L1 press the up-arrow key until L1 is highlighted, press CLEAR and ENTER. If other lists need to be cleared repeat this process. Use the arrows to place the cursor (black bar) below the L1 heading. Type each number and press ENTER after each number.

Question 1: Why do we enter three 25’s and three 29’s?

Step 2: Calculate the mean, and median. Press STAT. Then press the right-arrow to highlight CALC. With 1:1-Var Stats highlighted, press ENTER.
Because we entered the numbers in L1 press **L1** \( (2^{\text{nd}}, 1) \). Then press **ENTER**.

\[ \bar{x} = 25.9 \] is the mean of this set of numbers.

\( n = 12 \) reports how many numbers were entered. The \( \bigg\rfloor \) by the \( n \) indicates there are more statistics on another screen. Press the down-arrow to scroll through the other calculations.

\( \text{Med} = 25.5 \) gives the median of this set of numbers.

Notice the mode is not calculated on the TI-83. It is possible to sort a set of numbers and then scroll through the set. Let’s practice with p16 CKC (2).

**p16 CKC (2):**

**Step 1:** Clear L1. Press **STAT**, 4 (to select 4:Clr List), **L1** \( (2^{\text{nd}}, 1) \), **ENTER**.

**Step 2:** Enter the numbers. Press **STAT**, 1 (to select 1:Edit…). Enter the numbers pressing **ENTER** between numbers. (Note: It is not necessary to use the calculator on this problem, but it is helpful to learn calculator keystrokes on a problem you can easily check the answer.)

**Step 3:** Sort the numbers in the list. Press **STAT**, 2 (to select 2:Sort A( ), **L1**, **ENTER**.
To view the sorted list, press **STAT, 1** (to select 1:Edit…)

Press the down-arrow key to scroll through the sorted numbers.

**Question 2:** What is the mode or modes for this set of numbers?

**SUGGESTED PRACTICE:**
p 16 E&A (3)

**ANSWERS:**
Question 1: The height of the bar on the histogram indicates there are three of each of these numbers.
Question 2: The modes are 18, 19, and 23 because they each occur two times which is the most any number occurs.
Lesson 1.8 Organizing Data
Example 2

It is often not necessary to use a spreadsheet when you have access to a graphing calculator, but the problems need to be slightly modified.

p 41 Example 2:
Use a TI-83 to calculate the winning percentage for each team.

Step 1: Clear the lists in STAT.
Press \texttt{STAT}, 4 \,(\text{to select 4: ClrList}), \texttt{L1} \,(2^{\text{nd}},\ 1), \texttt{ENTER}. Repeat for L2 and L3 as necessary.

Step 2: Enter the number of wins in L1.
Press \texttt{STAT}, 1 \,(\text{to select 1:Edit….}), and enter each number followed by \texttt{ENTER}.
Press the right-arrow and enter the number of losses in L2.

Step 3: Have the calculator find the winning percentage for each city by entering a formula for L3.
\[
\frac{\text{wins}}{\text{wins + losses}} = \frac{L1}{L1 + L2}
\]
Press the right-arrow to move into the L3 column. Press the up-arrow to highlight L3.

(Notice L3 = at the bottom of the screen.)
Press $L_1, 1, (, L_1, +, L_2, ), \text{ ENTER.}$

The winning percentage for each city is in $L_3$.

Note: The labels are not entered in the TI-83 like they can be in a spreadsheet. You have to keep track of what you are storing or calculating in each list.

Suggested Practice:
P 42 CKC (3)
P 43 – 44 E&A (5, 10, 12)
Lesson 2.6 Using Graphs to Solve Problems
Example 2, T&C (1)

A hand sketched graph can help you estimate a solution, but a graphing calculator can be used to find more accurate estimates. The importance of knowing how to find a solution graphically is that this technique can be used for any function—even one that you don’t know how to solve symbolically. This technique is not necessary for solving a linear equation, but it is useful to learn calculator steps on a problem that it is relatively easy to check the solution symbolically.

p 85 Example 2:

We are going to use a graph on the TI-83 and the equation \( P = 7n - 70 \) to determine the profit from making and selling 75 t-shirts. The three basic steps to graphing an equation are to enter the equation in \( Y= \), set the window (either in WINDOW or ZOOM), and GRAPH the equation.

Step 1: Enter the equation in \( Y= \). You must solve the equation for the dependent variable, and since the TI-83 only uses \( x \) and \( y \), you must write it in terms of \( x \) and \( y \).

Press \( Y= \).

(Note: If Plot1 or Plot2 or Plot3 are highlighted, use the arrow keys to move the cursor on top of each one that is highlighted and press ENTER. This will turn a statistics plot off. If the statistics plots are turned on, you may get points plotted on your graph.)

