

A GUIDE FOR TEACHERS 教师指南
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TI-15
A Guide for Teachers

TI-15

A Guide for Teachers

Developed by
Texas Instruments Incorporated

Activities developed by
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About the Teacher Guide



How the Teacher Guide is Organized

This guide consists of two sections: *Activities* and *How to Use the TI-15*. The *Activities* section is a collection of activities for integrating the TI-15 into mathematics instruction. *How To Use the TI-15* is designed to help you teach students how to use the calculator.

Activities

The activities are designed to be teacher-directed. They are intended to help develop mathematical concepts while incorporating the TI-15 as a teaching tool. Each activity is self-contained and includes the following:





- An overview of the mathematical purpose of the activity.
- The mathematical concepts being developed.
- The materials needed to perform the activity.
- A student activity sheet.

How to Use the TI-15

This section contains examples on transparency masters. Chapters are numbered and include the following:

- An introductory page describing the calculator keys presented in the examples, the location of those keys on the TI-15, and any pertinent notes about their functions.
- Transparency masters following the introductory page provide examples of practical applications of the key(s) being discussed. The key(s) being discussed are shown in black on an illustration of the TI-15 keyboard.

Things to Keep in Mind

- While many of the examples on the transparency masters may be used to develop mathematical concepts, they were not designed specifically for that purpose.
- For maximum flexibility, each example and activity is independent of the others. Select the transparency master that emphasizes the key your students need to use to develop the mathematical concepts you are teaching. Select an appropriate activity for the mathematical concept you are teaching.
- If an example does not seem appropriate for your curriculum or grade level, use it to teach the function of a key (or keys), and then provide relevant examples of your own.
- To ensure that everyone starts at the same point, have students reset the calculator by pressing  and  simultaneously or by pressing , selecting RESET, selecting Y (yes), and then pressing .

How to Order Additional Teacher Guides

To place an order or to request additional information about Texas Instruments (TI) calculators, call our toll-free number:

1-800-TI-CARES (1-800-842-2737)

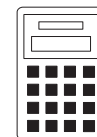
Or use our e-mail address:

ti-cares@ti.com

Or visit the TI calculator home page:

<http://www.ti.com/calc>

About the TI-15



Two-Line Display

The first line displays an entry of up to 11 characters. Entries begin on the top left. If the entry will not fit on the first line, it will wrap to the second line. When space permits, both the entry and the result will appear on the first line.

The second line displays up to 11 characters. If the entry is too long to fit on the first line, it will wrap to the second line. If both entry and result will not fit on the first line, the result is displayed right-justified on the second line. Results longer than 10 digits are displayed in scientific notation.

If an entry will not fit on two lines, it will continue to wrap; you can view the beginning of the entry by scrolling up. In this case, only the result will appear when you press **Enter**.

Display Indicators

Refer to Appendix B for a list of the display indicators.

Error Messages

Refer to Appendix C for a listing of the error messages.

Order of Operations

The TI-15 uses the Equation Operating System (EOS™) to evaluate expressions. The operation priorities are listed on the transparency master in Chapter 1, *Display, Scrolling, Order of Operations, and Parentheses*.

Because operations inside parentheses are performed first, you can use **(** or **)** to change the order of operations and, therefore, change the result.

Menus

Two keys on the TI-15 display menus: **Mode** and **Frac**.

Press **↓** or **↑** to move down or up through the menu list. Press **←** or **→** to move the cursor and underline a menu item. To return to the previous screen without selecting the item, press **Clear**. To select a menu item, press **Enter** while the item is underlined.

Previous Entries **←** **→**

After an expression is evaluated, use **←** and **→** to scroll through previous entries and results, which are stored in the TI-15 history.

Problem Solving (◊)

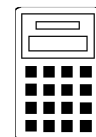
The Problem Solving tool has three features that students can use to challenge themselves with basic math operations or place value.

Problem Solving (Auto Mode) provides a set of electronic exercises to challenge the student's skills in addition, subtraction, multiplication, and division. Students can select mode, level of difficulty, and type of operation.

Problem Solving (Manual Mode) lets students compose their own problems, which may include missing elements or inequalities.

Problem Solving (Place Value) lets students display the place value of a specific digit, or display the number of ones, tens, hundreds, thousands, tenths, hundredths, or thousandths in a given number.

About the TI-15 (Continued)



Resetting the TI-15

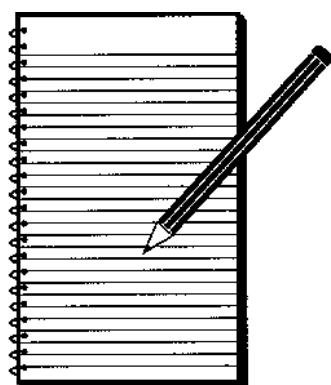
Pressing ON and CLEAR simultaneously or pressing MODE , selecting RESET, selecting Y (yes), and then pressing ENTER resets the calculator.

Resetting the calculator:

- Returns settings to their defaults: Standard notation (floating decimal), mixed numbers, manual simplification, Problem Solving Auto mode, and Difficulty Level 1 (addition) in Problem Solving.
- Clears pending operations, entries in history, and constants (stored operations).

Automatic Power Down™ (APD™)

If the TI-15 remains inactive for about 5 minutes, Automatic Power Down (APD) turns it off automatically. Press ON after APD. The display, pending operations, settings, and memory are retained.



