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KARL M. ZILM

Graphing

Calculator

Keystroke

Guide

Intermediate Algebra

SECOND EDITION

GRAPHING CALCULATOR KEYSTROKE GUIDE

INTERMEDIATE ALGEBRA

2nd Edition

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Lewis & Clark Community College

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Preface

This *Guide* is designed for students using a Texas Instruments TI-82 or TI-83 graphing calculator in conjunction with the textbook *Intermediate Algebra*, 2nd edition, by Hubbard and Robinson. There is a separate section of the *Guide* for each calculator model. The TI-82 section begins on page 1; the TI-83 section begins on page 45. The following description of the *Guide* and how to use it applies to both sections.

The *Guide* assumes no prior experience in using a graphing calculator. Therefore, it begins with an Introduction chapter dealing with the basics: how to turn the calculator on, how to turn it off, how to adjust the screen contrast, and how to enter and edit basic arithmetic expressions. You should probably go through the Introduction chapter of this *Guide* as soon as you get your calculator. The Introduction chapter will give you an opportunity to familiarize yourself with the basic operation of your calculator so that you will be ready to learn the other features described later in the *Guide*.

The Introduction chapter is followed by the Graphing Calculator Keystroke Guide, which is keyed to the textbook. As you look at the pages in the textbook, you will notice that in the left margin of some pages a book icon  appears next to a key word or phrase, with a brief reference to a related feature on the graphing calculator appearing in the body of the text. Corresponding to each of these key words or phrases in the textbook, this *Guide* provides a detailed description of how to use the related feature on your particular graphing calculator model. In the *Guide* each key word or phrase is printed as it appears in the textbook, and on the line above it is the number of the page on which it appears in the textbook. Each key word or phrase will also have its own number (in **boldface** type) for easy future reference. For example, on page 6 in the textbook you will find a book icon in the left margin with the key words “Absolute Value” next to it and a brief reference in the body of the text to the calculator notation **abs**. If you are using a TI-82 graphing calculator, look on page 7 in this *Guide*. If you are using a TI-83, look on page 52 in this *Guide*. You will see a reference to the absolute value feature:

page 6

5 Absolute Value,

followed by a description of how to enter expressions involving absolute values on your calculator. The boldface number **5** is a reference number which may be used later in the *Guide* to refer you quickly to this description of the absolute value feature.

As you begin to use the *Guide* to read about the key words and phrases, you may want to keep a bookmark in the *Guide* at the most recently examined key word or phrase. If you go through the chapters of the textbook in the order they are printed, you will encounter the new key words and phrases in the order they are printed in this *Guide*. Thus, your bookmark will usually be at or near the next key word or phrase you will want to read about, and you will be able to refer to it quickly when needed.

I would like to thank the authors of the textbook, Elaine Hubbard and Ronald D. Robinson, and the staff of Houghton Mifflin, particularly Charles Hartford, Editor in Chief; and Kathy Yoon, Editorial Assistant, for their support and assistance in the production of this *Guide*.

Karl M. Zilm

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TI-82 INTRODUCTION

On/Off, Contrast, Mode, and Editing Expressions

TURNING THE CALCULATOR ON

When the ON button is pressed, you should see a blinking dark rectangle (called the **cursor**) in the upper left-hand corner of the screen. The screen you are looking at is called the **Home screen**, where basic computations are performed. If you do not see the blinking cursor, you may need to adjust the display contrast. How that is done will be described next.

ADJUSTING THE DISPLAY CONTRAST (MAKING THE SCREEN LIGHTER OR DARKER)

Even if your display is presently easy to view, you may find that under different lighting conditions you may need to adjust the display contrast. Also, as the batteries in your calculator become weaker with use, you will have to make occasional adjustments in display contrast.

If you wish to make the display darker, press the light blue 2nd key and then **hold down** the Up Arrow (Δ) key until the desired level of darkness is obtained. If you wish to make the display lighter, press the light blue 2nd key and then **hold down** the Down Arrow (∇) key until the desired level of darkness is obtained. **As soon as you release the Up Arrow or Down Arrow key, the arrow keys no longer affect contrast, and you must press the 2nd key again to make the arrow keys affect the contrast.**

Note that when the 2nd key is pressed, an arrow pointing upward appears inside the cursor to let you know that the 2nd key has been pressed. (Why the arrow pointing upward denotes the 2nd key will be explained a bit later.) The Up, Down, Left, and Right Arrow keys are the blue-gray keys located in the upper right-hand portion of the keyboard. In many of the other uses we will have for them, they will function in the same way as the arrow keys on a computer keyboard.