Type \( 7x - 70 \) and press ENTER. (You must use the \( x, T, \theta, \) or \( n \) key for \( x \).) (Also, you must use the subtraction key not the (-) key for opposite.)
Step 2: Set the window so you will see the graph on the screen. Refer to the window settings given on p85. Press WINDOW, enter the values pressing ENTER after each one.

(Note: Xscl = 50 means there will be a tick mark on the x-axis every 50 units. The tick marks will be 200 units apart on the y-axis.)

Step 3: Press GRAPH to see the graph of y = 7x – 70 for the given window.

Step 4: To find the value of P when n is 75 (the value of y when x = 75), press TRACE. Then press the left-arrow until \( x \approx 75 \).

For a more accurate answer press ZOOM, 2 (to select 2:Zoom In), ENTER. (Note: You must press ENTER to zoom.) Press TRACE again and use the arrows to move the cursor until \( x \approx 75 \).

(Note: You won’t always get 75 exactly when you zoom and trace. When this occurs it means the pixel (light on the screen) has the exact value of 75.)
Think & Communicate (1):

Under WINDOW, enter the values for the original window except Ymax = 2000.

Option 1: Press GRAPH, TRACE, and use the arrows to estimate a solution.

Approximately 153 shirts should be made to get a $1000 profit.

Option 2: Graph y = 1000 and find the intersection of the two lines.

Press Y=, down-arrow to highlight Y2, type 1000, and press ENTER. Press GRAPH.

We are interested in finding the x-value of the point of intersection because the y = 1000.

Press CALC (2nd, TRACE), 5 (to select 5: intersect).
Press **ENTER** to tell the calculator the first curve is $Y_1 = 7x - 70$, press **ENTER** again to tell the calculator the second curve is $Y_2 = 1000$, press **ENTER** a third time to tell the calculator to use the point where the cursor is for a first guess.

The point of intersection is (152.9, 1000). Therefore, 153 shirts need to be made and sold to have a profit of $1000.

**SUGGESTED PRACTICE:**
p88 E&A(16 – 20)
Lesson 3.2 Direct Variation
Example 1, CKC (3,4)

p 107 Example 1:
Repeating steps to solve a problem (such as dividing dollars earned by hours worked) you can use the TI-83 to perform the calculations in one step.

**Step 1:** Clear the statistics lists and enter hours worked in L1 and earnings in L2.
Press **STAT**, 1 (to select 1:Edit…). If there are numbers in the lists use the arrow keys to highlight L1 (or any list to be cleared), press **CLEAR** and **ENTER**. Then enter the numbers in the two lists.

**Step 2:** Calculate the ratios of L2/L1. Use the arrows to highlight L3. Then type L2, 1, L1, and press **ENTER**.

**Step 3:** Check to see whether the data pairs have a constant ratio. The constant ratio in this case is 5.75 so the equation is E = 5.75h.

p 109 CKC(3,4):
**Step 1:** Clear the statistics lists and enter the data.
**Step 2:** Calculate the ratio of bounce height to drop height ($L_2/L_1$). Highlight $L_3$, type $L_2$, $1$ $L_1$, and press **ENTER**.

The constant of variation $\cup 0.8$. The equation is $y = 0.8x$.

**Step 3:** Create a scatter plot.
Press **STAT PLOT** ($2^{nd}$, Y=). Press **ENTER** to select Plot 1 and press **ENTER** again to turn the plot on.

Be sure Xlist is $L_1$ and Ylist is $L_2$. If not, use the arrow keys to highlight anything that needs to be changed, and press **ENTER**.

Press **Y=** and clear any equations. Graphs of unwanted equations will appear if you do not clear **Y=**.

Set the window. One possible window is given.

(Note: You can also press **ZOOM, 9** (to select 9: Zoomstat) to automatically select a window that includes all data points.)
Step 4: Enter the equation from Step 2 in Y=.
Press Y= and type .8x in Y1. Press GRAPH again.

Question: What does the scatter plot show?

SUGGESTED PRACTICE:
p 109 E&A (1 – 3)
p 112 AYP (4,5)

ANSWER:
Question: This data can be modeled with direct variation. The points lie on a line.
Lesson 3.4 Finding the Equations of Lines
Exploration

p 119 Exploration:

Step 1: To graph equations on the TI-83, press Y=. If Plot1 or Plot2 or Plot3 are highlighted at the top of the screen, use the arrow keys to highlight and press ENTER to turn off any plot. Clear any equations and move the cursor back to Y1=.