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Patterns in Percent

Grades 4 - 6

Overview

Students will use the $\%$ key to collect data about percentages of a given number. They will organize the data and look for patterns in percents. (For example, 10% of 20 is twice as much as 5% of 20.)

Math Concepts

- multiplication
- equivalent fractions, decimals, and percents

Materials

- TI-15
- pencil
- student activity (page 4)

Introduction

1. After students use manipulatives to develop the meaning of percent (1% = 1 part out of 100 parts), have them explore what happens when they press $\%$ on the calculator.

2. Present the following scenario to students:

Metropolis East (M.E.) and Metropolis West (M.W.) are neighboring cities. The sales tax in M.E. is 10%, but the sales tax in M.W. is only 5%. Collect data and display your results for each percent in a table to compare the amounts of money you would pay for tax on various items in each city.

3. Have students make conjectures about percent based on the patterns they observe. Students can then use manipulatives to verify their conjectures.


Examples:


- Students may observe that for every item, 10% of its price is twice as much as 5% of its price.
- Students may observe that it is easy to estimate 10% of a whole number by using place value and looking at the digits to the right of the ones place.

Collecting and Organizing Data

To guide students in organizing their data to bring out patterns, ask questions such as:

- *How could you organize your data to compare the 5% tax rate to the 10% tax rate?*
- *Why would it be useful to keep 5% in the left-hand column of one table all the way down and just change the total quantity?*

 When a student enters a 6% , the TI-15 displays **6%**. Then, when the student presses Enter , the display changes to **6%= 0.06** to show that 6% is another way to write 0.06 or 6/100.

 You will need to show students how to use multiplication on the TI-15 to express the percent of a given quantity. For example, to show 10% of \$20:

1. Enter **10**.
2. Press $\%$ \times .
3. Enter **20**; press Enter .

Students can verify the calculator display of **2** by using manipulatives to show 10% of \$20 = \$2.

Patterns in Percent (Continued)

- *How can you make a similar table for 10% to compare your data?*
- *What do you think would happen if you order the total quantity amounts from least to greatest?*
- *How else might you organize your data to compare the two tax rates and find patterns in the percents?*

Analyzing Data and Drawing Conclusions

To focus students' attention on looking for patterns in their data, ask questions such as:

- *How are the percentages (amounts of tax) in your 5% table like the amounts in the 10% table?*
- *How does 5% of a \$20 item compare to 5% of a \$10 item?*
- *How does 10% of a \$20 item compare to 10% of a \$10 item?*
- *How does 10% of the cost of an item compare to the total cost of the item?*
- *What conjectures can you make about finding 10% of a number?*
- *What conjectures can you make about finding 5% of a number?*
- *How can you use manipulatives to test your conjectures?*

Continuing the Investigation

Students can create other percent scenarios to investigate patterns in percents. For example, ask students:

- *What happens if you increase the sales tax by one percentage point each day?*
- *How does the tax on a \$20 item change each day?*
- *How does the tax on a \$40 item change each day?*
- *How do the taxes on the 2 items compare?*

Patterns in Percent

Name _____

Date _____



Collecting and Organizing Data

Use your calculator to collect data about percent, organize it in the table below, and then look for patterns.

Cost of Item	Amount of Tax in Metropolis West Tax Rate: ____%	Amount of Tax in Metropolis East Tax Rate: ____%

Patterns in Percent

Name _____

Date _____



Analyzing Data and Drawing Conclusions

1. What patterns do you see in your tables?

2. What conjectures can you make from these patterns?

3. Repeat the activity with a different percent in the left column and compare your results.

4. Repeat the activity, changing the percents in the left column while keeping the total quantity constant. Now what patterns do you see? What conjectures can you make?

Fraction Forms

Grades 4 - 6

Overview

Students will compare the results of using division to create fractions under the different mode settings for fraction display and make generalizations from the patterns they observe.

Math Concepts

- division
- multiplication
- common factors
- equivalent fractions

Materials

- TI-15
- pencil
- student activity (page 9)

Introduction


1. Present students with a problem such as:


In a small cafe, there are 6 cups of sugar left in the pantry to put into 4 sugar bowls. If you want them all to contain the same amount of sugar, how much sugar goes into each sugar bowl?

2. Have students present their solutions to the problem. Encourage them to find as many ways to represent the solution as possible.

Examples:

- By thinking of using a $\frac{1}{4}$ cup scoop to fill the bowls, each bowl would receive 6 scoops, or $\frac{6}{4}$ cups of sugar.
 - By thinking of separating each cup into half cups, there would be 12 half cups, and each bowl would receive 3 half cups, or $\frac{3}{2}$ cups of sugar.
 - If a 1-cup measuring cup was used first, each bowl would receive 1 cup of sugar, then the last two cups could be divided into eight fourths to give $1\frac{2}{4}$ cups per bowl.
 - The last two cups could be divided into 4 halves to give $1\frac{1}{2}$ cups per bowl.
3. Have students identify the operation and record the equation that they could use with the calculator to represent the action in the situation ($6 \text{ cups} \div 4 \text{ bowls} = \text{number of cups per bowl}$).

 Refer to page 45 for detailed information about mode settings on the TI-15.

 Division can be represented by $6 \div 4$ or $\frac{6}{4}$ (entered on the calculator as $6 \square \div \square 4 \square$). In this activity, the fraction representation is used.