Experiment with the contrast setting a bit. You will find that when you press 2nd and **hold down** Δ or press 2nd and **hold down** ∇ , a cursor with a number in it will appear in the upper right-hand corner

of the Home screen **as long as you hold down the Up Arrow or Down Arrow key**. Try to adjust the contrast, and as you do, be looking in the upper right-hand corner of the screen for the contrast number. This number indicates how dark, on a scale of 0 to 9, you have made your screen, with 9 representing the darkest possible contrast setting. As the batteries in your calculator become weaker, the contrast setting usually needs to be increased to provide the same level of contrast you may have obtained at a lower setting with fresh batteries. When you need to set the contrast setting to 8 or 9 on a regular basis to see the display clearly, it is time to change batteries.

When is the contrast set appropriately? To some extent it is a matter of personal preference, but there are some contrast qualities which most people find suitable. The screen is composed of tiny squares, called **pixels**, which darken to form the cursor, numbers, letters, etc., on the screen. Most people find that the contrast is set about right when the cursor is clearly visible and you can see that it is composed of 7 rows and 5 columns of pixels. You should also just barely be able to see where the other pixels are on the screen, but they should by no means be dark, just barely visible if you look closely.

TURNING THE CALCULATOR OFF

Pressing the 2nd key before pressing the ON key activates the ON key's second function, which is printed in light blue print above the ON key. Notice the word OFF written on the keyboard above the ON key. Thus, pressing the 2nd key and then the ON key turns the calculator off.

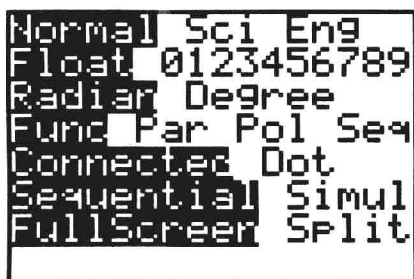
If you forget to turn the calculator off, it will turn itself off after a few minutes of non-use, using the Automatic Power Down (APD™) feature. Pressing the ON key turns the calculator back on, and the screen will appear exactly as it was before the (APD™) feature turned the calculator off.

SECOND FUNCTIONS FOR KEYS—NOTATION

To simplify matters in the future when referring to second functions served by keys, this Keystroke Guide will simply show 2nd followed by the name of the second function, enclosed in brackets. For example the keystroke sequence for turning the calculator off will be denoted 2nd [OFF]. Thus, the word in brackets is not on the key itself, but it is written above the key in light blue print as the key's second function. This is why, when you press the 2nd key, the arrow pointing upward appears inside the cursor. It is to remind you to look for the light blue print **above** the key, rather than what is written on the key, to determine what that key will do when you press it.

MODE

Before doing some basic computations, it would be a good idea to check the mode settings on the calculator which determine how results are displayed. Press the MODE key. The display should appear as shown at the top of the next page.



For now, it would be best to have all of the settings on each line highlighted (black background) as shown. If any of the highlighted settings on your calculator are not the ones shown above, use your Arrow keys to move the blinking cursor over the setting desired and press ENTER. Continue in a like manner until all of the settings on the left side are highlighted as shown.

EDITING EXPRESSIONS

Turn on your calculator and type in $3 + 2 \times 7$. (Don't worry just yet about calculating the value of the expression.) The calculator displays **3+2*7**. Note that the calculator displays multiplication with an asterisk (*). This is a common computer notation for multiplication.

Entering an expression and editing it before evaluation

As you can already see, the TI-82 differs from ordinary scientific calculators in more ways than just being able to draw graphs. One of its major advantages as a calculator is that it enables you to see an entire arithmetic expression as you enter it. The TI-82 also lets you easily edit the expression both before and after you evaluate it. To see how to edit, we will change the expression above, replacing the 2 with a 4. Use the Left Arrow key (\leftarrow) to move the cursor until it is over the 2. Type a 4. The expression should now look like this: **3+4*7**. We will now evaluate the expression. The cursor is still in the middle of the expression, but that doesn't matter. To evaluate the expression press the ENTER key in the lower right-hand corner of the keyboard. On the right-hand side of the calculator screen you should see 31 displayed, which is the value of the expression. Note that the calculator uses standard algebraic order of operations rules, performing the multiplication before the addition.