Step 2: Enter the following equations into Y= using the x,t,θ,n key for x. Press ENTER after each equation. (Be sure to use the subtraction key rather than (-).)

Step 3: Set the window to the standard viewing window and press GRAPH. Either press WINDOW and enter the standard values or press ZOOM, 6 (to select 6: Zstandard). The graph is automatically graph with Zoom 6.

Step 4: Determine the point where each graph crosses the y-axis. Press TRACE.
The equation of Y1 = 2x shows in the upper left-hand corner and the coordinates of the cursor show at the bottom of the screen.
The graph of $y = 2x$ crosses the y-axis at $(0,0)$. Press the down-arrow to trace $Y2 = 2x + 3$ and the down-arrow again to trace $Y3 = 2x - 3$.

**Question 1:** At what points do the equations $y = 2x$, $y = 2x + 3$, and $y = 2x - 3$ cross the y-axis?

**Step 5:** To visualize the slope of these lines you can trace points along the graph. Notice, however, in the standard window the x- and y- coordinates are decimal approximations with many digits. The calculator has a window on which the trace will move 0.1 with each press of the arrow key. It’s called Zdecimal.

Press ZOOM, 4 (to select 4: ZDecimal). Then press TRACE. Press the right-arrow until $x = 1$.

**Question 2:** With a vertical change of 2 and a horizontal change of 1, what is the slope of $Y1 = 2x$?

Press the down-arrow and trace values on $Y2 = 2x + 3$ to determine the slope of $Y2$.

**Question 3:** What is the slope of $Y2 = 2x + 3$?
Press the down-arrow and trace values on \( Y3 = 2x - 3 \) to determine the slope of \( Y3 \).

**Question 4:** What is the slope of \( Y3 = 2x - 3 \)?

**Question 5:** What patterns do you see with the graphs of these three lines?

A graphing calculator is a useful tool for checking predictions.

**Question 6:** What do you predict the slope of \( y = 2x + 6 \) will be?

**Question 7:** Where do you predict the graph of \( y = 2x + 6 \) will cross the y-axis?

Now, graph \( y = 2x + 6 \) on the standard viewing window.

Press **Y=** and clear the equations by pressing CLEAR, ENTER three times. Move the cursor to \( Y1 \) and enter \( 2x + 6 \). Then press **ZOOM, 6** (to select 6:Zstandard).

Press **TRACE**.

**Question 8:** Where does the graph of \( y = 2x + 6 \) cross the y-axis?

Press the left-arrow to trace another point on the line.

This point is approximately (-3,0).
Question 9: What is the vertical change from \( y = 6 \) to \( y = 0 \)?
What is the horizontal change from \( x = 0 \) to \( x = -3 \)?
What is the slope of the line \( y = 2x + 6 \)?

One way to write a linear equation is in the form \( y = mx + b \).

Question 10: Based on your observations, what does \( m \) represent?
What does \( b \) represent?

Question 11: Consider the equation \( y = 3x - 1 \). \( m = \) ______? \( b = \) ______?
Describe what the graph of the line will look like.
Graph the equation \( y = 3x - 1 \) on the TI-83 to check your prediction.

Question 12: Consider \( y = x + 2 \). \( m = \) ______? \( b = \) ______?
(Notice if there is no number in front of \( x \), \( m = 1 \) because \( 1 \cdot x = x \).)
Describe what the graph of the line will look like.
Graph the equation \( y = x + 2 \) on the TI-83 to check your prediction.

**SUGGESTED PRACTICE:**
p 121 Example 2, Method 2 (Note: The parentheses DO NOT have to be used on the TI-83, but may be used.)
p 122 CKC(1 – 3)
p 122 E&A (Use the TI-83 to check graphs sketched by hand on 7 – 15).

**ANSWERS:**
Question 1: (0,0), (0,3), (0,-3)
Question 2: 2
Question 3: 2
Question 4: 2
Question 5: slopes are the same (the lines are parallel); the slope is the number \( x \) is being multiplied by; the number without \( x \) in the equation is the \( y \) value of the point where the line crosses the \( y \)-axis.
Question 6: Your guess
Question 7: Your guess
Question 8: (0,6)
Question 9: vertical change = -6; horizontal change = -3; slope = 2
Question 10: \( m \) – slope; \( b \) – where line crosses \( y \)-axis.
Question 11: \( m = 3; \ b = -1 \)
Question 12: \( m = 1; \ b = 2 \)
Lesson 3.6 Modeling Linear Data
E&A(8)

p 134 E&A (8) – Using the data from the Geology Example on p 130:

Step 1: Clear the calculator’s statistical memory. Enter the data as xy-pairs.
Press STAT, 1 (to select 1:Edit…). If the data lists L1, L2, or L3 contain numbers clear each on by using the arrow keys to highlight L1 (or L2 or L3), press CLEAR and ENTER. Clear all lists.