Fraction Forms (Continued)

4. Have students enter the division to show the quotients in fraction form, and record the resulting displays.
5. Have students explore the quotient with the different combinations of settings and discuss the different displays that occur. If necessary, have them use manipulatives to connect the meanings of the four different fraction forms.
6. Have students, working in groups of four, choose a denominator and record the different fraction forms on the activity sheet provided.
7. Have students share their results, look for patterns, and make generalizations.

Collecting and Organizing Data

To guide students in creating data that will exhibit patterns in the fraction quotients, ask questions such as:

- *What denominator did you choose to explore with? Why?*
- *What denominators do you get with the settings $\frac{n}{d}$ man? With the settings $U \frac{n}{d}$ man?*
- *What denominators do you get with the settings $\frac{n}{d}$ auto? With the settings $U \frac{n}{d}$ auto?*
- *What denominator are you going to choose to explore with next?*


Example:

After exploring with denominators of 2 and 3, you might suggest exploring with a denominator of 6 and comparing results.

- *How can you organize your results to look for patterns?*

Example:

Continuing to increase the numerators by 1 each time.

 For example, for $6 \div 4$ as a fraction, enter $6 \square 4 \square \square$. The displays in the different modes will look like the following:

$$\frac{n}{d} \text{ man} \qquad \frac{6}{4}$$

$$\frac{n}{d} \text{ auto} \qquad \frac{3}{2}$$

$$U \frac{n}{d} \text{ man} \qquad 1 \frac{2}{4}$$

$$U \frac{n}{d} \text{ auto} \qquad 1 \frac{1}{2}$$

Fraction Forms (Continued)

Analyzing Data and Drawing Conclusions

To focus students' attention on the patterns in their fractions and the relationship of these patterns to the denominators, ask questions such as:

- *What patterns do you see in your results?*

Example:

When a denominator of 4 is used in the $\frac{n}{d}$ **auto** column, every fourth number is a whole number.

- *How do the results of using a denominator of 2 compare with the results of using a denominator of 4?*
- *How does a denominator of 5 compare to a denominator of 10?*
- *Which other denominators seem to be related?*

Example:

The pattern using a divisor of 6 is related to the patterns for 2 and 3.)

- *What pattern do you see in the related denominators?*

Example:

They are related as factors and multiples.

Continuing the Investigation

Have students brainstorm situations in which they would prefer to use each of the combinations of settings of fraction forms.

Example:

- When working with probabilities that may need to be added, using the $\frac{n}{d}$ **man** settings would keep the denominators of the probabilities all the same and make mental addition easier.
- In a situation where estimated results are close enough, using the **U** $\frac{n}{d}$ **auto** settings would make it easier to see quickly the whole number component of the result and whether the additional fraction part was more or less than $\frac{1}{2}$.

Fraction Forms

Name _____

Date _____



Collecting and Organizing Data

1. Have each person in your group set his/her calculator to one of the following combinations of modes for fraction display. (Each person should choose a different setting.)
 - improper/manual simp
 - improper/auto simp
 - mixed number/manual simp
 - mixed number/auto simp
2. Select a denominator: _____
3. Use this denominator with several numerators and record each person's results in the table below.

Numerator	Denominator	$\frac{n}{d}$ Man	$\frac{n}{d}$ Auto	$U \frac{n}{d}$ Man	$U \frac{n}{d}$ Auto
0					
1					
2					
3					
4					

Fraction Forms (Continued)

Analyzing Data and Drawing Conclusions

1. What patterns do you see?

2. What generalizations can you make?

3. Try the activity again with a different denominator and compare your results with the two denominators.

Comparing Costs

Grades 3 - 5

Overview

Students will solve a problem using division with an integer quotient and remainder, division with the quotient in fraction form, and division with the quotient in decimal form and compare the results.

Math Concepts

- division
- multiplication
- fractions
- decimals

Materials

- TI-15
- pencil
- student activity (page 14)

Introduction

1. Introduce the following problem:

The maintenance department has determined that it will cost \$.40 per square yard to maintain the district's soccer field each year. The soccer field is 80 yards wide and 110 yards long. The six schools that play on the field have decided to split the cost evenly. How much should each school contribute to the soccer field maintenance fund this year?

2. Have students use the calculator to solve this problem in three ways:
 - Finding an integer quotient and remainder.
 - Finding the quotient in fraction form.
 - Finding the quotient in decimal form.




Collecting and Organizing Data

Students should record their procedures and results on the Student Activity page. To help them focus on their thinking, ask questions such as:

- *What did you enter into the calculator to solve the problem?*

Example:

A student may have entered $80 \times 110 \text{ [Enter]}$ to determine the area of the soccer field, then entered $\times 0.40 \text{ [Enter]}$ to find the total maintenance cost, then $\div 6 \text{ [Enter]}$ to find the cost for each school in fraction or decimal form.

-  To display an integer quotient with a remainder, use the $\text{[Int}\div\text{]}$ key.
-  To display a quotient in fraction form, press [Mode] \rightarrow [Enter] to select **n/d**, then use the $\text{[}\div\text{]}$ key.
-  To display a quotient in decimal form, press [Mode] \leftarrow [Enter] to select **.**, then use the $\text{[}\div\text{]}$ key.

Comparing Costs (Continued)

- *Could you have solved the problem more efficiently? How?*

Example:

A student may see that 80×110 could be done mentally, and the key presses could be simplified to **8800** \times **.4** \div **6** Enter .

- *How are your procedures alike for each type of solution?*

Examples:

They all involve finding how many square yards in the soccer field; they all involve multiplication and division.

- *How are they different?*

You use different keys to tell the calculator in what form you want the answer displayed.