Editing an expression after evaluation

Suppose you wanted to evaluate $3 + 5 \times 7$. Since this expression differs from the previous one in only one spot (5 instead of 4), there is a way we can quickly obtain the new expression from the old. Rather than enter the entire expression again, just press 2nd [ENTRY]. An exact copy of the last expression entered is reproduced on the screen. Now use the arrow keys as before to change the 4 to a 5, and press ENTER to obtain the value of the new expression.

INS (Insert) and DEL (Delete)

Suppose we want to evaluate $3 + 4.85 \times 7.6$ by editing the last expression. If we press 2nd [ENTRY], we get **3+5*7** on the display. Move the cursor over the 5. We have one problem here that we must recognize: if we type in 4.85, we will type over part of the expression we want to keep. To avoid that, type the 4 over the 5, and then press 2nd [INS], which puts the calculator in Insert mode. Note that the cursor becomes a blinking underline. That means that the character at the cursor position and all those to the right of it will be moved to the right to make room for some inserted symbols. Type in the remaining .85 to complete the 4.85 and see how the other characters are moved to the right to make room. Now use the arrow keys to put the cursor at the end of the expression. Note that as soon as you

move the cursor with an arrow key, the calculator leaves Insert mode. We are now going to change 7 to 7.6. Since the cursor is at the end of the expression, the calculator need not be in Insert mode to make this change (though it would make the change just the same if it were in Insert mode). After the 7 type in .6, and press **ENTER** to display the value of the new expression (39.86).


Now suppose we want to evaluate $3 + 5.2 \times 7.6$ by editing the last expression. Press **2nd [ENTRY]** to reproduce the last expression, and use the arrow keys to place the cursor over the 4. Type in 5.2. Since 5.2 contains one less character than 4.85, the last digit of the 4.85 is still on the screen and must be eliminated. The cursor should now be resting on this last digit (5) of the old 4.85. Press the **DEL** key to delete this character. (Each time the **DEL** key is pressed, it deletes the character at the cursor position.) Press **ENTER** to display the value of the expression (42.52).

Next, suppose we want to evaluate $3 + 5 \times 8$. Notice that this expression could be produced by editing the last expression we evaluated, but it really looks more like the expression **3+5*7** that we evaluated some time earlier. One of the nice features of the TI-82 is that it stores as many previous entries as it can. Press **2nd [ENTRY]** once to produce the last expression. Now press **2nd [ENTRY]** again. Note that you now see the next-to-last expression we evaluated. If you press **2nd [ENTRY]** one more time, you will see the expression we evaluated before that, which was **3+5*7**. You could now edit this expression as before to produce **3+5*8**. Press **ENTER** to evaluate it. If you continue to press **2nd [ENTRY]** beyond the calculator's ability to recall previous entries, it will return you to the most recently evaluated expression.

Clearing the Home screen

By now your Home screen may look pretty full, and the original expressions you entered may have scrolled off the top of the screen. Any time you want to erase everything on the Home screen, just press the **CLEAR** key, located below the arrow keys. If you want to retrieve these erased expressions, you may still do so by pressing **2nd [ENTRY]** as often as needed.

TI-82 GRAPHING CALCULATOR KEYSTROKE GUIDE

As you look at the pages in your textbook, you will notice that on some pages a book icon  appears with a brief description of a feature on your TI-82 graphing calculator. In this guide the page number in the textbook on which each of these book icons occurs is shown, as well as the key word or phrase which appears next to the icon, followed by a detailed description of how to use this feature on your TI-82. Each feature is also given its own number for easy reference.

page 2

1 Negative and Subtract

You may have noticed that the calculator has two keys with a minus sign on them. The gray (–) key in the bottom row of keys is actually the **negative key**. **The negative key is used only to write a negative number.** The following numbers and expressions would be entered using the gray negative key:

$$-5 \qquad -7 * 6 \qquad -4 + 1 \qquad 54 / (-6)$$

The blue-gray key in the right-hand column on the keyboard is the **subtraction key**. It is grouped with the other keys used to perform the basic four arithmetic operations (addition, subtraction, multiplication, and division). **The subtraction key is used between two numbers to indicate that a subtraction is to be done.** The following expressions would be entered using the blue subtraction key:

$$17 - 8 \qquad 13 * 7 - 2 \qquad 5 - 6(3 + 4)$$

You can tell which of these keys has been used from the screen display, if you look closely. The negative sign produced by the negative key is one pixel (dot) shorter and placed one pixel row higher than the subtraction sign produced by the subtraction key.