Enter the length of eruption values in L1. Press the right-arrow and enter the time until next eruption in L2.

Step 2: Choose a good viewing window. Then draw a scatter plot.
Press STAT PLOT (2nd, Y=). Press ENTER to select Plot1 and press ENTER again to turn Plot1 on.

Make sure the same selections are chosen on your calculator. To set the window either select values are press ZOOM, 6 (to select Zstat). Let’s use the same window as in the example on page 131. You will want to clear the Y= also so no graphs appear that you don’t want.
Step 3: Have the calculator perform a linear regression (find the line of best fit.) Press STAT and use the right-arrow to highlight CALC. Press 4 (to select 4: LinReg(ax + b)). Then type L1, L2 and press ENTER.

The calculator has determined that the equation of the line that best fits the data points is $y = 12.4x + 31.6$ (rounded to tenths). Note: The number, $r$, is the correlation coefficient. The closer $|r|$ is to 1 the more linear the data.

Step 4: Graph the line of fit on the scatter plot from Step 2.
**Option 1:** Use the approximation:
Press $Y=\text{ and enter } 12.4x+31.6$ into $Y_1$. Then press GRAPH.

**Option 2:** Use the exact equation the calculator calculated. This equation is stored in a variable called RegEQ.

Press $Y=\text{ and with } Y_1 \text{ cleared and highlighted, press } \text{VARS, 5 (to select 5:Statistics). \text{Press the right-arrow to highlight EQ and 1 (to select 1:RegEQ). The entire equation is stored in } Y_1. \text{Press GRAPH to see the graph of the line and the scatter plot.}}$

**Question:** Does the calculator give a line of fit that is close to the one you found? Which equation is most accurate?

**SUGGESTED PRACTICE:**
p 134 E&A(10)
p 135 AYP(8 – 10)
Lesson 4.1 Solving Problems Using Tables and Graphs
Exploration

P 147-148 Exploration:

Step 1: Investigate the pattern for cost of CDs at the store and cost of CDs with the discount club.

Store Cost: Each CD costs $11.00. The cost starts at 0 for 0 CDs and goes up $11.00 for each additional CD. Fill in the cost for each number of CDs.

Club Cost: The first 8 CDs are free. Each additional CD is $15.00 for at least 6 more CDs. In other words, the minimum number of CDs you must buy is 14. It is easier to see the pattern if we start with numbers below 14, however.

Complete the following table:

<table>
<thead>
<tr>
<th>Number of CDs</th>
<th>Cost at store</th>
<th>Cost with discount club</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
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<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To use the TABLE feature on the TI-83 we need to have an understanding of the pattern. We need to represent each pattern with an equation.

Let $x =$ the number of CDs purchased
Let $y =$ the cost for $x$ CDs.
STORE: Initial value: For $x = 0$, $y = 0$.
Rate of change: $\$11.00$ per CD purchased
Equation: $y = 11x$
DISCOUNT CLUB: This is more difficult because the pattern is different from 0 to 8 CDs than it is for 9 or more CDs. The rate of change for 9 or more CDs is $15.00 per CD. Let’s pick two points on the line for 9 or more CDs sold and find an equation for the line as we did in lesson 3.5. Let’s use the points (9,15) and (14, 90).

What is the slope of the line between (9,15) and (14,90)?

\[
\frac{90-15}{14-9} = \frac{75}{5} = 15
\]

Is this a surprise for you? Recall that the rate of change is $15.00 per CD.

Using \( y = mx + b \), \( m = 15 \), and the point (9,15):

\[
15 = 15(9) + b \\
15 = 135 + b \\
15 – 135 = b \\
-120 = b
\]

Therefore, \( y = 15x – 120 \).

Enter these two equations in Y=.

Next, we need to set up the table so we can see appropriate values. Press \( \text{TBLSET} \) (2\text{nd}, WINDOW) and enter the values below. Then, press \( \text{TABLE} \) (2\text{nd}, \text{GRAPH}).

Do the values for \( x = 14 \) make sense to you?

**Question 1:** What is represented by \( Y1 \)?

**Question 2:** What is represented by \( Y2 \)?

**Question 3:** Looking at this screen, which is the better deal? Why?

Press the down-arrow key to scroll down through the table:
Question 4: When will the total cost through the club equal the total cost at the store? How can you tell?

Question 5: When would you choose the club? Why?

Question 6: When would you choose the Store? Why?