Analyzing Data and Drawing Conclusions

To guide students in the analysis of their data, ask questions such as:

- *How are your solutions in the three forms alike?*


They all have a whole number component of 586.


- *How are your three solutions different?*

The remainder form just tells how many dollars are left over. The fraction and decimal forms tell how much more than \$586 each school has to pay.

Comparing Costs (Continued)

- *What happens if you multiply each solution by 6 to check it?*


For the remainder form, you have to multiply 586×6 and then add 4 to get the total cost of \$3520. You can multiply $586\frac{2}{3} \times 6$ in fraction form to get \$3520. If you enter **586.666667 x 6** and press , you get **3520**, but that doesn't make sense because 6×7 doesn't end in a 0!

If you enter **586.66667**, then fix the decimal quotient to hundredths since it is money, and then find 586.67×6 , you *still* get 3520.00, which still doesn't make sense because $6 \times 7 = 42$. If you clear the calculator and enter **586.67 x 6**, and press , then the display reads **3520.02**, which does make sense.

- *As a school, which form of the quotient would you want to use?*

Responses may vary. Some students may want to use the decimal form, since it is the closest to the representation of money. Some students may want to use the integer quotient and remainder form and suggest that the Central Office pay the \$4.00 remainder.

Although the fraction form of the quotient describes the exact quantity that each school should pay, most students will recognize, by comparing it to the decimal form, that the fraction form is not easily translated into money.

 When you fix 586.666667 to 2 decimal places, and then multiply by 6, the calculator “remembers” the original number and uses it as the factor. The product rounded to the nearest hundredth, using the original factor, is 3520.00. When you enter 586.67, the calculator uses this number for the factor, showing the actual product of 3520.02.

Comparing Costs

Name _____

Date _____



Collecting and Organizing Data

The Maintenance department has determined that it will cost \$4.00 per square yard to maintain the district's soccer field each year. The soccer field is 80 yards wide and 110 yards long. The 6 schools that play on the field have decided to split the cost evenly. How much should each school contribute to the soccer field maintenance fund this year?

1. Use division with an integer quotient and remainder:

2. Use division with a quotient in fraction form:

3. Use division with a quotient in decimal form:

Analyzing Data and Drawing Conclusions

Write a short paragraph comparing the three solutions.

Number Shorthand: Scientific Notation

Grades 5 - 6

Overview

Students will use patterns created on the calculator with the constant operation ($\boxed{Op1}$ or $\boxed{Op2}$) to develop an understanding of scientific notation.

Math Concepts

- multiplication
- powers of 10
- exponents

Materials

- TI-15
- pencil
- student activity (page 18)

Introduction

1. Have students review the pattern created when using 10 as a factor.

Example:

$$1 \times 10 = 10$$

$$2 \times 10 = 20$$

$$3 \times 10 = 30$$

$$10 \times 10 = 100$$

2. Ask students:


Based on this pattern, what do you think happens when we multiply by 10 over and over again?

3. After students share their conjectures, have them use $\boxed{Op1}$ to test their conjectures. As students press $\boxed{Op1}$, have them record the resulting displays on the Student Activity page.

4. When students reach the point where the left-hand counter is no longer displayed, ask them what they think has happened to the calculator. (The product has become so large that there is not room to display both the product and the counter, so the counter has been dropped.)

Have students continue to record the counter data, even though it no longer shows on the calculator.

5. When the left-hand counter reappears, have students describe what has happened to the display of the product. (It has been replaced with a right-hand display of scientific notation: for example, 1×10^{11} .)

 To multiply repeatedly by 10, enter:

1. $\boxed{Op1} \times 10 \boxed{Op1}$

This “programs” the constant operation.

2. Enter 1 as the starting factor.

3. Press $\boxed{Op1}$.

When you press $\boxed{Op1}$ the first time, the calculator performs the operation 1×10 and the display shows:

1x10

1 10

The 1 represents using $\times 10$ one time.

Number Shorthand: Scientific Notation

(Continued)

6. Have students continue to press $\boxed{0p}$ and record the results.
7. Have students analyze their data and make some conclusions about the scientific notation display.

For example, 1×10^{11} represents the product:
 $1 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$.

Explain to students that exponential or scientific notation is a shorthand for repeated factors:
 1×10^{11} .

8. Have students continue to explore the use of scientific notation to represent repeated multiplication by 10 with other starting factors. (For example, using 2 as the starting factor, the display 2×10^{11} represents multiplying 2 by 10 eleven times, or 2×10^{11} .)

Collecting and Organizing Data

To focus students' attention on the relevant changes in the calculator's display, ask questions such as:

- *What does the display **3 1000** mean?*
- *When did the counter on the left disappear? Why do you think that happened?*
- *When did the counter on the left reappear? What else has changed?*

The product looks different. It changed from 1000000000 to 1×10^{10} .

- *What do the displays look like after this change takes place?*

The 1×10 stays the same, but the right-hand number (the exponent) goes up one each time $\boxed{0p}$ is pressed, and it matches the left-hand counter.

Number Shorthand: Scientific Notation

(Continued)

Analyzing Data and Drawing Conclusions

To focus students' attention on the connection between the repeated factors of 10 and the scientific notation display, ask questions such as:

- *What patterns do you see in your products before the counter disappears?*

They all have a 1 followed by the same number of zeroes as factors of 10 that were used in the product.

- *If you continued this pattern, what would the product be at the point where the display of the product changed? How is the product related to the new display?*

For example, 1×10^{11} is in the place where the product should be 100,000,000,000. The display 1×10^{11} represents the product 1×10^{11} .