Be aware that it is a common mistake among new users of the TI-82 to press the wrong one of these two keys. If you do, sometimes you will get an error message on the calculator screen when you press **ENTER** to evaluate an expression. Other times the calculator will do something different from what you intend.

For example, suppose you wanted to do the subtraction $8-5$ on the calculator. First do it the correct way with the blue-gray subtraction key and press **ENTER** to evaluate it. Of course, you should get 3 as the answer. Now enter it the wrong way by using the gray negative key between the 8 and the 5 and press **ENTER** to evaluate it. You get an error message (ERR: SYNTAX, which you can read more about some other time in the Error Conditions portion in the back of the manual that came with your calculator). What happened? The calculator does **not** interpret the negative key as meaning to subtract. The calculator sees this last expression as two numbers written side by side, 8 and -5 , with no indication of which operation you wanted to perform on them. Therefore, the calculator doesn't know what you want done with these numbers. That's why it gave you an error message. The calculator is smart enough, however to know where the problem probably lies. Notice that with the error message you have two choices: **Goto** (go to the error) and **Quit**. Choose **Goto** by pressing 1 or by pressing **ENTER** (since choice 1 is already highlighted). The calculator returns to the Home screen with the cursor blinking on the negative sign which should have been a subtraction sign. While the cursor is there, type a subtraction sign, which will replace the incorrect negative sign, and then press **ENTER** to evaluate the expression. Now the problem has been fixed.

page 3

2 Decimal

Press the **MODE** key. Notice that on the second line of mode settings the word **Float** is probably highlighted. If not, move the blinking cursor over the word **Float** and press **ENTER**. Press **2nd [QUIT]** to return to the Home screen. Unless the computation comes out exactly using fewer digits, when the calculator is set to **Float** mode, the calculator displays 10 digits, and the decimal point occurs at its appropriate place in the 10-digit display. As a result, sometimes more digits are displayed to the right of the decimal point on some computations than others. The decimal point "floats" to wherever it should be in the 10-digit display for a given computation. For example, perform the following three divisions: $17 \div 8$, $368 \div 7$, and $9543 \div 7$. Since the computation of $17 \div 8$ comes out exactly at the third decimal place, the calculator displays only the number of decimal places needed to show the result: 2.125. The other two computations do not come out exactly, no matter how many decimal places are used, so the calculator displays ten digits and locates the decimal point where it should occur in the 10-digit display: $368 \div 7 = 52.57142857$ and $9543 \div 7 = 1363.285714$. Notice how in these last two computations the first displays ten digits with eight of them to the right of the decimal point, while the last also displays ten digits but with only six of them to the right of the decimal point.

Suppose instead that you want your calculator to automatically round computations to a fixed number of decimal places. Press the **MODE** key again. The second line reads **Float 0123456789**. To make the calculator automatically round all calculations to two decimal places, on the second line of the **MODE** screen use the arrow keys to move the blinking cursor over the number **2** and press **ENTER**. Press **2nd [QUIT]** to return to the Home screen. Now if you do the same three computations above again, the calculator will display the results rounded with only two digits to the right of the decimal point (that is, rounded to the nearest hundredth): $17 \div 8 = 2.13$, $368 \div 7 = 52.57$, and $9543 \div 7 = 1363.29$. When you are through making the calculator round to two decimal places, it would probably be best to return to the **MODE** menu and change the setting back to **Float**.

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3 Square Root

The square root is the second function on the x^2 key. (Note the square root sign printed above the x^2 key in light blue print.) To produce a square root sign on the Home screen display, first press the light blue 2nd key and then press the x^2 key to produce its second function, the square root sign. In the future, this key sequence will be denoted 2nd [$\sqrt{}$], where the second function of the key is enclosed in brackets. Other keystrokes involving the 2nd key will be denoted in a similar fashion. The expression in the brackets should be found printed above one of the keys on the keyboard.

Unlike with most scientific calculators, with the graphing calculator you enter the square root sign first. To find the square root of 324, use the following keystrokes: 2nd [$\sqrt{}$] 324 ENTER. On the Home screen you will see $\sqrt{324}$. The value of this square root, 18, should have appeared on the right of the screen after you pressed ENTER.