As you can see, most of the work is done is obtaining the equations necessary to use the table on the TI-83. You cannot use TABLE or GRAPH on the TI-83 until you figure out the equations from the information in the problem.

Press WINDOW and enter the values given on page 148. Press GRAPH.

For a particular x value, you can compare the y values from the two lines. Press TRACE and move to a particular x. Press the down-arrow to see the y value for the other equation for the same x. You can see the equation for the line being traced in the upper left corner.
Of course, we are particularly interested in the point of intersection between the two lines. You can TRACE to approximate the intersection or you can have the calculator calculate the point of intersection.

Press **CALC** (2nd, TRACE), 5 (to select 5:intersect). Press ENTER to select Y1 as the first curve, press ENTER again to select Y2 as the second curve, and press ENTER a third time to select the current point as the first guess.

The intersection on the graph gives us the same point as the table did. The costs are the same for (30,330). That is, when 30 CDs are purchased both the club and the store costs will be $330.

**SUGGESTED PRACTICE:**
p 148 EXAMPLE  
p 150 E&A(1-3, 5-7, 13)

**ANSWERS:**
Question 1: Y1 = cost in store  
Question 2: Y2 = cost with club  
Question 3: club; cheaper  
Question 4: 30 CDs; Y1 = Y2 = 330 for x = 30.  
Question 5: club when 14 < x < 30  
Question 6: store when x > 30
Lesson 6.3 Calculating with Radical
CKC(1), CKC(5)

When simplifying expressions with radicals, the TI-83 is a useful tool to check the accuracy of answers. It is useful because the expression shows on the screen with the decimal approximation.

p 254 CKC(1): \( \sqrt{12} = \sqrt{4 \cdot 3} = 2\sqrt{3} \)

On the TI-83:

\[
\begin{array}{c}
\sqrt{12}\\
3.464101615\\
2\sqrt{3}\\
3.464101615
\end{array}
\]

Since \( \sqrt{12} \) and \( 2\sqrt{3} \) give the same decimal value, \( \sqrt{12} = 2\sqrt{3} \).

Note: The calculator does not check to see if you have simplified radicals as much as you can. It simply can verify that your answer is equivalent to the original problem if you key it in correctly.

Example: \( \sqrt{32} = \sqrt{4 \cdot 8} = 2\sqrt{8} \). On the TI-83:

\[
\begin{array}{c}
\sqrt{32}\\
5.656854249\\
2\sqrt{8}\\
5.656854249
\end{array}
\]

But \( \sqrt{8} \) simplifies because 8 is divisible by 4 which is a perfect square. It is helpful to consider the perfect square numbers and determine the largest perfect square that divides evenly into the original radical number.

\[\begin{align*}
2^2 &= 4, & 3^2 &= 9, & 4^2 &= 16, & 5^2 &= 25, & 6^2 &= 36, & 7^2 &= 49, & 8^2 &= 64, & 9^2 &= 81, \\
10^2 &= 100, & \text{etc.}
\end{align*}\]

The largest perfect square number that divides evenly into 32 is 16. You can use the calculator to do the division for more difficult numbers.
\sqrt{32} = \sqrt{16 \cdot 2} = 4\sqrt{2} \text{. } \text{On the TI-83:}

\begin{array}{c|c}
\sqrt{32} & 5.656854249 \\
\sqrt{2} & 5.656854249 \\
\end{array}

p 254 CKC (5): \quad \sqrt{20} + \sqrt{5} = \sqrt{4 \cdot 5} + \sqrt{5} = 2\sqrt{5} + \sqrt{5} = 3\sqrt{5} \text{.}

\begin{array}{c|c}
\sqrt{20} & 4.472135955 \\
\sqrt{5} & 2.236067978 \\
\end{array}

SUGGESTED PRACTICE:

p 254 CKC (1 – 9)
p 254 E&A(1 – 12, 14)
Lesson 7.2 Solving Systems of Equations
Example 2

Systems of equations can be solved in several ways on the TI-83. Two of these methods
are by using tables and using graphs.

p 288 Example 2: Solve: \[ a + s = 50 \]
\[ 98a + 46s = 3500 \]

To use tables or graphs on a TI-83 you must have equations written in terms of \( x \)
and \( y \), and the equations must be solved for \( y \).

Step 1: Rewrite each equation using the variables \( x \) and \( y \).

\[
\begin{align*}
    x + y &= 50 \\
    98x + 46y &= 3500
\end{align*}
\]

Step 2: Solve each equation for \( y \).

\[
\begin{align*}
    x + y &= 50 \\
    98x + 46y &= 3500 \\
    y &= 50 - x \\
    46y &= 3500 - 98x \\
    y &= \frac{3500 - 98x}{46}
\end{align*}
\]

Step 3: Enter the two equations into \( Y= \).