- *What happens if you use 2 as the starting factor and multiply by 10 repeatedly?*

The displays are the same, except the first number in all the products is 2. The display 2×10^{11} represents the product 2×10^{11} .

Continuing the Investigation

Students can use other powers of 10 as the repeating factor, record the results in the table, and look for patterns. For example, using 100 as the repeating factor causes the exponent part of the scientific notation display to increase by 2 every time $\boxed{00}$ is pressed.

Students can use a starting factor of 10 or greater, record the results in the table, and look for patterns. For example, using 12 as the starting factor soon results in a display like $12 \quad 1.2 \times 10^{13}$, where the exponent part of the display is one more than the number of times 10 has been used as a factor.

Number Shorthand: Scientific Notation

Name _____

Date _____



Collecting and Organizing Data

Program the constant operation feature on your calculator to multiply by 10. Record the results in the table below for each time you press **[Op]**.

Number of Times Used as a Factor	Display
0	(starting factor)
1	
2	
3	
4	

Number Shorthand: Scientific Notation

Name _____

Date _____



Analyzing Data and Drawing Conclusions

1. What patterns do you see?

2. What does it mean when the right-hand display changes?
(For example, 1×10^{15} .)

3. Try the activity again with another multiple of 10 and compare your results.

Related Procedures

Grades 2 - 6

Overview

Students will use the two constant operations ($\boxed{Op1}$ and $\boxed{Op2}$) to compare the results of different mathematical procedures and determine how they are related.


Math Concepts

- whole numbers
- addition, subtraction, multiplication, division
- fractions (Grades 5-6)
- decimals (Grades 5-6)

Materials

- TI-15
- pencil
- student activity (page 23)

Introduction

1. Have students program $\boxed{Op1}$ with +2 and $\boxed{Op2}$ with -2.
 2. Have students enter **8** on their calculators, press $\boxed{Op1}$, and read the output (**1 10**, which means adding 2 once to 8 gives 10).
 3. Have students press $\boxed{Op2}$ to apply the second constant operation to the output of the first constant operation, and then read the output (**1 8**, which means subtracting 2 once from 10 gives 8).
 4. Have students continue this process with various numbers as their first input. Discuss their results. (Pressing $\boxed{Op1}$ and then $\boxed{Op2}$ always gets you back to the first input number, which means $\boxed{Op1}$ and $\boxed{Op2}$ are inverse procedures.)
 5. Challenge students to find more pairs of procedures for $\boxed{Op1}$ and $\boxed{Op2}$ that will follow the same pattern and record their investigations using the *Related Procedures* student activity page.
-  To use $\boxed{Op1}$ and $\boxed{Op2}$:
1. Press $\boxed{Op1}$ (or $\boxed{Op2}$).
 2. Enter the operation and the number (for example, $\boxed{+}$ 2).
 3. Press $\boxed{Op1}$ (or $\boxed{Op2}$).
 4. Enter the number to which you want to apply the constant operation.
 5. Press $\boxed{Op1}$ (or $\boxed{Op2}$).
The display will have a **1** on the left and the result on the right. If you press $\boxed{Op1}$ (or $\boxed{Op2}$) again, the calculator will apply the constant operation to the previous output and display a **2** at the left, indicating the constant operation has been applied twice to the original input.

Related Procedures (Continued)

Collecting and Organizing Data

As students use $\boxed{\text{Op1}}$ and $\boxed{\text{Op2}}$, have them record their results in the appropriate tables on the Student Activity page. For example, if a student is exploring the relationship between $\times 2$ and $\div 2$, the tables might look something like this:

Table for $\boxed{\text{Op1}}$

Input	Procedure	Output
1	$\times 2$	2
2	$\times 2$	4
3	$\times 2$	6

Table for $\boxed{\text{Op2}}$

Input	Procedure	Output
2	$\div 2$	1
4	$\div 2$	2
6	$\div 2$	3


Analyzing Data and Drawing Conclusions

Ask students:

- *What patterns do you see in your data?*
- *Are the procedures inverses of each other? How do you know?*

If the output number for $\boxed{\text{Op1}}$ is used as the input number for $\boxed{\text{Op2}}$ and gives an output number equal to the original input number for $\boxed{\text{Op1}}$, then the procedures may be inverses of each other, as in $\times 2$ and $\div 2$.

- *Does the pattern work with special numbers like 1 and 0? With fractions and decimals? With positive and negative integers?*
- *What happens if you use $\boxed{\text{Op2}}$ first, and then $\boxed{\text{Op1}}$?*

 To recognize the equivalent procedures, students may need to use the $\boxed{\text{F}\leftrightarrow\text{D}}$ key to change outputs from decimal to fraction form or vice versa.

Related Procedures (Continued)

Continuing the Investigation

Older students can investigate equivalent procedures, such as dividing by a number and multiplying by its reciprocal. For example, if a student is exploring the relationship between $\times \frac{1}{2}$ and $\div 2$, the tables might look something like this:

Table for **Op1**

Input	Procedure	Output
1	$\times \frac{1}{2}$	$\frac{1}{2}$
2	$\times \frac{1}{2}$	1
3	$\times \frac{1}{2}$	$1.5 = 1\frac{1}{2}$

Table for **Op2**

Input	Procedure	Output
1	$\div 2$	$0.5 = \frac{5}{10} = \frac{1}{2}$
2	$\div 2$	1
3	$\div 2$	$1.5 = 1\frac{5}{10} = 1\frac{1}{2}$

Related Procedures

Name _____

Date _____



Collecting and Organizing Data

1. Choose a procedure for $\boxed{\text{Op1}}$ (for example, $\times \frac{1}{2}$).
2. Choose a procedure for $\boxed{\text{Op2}}$ (for example, $\div 2$).
3. Select an input number to apply the procedure to and record both the input and output numbers in the appropriate table.
4. Use the tables below to record and compare your results using $\boxed{\text{Op1}}$ and $\boxed{\text{Op2}}$.