Note that the calculator only does the square root of the number immediately following the square root sign. If you want to compute $\sqrt{7+18}$, you must group the sum in parentheses, $\sqrt{(7+18)}$, to assure that the sum is computed before the square root is taken. (The correct value of this expression is 5.)

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4 Test

The items on the TEST menu may be used to tell whether a relationship between two numbers or expressions is true or false. To see how it works, let's let the calculator verify something you already know: 7 is less than 8. At the Home screen type a 7 and then press 2nd [TEST] (the second function on the MATH key) to produce the TEST menu. The "less than" symbol < is choice 5 on the menu. Either press 5 or use the Down Arrow key to highlight the 5 and press ENTER. The < symbol will appear on the Home screen after the 7. Then type an 8, so that the Home screen now shows 7<8. You want to know if this statement is true. The calculator will tell you when you press ENTER. The calculator will display a 1 if the statement is true or a 0 if the statement is false. In this case, of course, the calculator displays a 1, since 7 is less than 8.

Now let's enter a false statement: $4 > 11$. Type a 4 and then press 2nd [TEST] to produce the TEST menu. The "greater than" symbol > is choice 3 on the menu, so press 3 to produce the > symbol on the Home screen after the 4. Now type 11 and press ENTER. The calculator displays a 0 to tell you that the statement is false.

Next let's try one that perhaps isn't so obvious. Is $\frac{5}{8} > \frac{59}{93}$? Type in $5/8 > 59/93$ (using the division key \div to produce the diagonal slash division sign /) and press ENTER to find out. The statement is false, since the calculator responds with a 0.

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5 Absolute Value

The absolute value of a number is the number's distance from zero on the number line. The absolute value key is the second function on the x^{-1} key. It is denoted ABS. Thus, the keystrokes needed to get the absolute value would be denoted 2nd [ABS]. When we write the absolute value of -7 with pencil and paper, we enclose the number within two vertical bars: $|-7|$. On the

calculator the absolute value of -7 is denoted **abs (-7)**. Produce this expression on your Home screen by first pressing 2nd [ABS]. Then open a set of parentheses, type in -7 (being sure to use the gray negative key), and close the parentheses. Press ENTER to find the absolute value of -7 , which is 7. Try doing this problem again, only don't use the parentheses. You will find that when you take the absolute value of a single number, the parentheses are optional.

As was the case with square roots, the calculator only takes the absolute value of the number immediately to the right of the **abs** symbol. To evaluate $|-17 + 5|$ we may **not** just enter **abs-17+5**, because the calculator would do the absolute value of the -17 only. We want it to do the absolute value of the entire expression contained within the absolute value bars. To do this, we **must** put the expression inside a set of parentheses: **abs (-17+5)**. The result is 12, since $|-17 + 5| = |-12| = 12$.

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6 Add

The addition key $+$ is on the right-hand side of the keyboard with the other basic operation keys (subtraction, multiplication, and division). Basic addition is done as it is on most other kinds of calculators: the expression containing addition may be entered just as it appears in print or when written by hand. To evaluate the expression once you have typed it in, press ENTER. For example, to evaluate $7 + 15$, type this expression just as it appears and press ENTER to display the value 22.

To add expressions involving negative numbers, such as $5 + (-8)$, you may type this expression just as it appears, using the parenthesis keys, and pressing ENTER to obtain the value -3 . Be sure you use the gray negative key—not the blue-gray subtraction key—when you type in the -8 . (See **1 Negative and Subtract**.) It turns out that you could also type in this expression without using the parentheses, and it will still work: $5 + -8$ will still produce the value -3 .

To add absolute values (see **5 Absolute Value**), you need to use 2nd [ABS] to enter the absolute values. For example, to evaluate $|-5| + |2|$ you would type in **abs (-5) +abs (2)** or **abs-5+abs2**. Press ENTER to obtain the value 7.

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7 Fraction

Fractions may be entered into the calculator by using the division key \div to produce a diagonal slash fraction bar. The TI-82 can perform operations on fractions and give answers in either decimal or fraction form. Enter the expression $\frac{5}{6} - \frac{1}{2}$ by typing $5 \div 6 - 1 \div 2$. The expression will appear on the Home screen as **5/6-1/2**. Press ENTER to get the decimal form of the value of this expression (approximately .3333333333). If you prefer to get your answer in fractional form, you must do one extra thing before pressing ENTER. To see how to get a fractional answer, either type in the original expression again or use 2nd [ENTRY] to reproduce it on the Home screen. With the cursor at the end of the expression, press the MATH key. Choice 1, which is already highlighted, is \blacktriangleright Frac, which converts the preceding expression to fractional form, if it can. Press 1 or ENTER (since choice 1 is already highlighted). The display will return to the Home screen,

where the fraction conversion symbol will appear after the expression: $5/6-1/2 \blacktriangleright \text{Frac}$. Now press ENTER to see the fractional value of the expression (one-third).