Step 4: Determine an appropriate window and graph. One way to see
appropriate values for the equations is to use \( \text{TABLE} \). Press \( \text{TBLSET} \) (2\text{nd},
WINDOW), and enter the given values. Press \( \text{TABLE} \) (2\text{nd}, GRAPH). You can
see that the solution for \( x \) will be between 20 and 25.
**Question 1:** How can you tell that the solution for \( x \) in this system of equations is between 20 and 25?

From the information on the table above, we see that an appropriate window would be the following. Enter the values under **WINDOW** and press **GRAPH**.

![Graph window](image1)

To find the point of intersection, press **CALC** (2\(^{nd}\), **TRACE**), 5 (to select 5:intersect). Press **ENTER** to select Y1 as the first curve, press **ENTER** a second time to select Y2 as the second curve, and press **ENTER** a third time to select the current point as the first guess.

![Graph traces](image2)

To solve the problem on the table, press **TBLSET** (2\(^{nd}\), **WINDOW**), and enter the following values. Press **TABLE** (2\(^{nd}\), **GRAPH**) and scroll down with the down-arrow.

![Table setup](image3)

**Question 2:** What tells you the point of intersection is for \( x \) between 23 and 23.5?
Return to **TBLSET** and enter the following values. Scroll down until you see where the intersection occurs.

![TBLSET Table Setup](image)

**Question 3:** From this screen, what would you approximate the intersection to be?

**SUGGESTED PRACTICE:**  
P 290 – 291 E&A (1 – 4, 16)

**ANSWERS:**  
Question 1: For x = 20, Y1 < Y2 and for x = 25, Y1 > Y2. Therefore, Y1 = Y2 for some x between 20 and 25.  
Question 2: For x = 23, Y1 < Y2 and for x = 23.5, Y1 > Y1. Therefore Y1 = Y2 for some x between 23 and 23.5.  
Question 3: (23.08, 26.92)
PPS
TI-83 Activities
Algebra 1-2

Lesson 7.3 Solving Linear Equations by Adding or Subtracting

Example 2

One strategy for solving a system of equations is to use either addition or subtraction. To illustrate why this works, let’s use the system:

\[
\begin{align*}
2x + 3y &= 6 \\
3x - y &= 2
\end{align*}
\]

To graph these equations, we need to solve each equation for \( y \).

\[
\begin{align*}
2x + 3y &= 6 \\
3y &= -2x + 6 \\
y &= \frac{-2}{3}x + 2
\end{align*}
\]

\[
\begin{align*}
3x - y &= 2 \\
-y &= -3x + 2 \\
y &= 3x - 2
\end{align*}
\]

Enter and graph these equations on the standard window on the TI-83.

Now, add the two equations together.

\[
\begin{align*}
2x + 3y &= 6 \\
3x - y &= 2 \\
5x + 2y &= 8
\end{align*}
\]

Solve this equation for \( y \) and graph as Y3.

\[
\begin{align*}
5x + 2y &= 8 \\
2y &= -5x + 8 \\
y &= \frac{-5}{2}x + 4
\end{align*}
\]
**Question 1:** What do you notice about the graph of this Y3 equation compared to the graphs of the equations we added together to get Y3?

Next, let’s subtract the two equations.

\[
\begin{align*}
(2x + 3y &= 6) \\
- (3x - y &= 2)
\end{align*}
\]

\[
\begin{align*}
2x + 3y &= 6 \\
-3x + y &= -2 \\
-x + 4y &= 4
\end{align*}
\]

Solve this equation for y and replace Y3 with this equation. Then graph.

\[
-x + 4y = 4 \\
4y = x + 4 \\
y = \frac{x}{4} + 1
\]

**Question 2:** What do you notice about the graph of this Y3 equation compared to the graphs of the two equations we subtracted to get Y3?

It is only helpful to add or subtract two equations to solve a system of equations when either the x or y terms have opposite coefficients. (This means that the numbers that x or y are being multiplied by are opposites.)

**P295 Example 2:**

\[
\begin{align*}
8x - 9y &= 13 \\
3x + 9y &= 9 \\
11x &= 22
\end{align*}
\]

\[
\begin{align*}
8(2) - 9y &= 13 \\
16 - 9y &= 13 \\
-9y &= -3
\end{align*}
\]

\[
\begin{align*}
x &= 2 \\
y &= \frac{1}{3}
\end{align*}
\]

The solution is \((2, \frac{1}{3})\).