Table for $\boxed{\text{Op1}}$

Input	Procedure	Output

Table for $\boxed{\text{Op2}}$

Input	Procedure	Output

Analyzing Data and Drawing Conclusions

5. How do the two procedures compare?

6. What patterns do you see?

7. Are the two procedures related? Explain.

In the Range

Grades 3 - 6

Overview

Students will interpret the rounding involved in measuring to identify the possible range of a given measurement.

Math Concepts

- rounding whole numbers
- rounding decimals
- measurement with metric units (length, mass, capacity)

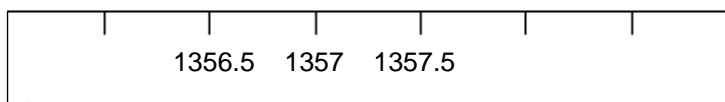
Materials

- TI-15
- pencil
- meter sticks or metric measuring tapes
- student activity (p.27)

Introduction

1. Have students measure the length of a table or desk in the room and record the measurement to the nearest millimeter, for example, 1357 mm.

Discuss how measurements in millimeters can be recorded as 1357 mm or as thousandths of meters, 1.357 m. Note that the measurement was rounded to 1357 mm because it fell somewhere between $\frac{1}{2}$ of a millimeter less than 1357 mm (1356.5 mm) and $\frac{1}{2}$ of a millimeter more than 1357 mm (1357.5 mm).





2. Have students then use rounding to record the same measurement to the nearest centimeter (136 cm or 1.36 m).
3. Enter the original measurement on the calculator as 1.357 and fix the display at two decimal places.
4. Have students fix the display at one decimal place. Ask:
What does this number represent? (The measurement rounded to the nearest tenth of a meter, or the measurement rounded to 14 decimeters.)

- To fix the display at 2 decimal places, press **Fix** **0.01** **Enter**.
- Have students discuss how the display of **1.36** matches their rounding of the measurement to 136 cm.

In the Range (Continued)

5. Have students fix the display to no decimal places. press **Fix** and then **1** to display 1. Ask: *What does this number represent?* (The measurement rounded to the nearest meter.)
6. Introduce the *In the Range* game by secretly entering a number on the calculator with three decimal places to represent a measurement in millimeters; for example, 2.531. Then display the number rounded to the nearest whole number (3). Show this display to students.
7. Tell students that this number represents the measurement of a length of board to the nearest meter. Ask students:
What could its measurement be if it had been measured to the nearest decimeter?
(2.5 m to 3.5 m)
8. Round the original number to the nearest tenth (2.5). Ask students:
Does this lie within the range we identified?
9. Repeat for measuring to the nearest centimeter (hundredths) and millimeter (thousandths). (The range for centimeters would be 2.45 to 2.55, with 2.53 lying within that range; and the range for millimeters would be 2.525 to 2.535, with 2.531 lying within that range.)
10. Have students work in pairs to play the game and record their observations on their student activity pages.

 To round to the nearest whole number, press **Fix** **1** **Enter**.

 To round to the nearest tenth, press **Fix** **0.1** **Enter**.

In the Range (Continued)

Collecting and Organizing Data

As students are playing the game, focus their attention on the patterns that are developing by asking questions such as:

- *When you record a measurement, why is rounding always involved?*
- *When you read a measurement, what interval should that measurement always indicate to you? ($\frac{1}{2}$ a unit less or $\frac{1}{2}$ a unit more)*
- *How would this interval look on a number line (or meter stick)?*
- *How is $\frac{1}{2}$ represented in the metric system?*
- *How are you deciding how to represent the range of possible measurements? What patterns are you using?*

Analyzing Data and Drawing Conclusions

To guide students in the analysis of their data, ask questions such as:

- *What range is indicated by every measurement?*
- *What patterns did you use in identifying the range of possible measurements?*
- *How would you use these patterns to round 256.0295 to the nearest tenth?*

Continuing the Investigation

Have students replace the units of length with units of mass (grams, centigrams) or capacity (liters, milliliters) to notice the same patterns.

Have students discuss why this decimal place-value approach with the calculator does not work for measurements in yards, feet, and inches. Have them identify what range a measurement would lie in if it was measured to the nearest yard, nearest foot, and nearest inch. (For example, 2 yards would lie between 1 yard and 18 inches and 2 yards and 18 inches.)

In the Range

Name _____

Date _____



Collecting and Organizing Data

Have your partner secretly enter a measurement with three decimal places into the calculator, and then fix the number to be rounded to the nearest whole number. Now look at the display and answer the following questions:

1. What is the measurement to the nearest meter? _____

a. What could be the range of the measurement if it had been measured to the nearest tenth of a meter (decimeters)?

b. Set **Fix** to the nearest tenth (**0.1**).

What is the measurement to the nearest tenth? _____

Is that within the range you identified? _____

2. What is the measurement to the nearest tenth of a meter? _____

a. What could be the range of the measurement if it had been measured to the nearest hundredth of a meter (centimeters)?

b. Set **Fix** to the nearest hundredth (**0.01**).