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8 Subtract

See 1 Negative and Subtract.

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9 Multiply

The TI-82 interprets the following as indicating multiplication: the multiplication key \times , numbers or expressions written side by side in parentheses, numbers and letters written side by side, and letters written side by side. If you type 3×6 , the calculator will display it as $3*6$. The asterisk $*$ is a common computer notation for multiplication. When you press ENTER, the calculator will display the value 18. If you place one or both of the numbers in a multiplication in parentheses *without* using the multiplication key, the calculator still knows that you mean to multiply. Thus, the calculator will also produce 18 if you enter 3×6 as $3(6)$, $(3)6$, or $(3)(6)$. Parentheses may also be used for grouping calculations to be done in a certain order. Thus, the calculator interprets $5(3+4)$ as meaning to add $3 + 4$ first to get 7, and then to multiply 5 times the 7 to get 35.

As an example of placing numbers and letters side by side, the calculator interprets $3X$ as meaning "3 times X." (How to enter letters will be discussed later.) To see how this way of writing multiplication works, try typing in 2π , where π (the Greek letter pi) represents that special number having to do with circles. The value of π is approximately 3.141592654. Your calculator has this special number as the second function on the caret key \wedge . (You should see the symbol π printed above the caret key in light blue type.) To type in 2π , type the 2 and then press the light blue 2nd key and then the caret key. (In the future we will denote these last two keystrokes as 2nd [π].) Your calculator should display 2π . Press ENTER to see the value 6.283185307, which is two times the value of π .

To multiply the absolute value of -4 by the absolute value of 10, $|-4| \cdot |10|$, you could use the multiplication key to type in $\text{abs}(-4) * \text{abs}(10)$, or you could just put the two absolute values side-by-side with no symbol in between: $\text{abs}(-4) \text{abs}(10)$. (In either case, the parentheses are optional.) The calculator still knows you mean that these two absolute values are to be multiplied. The value of this expression is 40, since $|-4| \cdot |10| = 4 \cdot 10 = 40$.

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10 Divide

The symbol \div appears on the division key of the TI-82, but on the screen division is indicated by the diagonal slash $/$. Do the division 24 divided by 6 by pressing $24 \div 6$ ENTER. Note that on the Home screen the division appears as $24/6$, which means the same thing, and the result is still 4.

Fractions may also be entered as divisions. For example, the fraction $\frac{3}{4}$ may be interpreted as 3 divided by 4. You may enter the fraction that way on your calculator. On the screen you will see $3/4$. When you press ENTER, you will see the decimal equivalent of .75. (See also 7 Fraction.)

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11 Exponent

The caret key \wedge is used to enter most exponents. For example, the expression 2^5 , is entered into the calculator as **2^5**. Thus, the base is entered first, then the caret, and then the exponent. Press ENTER to produce this expression's value, 32. To raise a negative number to a power, it is necessary to enclose the negative number base in parentheses. For example, to raise the number -3 to the fourth power the expression must be written as $(-3)^4$. Likewise, we must enter this expression into the calculator as **(-3)^4**. The result is 81. Without the parentheses, **-3^4** would (and should) be interpreted as taking the negative of 3^4 . That is, **-3^4** is interpreted as $-3^4 = -(3^4) = -(81) = -81$.

Two special exponents that can be produced on screen as raised exponents are the exponents 2 and 3. To enter the expression 5^2 you could use the standard approach of typing **5^2**, or you could instead type the 5 and then press the x^2 key. The x^2 key produces only the raised exponent 2 on the screen, not the x . Either way, the calculator produces the result of 25 when you press ENTER. To produce a raised exponent 3, as in the expression 4^3 , first type 4 and then press the MATH key. The calculator will display the MATH menu. Choice 3 on the MATH menu is the raised exponent 3. Select it by pressing 3 (or by using the Down Arrow key to highlight the number 3 and pressing ENTER). The MATH menu will then disappear, and the calculator will display **4^3**. Press ENTER to display the value of the expression, 64.