Because \(-9y + 9y = 0y\) or 0, it is useful to use this method of adding two equations together. The y’s are eliminated with the addition, and you can solve for x. The line 11x = 22 will still pass through the original point of intersection.

**Question 3:** What does the graph of 11x = 22 look like?
ANSWERS:
Question 1: The graph of Y3 passes through the intersection of Y1 and Y2.
Question 2: The graph of Y3 passes through the intersection of Y1 and Y2.
Question 3: A vertical line through x = 2.
Lesson 8.2 Exploring Parabolas

Exploration

P331 Exploration:

Step 1: Set the viewing window:

Step 2: Enter the equations in Y=.
Press Y=, clear the equations, and enter the three equations.

Step 3: Press GRAPH.

Step 4: Press TRACE and use the right-arrow to move over on Y1 = \( x^2 \). Press the down-arrow to move to Y2 = \( 2x^2 \). Press the down-arrow again to move to Y3 = \( x^2 \).
**Question 1:** What do you think the graph of \( y = 4x^2 \) will look like in relation to the other three graphs?

**Step 5:** Clear the equations in Y= and enter these equations. Then press **GRAPH.**

![Graphs](image)

**Step 6:** Repeat Step 4.

![Graphs](image)

**Question 2:** What do you think the graph of \( y = \frac{1}{4}x^2 \) will look like in relation to the graphs above?

**NOTE:** To sketch parabolas by hand it is helpful to consider the value of y when x is 1 and –1.

<table>
<thead>
<tr>
<th>Equation</th>
<th>For x = 1, y = 1</th>
<th>For x = -1, y = 1</th>
<th>Plot (0,0), (1,1), and (-1,1) and sketch the parabola.</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y = x^2 )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( y = \frac{1}{2}x^2 )</td>
<td>For x = 1, y = ( \frac{1}{2} ).</td>
<td>For x = -1, y = ( \frac{1}{2} ).</td>
<td>Plot (0,0), (1, ( \frac{1}{2} )), and (-1, ( \frac{1}{2} )) and sketch the parabola.</td>
</tr>
<tr>
<td>( y = 3x^2 )</td>
<td>For x = 1, y = 3.</td>
<td>For x = -1, y = -3.</td>
<td>Plot (0,0), (1,3), and (-1,3) and sketch the parabola.</td>
</tr>
</tbody>
</table>

**Step 7:** To generalize what happens to the graph of the equation \( y = ax^2 \) as \( a \) increases from 0 to 1 and beyond.
Question 3: What happens to the graph of $y = ax^2$ as $a$ increases from 0 to 1 and beyond?

Step 8: Repeat Step 7 for values of $a$ decreasing from 0 to $-1$ and beyond.

Question 4: What happens to the graph of $y = ax^2$ as $a$ decreases from 0 to $-1$ and beyond?

Question 5: What effect does a negative value of $a$ have on the graph of $y = ax^2$?

SUGGESTED PRACTICE:
P 334 E&A(7 – 15)

ANSWERS:
Question 1: Through (0,0) but narrower than other three graphs.
Question 2: Through (0,0) but wider than other three graphs.
Question 3: Still passes through (0,0) but becomes narrower.
Question 4: Still passes through (0,0) but becomes wider.
Question 5: Opens down.
Lesson 8.3 Solving Quadratic Equations

Example 2

Graphing calculators are helpful for visualizing what it means to solve an equation. We will use the TI-83 to visualize solving a quadratic equation.

P339 Example 2: Solve the equation $2x^2 - 4 = 24$.

Step 1: Rewrite the equation in the form $ax^2 + c = 0$. This is done because if you graph $y = ax^2 + c$ you need to find the value of $x$ that makes $y = 0$.

Question 1: Where on a graph is $y = 0$?

$Y = 0$ for every point on the x-axis. Therefore to find the solution of $ax^2 + c = 0$, find where the graph of $y = ax^2 + c$ crosses the x-axis.

\[
\begin{align*}
2x^2 - 4 &= 24 \\
2x^2 - 28 &= 0
\end{align*}
\]

Step 2: Clear Y= and enter $2x^2 - 28$ in Y1.

Step 3: Determine an appropriate window for the graph. You can use the table to determine values for the window.

Press TBLSET and enter the given values. Then press TABLE.

NOTE: You can use the table to determine points to sketch the graph by hand also.
It appears that $-5 < x < 5$ and $-30 < y < 30$ is an appropriate window.

![Graphs showing the window settings.]

**Step 4: Option 1:** Trace the points where the graph of $y = 2x^2 - 28$ crosses the x-axis to approximate the solutions to $2x^2 - 28 = 0$.

![Graph showing a trace of a point on the x-axis.]