What is the measurement to the nearest hundredth? _____

Is that within the range you identified? _____

3. What is the measurement to the nearest hundredth of a meter? _____

a. What could be the range of the measurement if it had been measured to the nearest thousandth of a meter (millimeters)?

b. Set **Fix** to the nearest thousandth (**0.001**).

What is the measurement to the nearest thousandth? _____

Is that within the range you identified? _____

In the Range

Name _____

Date _____



Analyzing Data and Drawing Conclusions

Identify three measurements to the nearest millimeter that would be:

a. 10 m when rounded to the nearest meter. _____

b. 9.0 m when rounded to the nearest tenth of a meter (decimeter).

c. 9.05 m when rounded to the nearest hundredth of a meter (centimeter).

The Value of Place Value

Grades 2 - 6

Overview

Students will build their flexibility in using numbers by exploring the connections between the number symbols and their representations with base-ten materials.

Math Concepts

Grades 2 - 4

- whole number place value (through thousands)
- money

Grades 4 - 6


- decimal place value (through thousandths)
- metric units (meters, decimeters, centimeters)






Materials


- TI-15
- pencil
- *Counting on Frank* by Rod Clement
- base-ten materials
- student activity (pages 32 and 33)




Introduction

1. Read *Counting On Frank* by Rod Clement. Discuss some other kinds of questions that a person could ask about how many objects fit in or on other objects.
2. Give each group of students a large pile of units (over 300) from the base-ten materials, and tell them that this is how many jelly beans fit into a jar that you filled. Ask them to count the “jelly beans,” and observe the techniques they use (counting one at a time, making groups of 10, etc.).
3. Tell students you have run out of unit pieces and then ask:
How many rods (groups of 10) would I need to use to make a pile of jelly beans the same size as yours?
4. Have students explore the answer to this problem with their units or apply their knowledge of place value. Then show them how to explore the answer using the calculator.
5. Have students compare their solutions with the base-ten materials to the calculator display. (They can make 31 tens rods from the 314 units, with 4 units left over.)

 To use the Place Value feature for this activity:

1. Press  **Mode**.
2. Press   to select **MAN** (Manual).
3. Press   to set the **Place Value** mode to **11-**. This lets you find out how many ones, tens, hundreds, etc., are in a number. (The mode **- 1 - .** is used to find what digit is in the ones, tens, hundreds, etc., place.)

 To explore answers to this problem on the calculator:

1. Press .
2. Enter the number of units (for example, 314).
3. Press   to see the display. (Using 314, the display is **31.**, meaning there are 31 tens in 314.)

The Value of Place Value (Continued)

Collecting and Organizing Data

Have students use their base-ten materials and the calculator to continue the exploration with other numbers, identifying how many hundreds and thousands (and 0.1s and 0.01s for older students). Encourage exploration with questions such as:

- *How many hundreds are in 120? 2478? 3056?*
- *How many tens are in 120? 2478? 3056?*
- *How many units (ones) are in 120? 2478? 3056?*
- *What numbers can you find that have 12 units? 12 tens? 12 hundreds?*
- *What numbers can you find that have 60 units? 60 tens? 60 hundreds?*

Analyzing Data and Drawing Conclusions

Have students use the table on *The Value of Place Value* Student Activity page to record their findings and identify the patterns they see. To help them focus on the patterns, ask questions such as:

- *How does the number of tens in 1314 compare to the number 1314? How about 567? 2457? 4089, etc.?*



If you cover the digit in the units place, you see how many tens are in a number.

- *How does the number of hundreds in 1314 compare to the number 1314? How about 567? in 2457? in 4089, etc.?*

If you cover the digits to the right of the hundreds place, you see how many hundreds are in a number.

- *How does the display on the calculator compare to what you can do with the base-ten materials?*

If the calculator shows 31_, for 316, I should be able to make 31 tens rods out of the 316 units I have.

 Students can use the **11 - . Place Value** mode to test their conjectures. For example, if they think 1602 has 160 hundreds, they enter **1602**, press  **[00]**, and see **16_**_. They can then use the base-ten materials to see why there are only 16 hundreds in 1602. (If students use the **- 1 - .** mode to find what digit is in the hundreds place, they will see **_6_** displayed to show that 6 is the digit in the hundreds place.)

The Value of Place Value (Continued)

Continuing the Investigation

Connect the place-value patterns to money. For example, ask students:

- *If each one of your “jelly beans” costs a penny, how many pennies would you spend for 1,314 jelly beans?*

1,314 pennies.

- *How many dimes (tens) would you spend?*

131 dimes and 4 more pennies.

- *How many dollars (hundreds)?*

13 dollars, plus 14 more pennies, or 1 dime and 4 pennies.

Older students can record the money (and enter it into the calculator) in decimal form, 13.14. Then they can use the calculator to connect dimes to one tenth (0.1) of a dollar (\$13.14 has 131 dimes or tenths) and pennies to one hundredth (0.01) of a dollar (\$13.14 has 1314 pennies or hundredths).

For older students, connect the place-value patterns to conversions between metric units. For example, a measurement of 324 centimeters can also be recorded as 32.4 decimeters (or rounded to 32 dm) because 1 dm = 10 cm, or it can be recorded as 3.25 meters (or rounded to 3 m), because 1 m = 100 cm.