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12 Reciprocal

Since the reciprocal of an integer, such as 5, may be written as $\frac{1}{5}$, it may be entered into the calculator as we would enter any fraction of this type: **1/5**, using the division key \div to produce the diagonal slash / on the screen. Similarly, the reciprocal of a fraction, such as $\frac{5}{8}$, may be written by interchanging the numerator and denominator: $\frac{8}{5}$, appearing as **8/5** on screen.

Another way to enter the reciprocal of a number is to use the x^{-1} key. For reasons that will be explained in a later chapter of your text, the reciprocal of 4 may be written as 4^{-1} . To produce this expression on screen, press 4 and then the x^{-1} key, which produces only the exponent -1 , not the x . Press ENTER to display the value of the expression, .25, which of course is the decimal equivalent of $\frac{1}{4}$.

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13 Store

The STO> key is used to store a particular number value in a variable (letter). That is, it assigns a specific numerical value to a letter. If you wish to make the letter B represent the value 7, then you must store the value 7 in the letter B. To do this, first type the number 7 and then press the STO> key. Notice that an arrow appears on screen next to the number 7. To type the letter B (or any other letter) first press the ALPHA key. Note that the cursor has changed: there is a letter A inside the cursor, which indicates that the calculator is in Alpha mode. You may have noticed that letters of the alphabet appear above many of the keys on your calculator. When the calculator is

in Alpha mode, as it is now, and you press one of these keys, it produces on screen the letter of the alphabet shown above the key, rather than performing its usual function. Since you want to store the value 7 in the letter B, press the key that has the letter B printed above it: the **MATRX** key. Your screen should now show **7→B**. The calculator doesn't actually store 7 in the letter B until you press **ENTER**, which you should do now. From now on, until you change the value stored in B, the calculator assigns the value 7 to the letter B. Even turning the calculator off won't erase this result. To type in 3B, type 3 and then press the **ALPHA** key to put the calculator into Alpha mode. (When you do, the letter A should appear inside the cursor.) Then press the **MATRX** key, which has the letter B printed above it. Press **ENTER** to display the value of 3B (3 times B), which is 21, since $3B = 3(7) = 21$.

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14 Evaluate

To evaluate an algebraic expression when the variable (letter) takes on a particular value, first store the value in the variable (see **13 Store**), and then type in the expression and press **ENTER** to display the value of the expression. For example, if you want to know the value of $5x + 2(1 - x)$ when $x = -3$, first store -3 in the variable x by typing $-3 \rightarrow X$, where the \rightarrow is produced by pressing the **STO>** key. (Notice that you may produce the variable **X** on screen in this case by pressing **ALPHA**, and then the **STO>** key again, since X is the Alpha mode character printed above the **STO>** key. An easier way to produce the **X** on screen is to press the **X,T,θ** key.) Press **ENTER** to execute the store command. Now, type in the expression **5X+2 (1-X)**, using the **X,T,θ** key to type in each **X**. Press **ENTER** to display the value of this expression when $x = -3$. The value should be -7 . Internally, the calculator has just done all of this for you:

$$\begin{aligned} 5x + 2(1 - x) &= 5(-3) + 2(1 - (-3)) \\ &= 5(-3) + 2(1 + 3) \\ &= 5(-3) + 2(4) \\ &= -15 + 8 \\ &= -7 \end{aligned}$$

Now type in $x^2 + 7$ and press **ENTER** to evaluate this expression when $x = -3$. The result should be 16.

If an expression has more than one variable, you may store values in each variable before entering the expression. For example, to evaluate $\frac{2c + 21d}{c^2d}$ when $c = 3$ and $d = -2$, first store 3 in C. (Type 3 **STO>** **ALPHA** C **ENTER**.) Then store -2 in D. Finally, pressing the **ALPHA** key prior to typing each letter, type in the fraction as **(2C+21D) / C²D**, and press **ENTER** to evaluate the expression, which should be equal to 2.

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15 Alpha

To type letters of the alphabet, which are printed above many of the keys, the calculator must be in Alpha mode. To put the calculator in Alpha mode **for one keystroke only**, press the **ALPHA** key and then press the key that has the desired letter printed above it. When you press the **ALPHA** key, the calculator lets you know it is in Alpha mode by displaying the letter A inside the cursor. (If the calculator is also in Insert mode because **2nd** [**INS**] was pressed first, the Insert mode underline cursor will have an A printed above the underline.) For example, to produce the letter P on screen,