**Option 2:** Use the calculator to calculate the points where the graph crosses the x-axis. Press **CALC** (2nd, TRACE), 2 (to select 2:zero).

Note: A point where the graph of an equation crosses the x-axis is called a zero of the equation because the value of $y$ for any point on the x-axis is 0.

![Calculator menu showing options for graph analysis.]

Use the left-arrow to move the cursor slightly to the left of the point where the graph crosses the x-axis and press **ENTER**. Press the right-arrow until the cursor is clearly to the right of the point where the graph crosses the x-axis and press **ENTER**. Press **ENTER** a third time and the calculator will use this point as a first guess to determine the zero.
Question 2: Looking at the symmetry of the graph, what do you think the value of the other zero is?

SUGGESTED PRACTICE:
P342 E&A(21 – 29)  
Be sure to use the TI-83 on p341 E&A(17 – 19) also.

ANSWERS:  
Question 1: Points with y = 0 are on the x-axis.  
Question 2: -3.7416574
Lesson 8.4 Applying Quadratic Equations

Example 1

All quadratic equations can be written in the form $ax^2 + bx + c = 0$. You can find the solutions of an equation in this form by using a graph. In fact, finding solutions of a quadratic equation is so important in mathematics that the TI-83 has a zero feature that will find the solutions for you. The solution to the equation $ax^2 + bx + c = 0$ is called a zero because the solutions are the values of $x$ that make $y = ax^2 + bx + c$ equal zero.

p345 Example 1:  

a. $x^2 - 2x - 5 = 0$

Step 1: Clear Y= and enter $x^2 - 2x - 5$ in Y1.

Step 2: Press ZOOM, 6 (to select 6: ZStandard).

Step 3: Find the x-intercepts.  
Press CALC, (2nd, TRACE), 2(to select 2:zero). Move the cursor slightly to the left of one of the x-intercepts and press ENTER. (Note: The x-value of the point where the cursor must be must be to the left of the x-value of the point where the graph crosses the x-axis. Often the cursor looks like it is moving up or down when you press the left- or right-arrow.)
Press the right-arrow until the blinking cursor is clearly to the right of the x-intercept and press ENTER. Press ENTER a third time for the calculator to use the point where the cursor is as a first guess for the x-intercept.

Repeat these steps to find the second y-intercept.

NOTE: There are several strategies to use when solving quadratic equations. One strength of using this graphing method is that you get to visualize the fact that the solutions to a quadratic equation are the x-intercepts.

SUGGESTED PRACTICE:
p 346 CKC(4 – 9)
p 348 E&A(9 –20)
9.2 Exponential Growth

E&A(28)

A graphing calculator like the TI-83 is a useful tool for determining the effect on the
graph of an equation of changing one number (called a parameter) in the equation.
Consider the exponential equation, \( y = ab^x \).

To determine how the graph of \( y = ab^x \) is affected when the value of \( b \) is changed, use
the TI-83 to complete \textbf{p 381 E&A(22)}. Try other values of \( b \) to check your prediction.

To determine how the graph of \( y = ab^x \) is affected when the value of \( a \) is changed, use
the TI-83 to complete \textbf{p 381 E&A(23)}. Again, use more values of \( a \) to check your
prediction.

\textbf{P 381 E&A(28)}: This problem can easily be done using the TABLE feature of the TI-83
rather than using a spreadsheet on a computer.

**Step 1:** Enter the three equations in \( = \).
Press \( \text{Y=} \). Clear any equations and enter the equations.

\[
\begin{align*}
y_1 &= a \\
y_2 &= b \\
y_3 &= x
\end{align*}
\]

**Step 2:** Set up the table.
Press \textbf{TBLSET} (2\textsuperscript{nd}, \text{WINDOW}) and enter the following values:

\[
\begin{align*}
\text{Table Start} &= 1 \\
\text{TblStart} &= 1 \\
\text{Indep} &= \text{Auto} \\
\text{Depend} &= \text{Ask}
\end{align*}
\]

**Step 3:** Press \textbf{TABLE} (2\textsuperscript{nd}, \text{GRAPH}). Press the right-arrow to scroll to the right to see
Y3. Notice what happens to the other columns.
Question 1: Which function grows more quickly when \( x > 4 \)? How can you tell?

Graph the three functions on the same window.

Question 2: Do the graphs support your answer to Question 1? If so, how?

ANSWERS:

Question 1: \( y = 2^x \); The numbers for Y3 get bigger than those in Y1 and Y2 for \( x > 4 \).

Question 2: Yes. The graph for \( y = 2^x \) is steeper than the graphs for Y1 and Y2 for \( x > 4 \).