The Value of Place Value, Part A

Name _____

Date _____



Collecting and Organizing Data

1. Use your base-ten materials and your calculator to explore how many tens, hundreds, and thousands are in a number. Record your observations in the table. What patterns do you see?

Number	Number of Thousands	Number of Hundreds	Number of Tens

Analyzing Data and Drawing Conclusions: Patterns

2. Write 5 numbers that have 15 tens.

3. Write 5 numbers that have 32 hundreds.

4. Write 5 numbers that have 120 tens.

The Value of Place Value, Part B

Name _____

Date _____



Collecting and Organizing Data

1. Use your base-ten materials and your calculator to explore how many tenths, hundredths, and thousandths are in a number. Record your observations in the table. What patterns do you see?

Number	Number of Tenths	Number of Hundredths	Number of Thousandths

Analyzing Data and Drawing Conclusions: Patterns

2. Write 5 numbers that have 15 tenths.

3. Write 5 numbers that have 32 hundredths.

4. Write 5 numbers that have 120 tenths.

What's the Problem?

Grades 2 - 5

Overview

Students will connect number sentences to problem situations and use addition, subtraction, multiplication, and division to solve the problems.

Math Concepts





- addition, subtraction
- multiplication, division (Grades 3 - 5)
- number sentences (equations)
- inequalities (Grades 3 - 5)


Materials

- TI-15
- counters
- pencil
- student activity (page 37)

Introduction

1. On a sentence strip or on the overhead, display a number sentence such as " $8 + 2 = ?$ " Have students brainstorm situations and related questions that this number sentence could be representing. For example, "If I bought eight postcards on my vacation and I had two postcards already at home, how many postcards do I have now?"
2. If necessary, have students act out the situation with counters and determine that the value of "?" is 10.
3. Demonstrate how to display this equation on the calculator, and how to tell the calculator what the value of ? is.
4. Now display an equation such as $? - 10 = 5$. Have students brainstorm situations and related questions that this number sentence could be representing. For example, "I had some money in my pocket, and I spent 10 cents of it. I only have 5 cents left. How much money did I have in my pocket to begin with?" Have students practice the keystrokes necessary to display this equation and test the value they determine for "?".
5. Over a period of time, continue to introduce students to different types of number sentences to explore. For example, $? - 8 < 5$ (which has 13 whole number solutions) and $? \times ? = 24$ (which has 8 solutions of whole number factor pairs) and $? \times 4 = 2$ (which has no whole number solution).

 To display this equation on the calculator, put the calculator in Problem Solving mode by pressing the  key. Then enter the equation $8 + 2 = ?$ and press . The calculator display (1 SOL) tells how many whole number solutions there are to the equation. To test your solution to the equation, enter the value of **10** and press . The calculator will display **YES**.

 If an incorrect value is tested for ?, the calculator will display **NO** and provide a hint. For example, if a student tests 5 for the equation $? - 10 = 5$, the calculator displays **NO**, then shows $5 - 10 < 5$, and then returns to the original equation.

What's the Problem? (Continued)

Collecting and Organizing Data

As an ongoing activity, have students work in pairs and use the *What's The Problem?* Student Activity sheet to create problem-solving cards. Have one partner create an addition, subtraction, multiplication, or division number sentence, using the “?” and record it in the top box and on the calculator. If possible, the other partner creates a situation and question to go with the number sentence and records it in the bottom box. The two boxes can be glued or taped to opposite sides of an index card.

Have students work together with the calculator to explore how many whole number solutions the equation has and test what the solutions are. Provide ideas for exploration by asking questions such as:

- *What actions could be happening in your story to go with addition (subtraction, multiplication, or division)?*
- *How could you use these counters to act out this number sentence?*
- *What could this number in the number sentence represent in your story?*
- *What could the question mark in the number sentence represent in your story?*
- *Can you make a story for a number sentence that begins with a question mark?*

Analyzing Data and Drawing Conclusions

To focus students' thinking on the relationships between their stories and the numbers and operations in their number sentences, ask questions such as:

- *How would using a different number here change your story?*
- *How would using a greater than or less than symbol instead of an equal sign in the number sentence change your story?*
- *How would using a different operation in your number sentence change your story?*

What's the Problem? (Continued)

Continuing the Investigation

- Have partners create stories and trade them. Each partner can then write a number sentence to go with the other partner's story.
- Have students sort the number sentences they have made into categories: e.g., those with 0 whole number solutions, those with one whole number solution, those with two whole number solutions, those with infinite whole number solutions.
- Have students try to find an equation or inequality with exactly 0 whole number solutions, exactly 1 whole number solution, exactly 2 whole number solutions, more than 5 whole number solutions, etc.

What's the Problem?

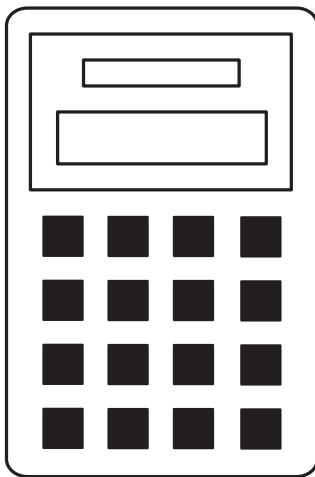
Name _____

Date _____



Write a number sentence using an operation and the “?”

Write a story that describes a situation and asks a question that can be represented by the number sentence.



How to Use the TI-15

Display, Scrolling, Order of Operations, Parentheses	39
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Display, Scrolling, Order of Operations, and Parentheses

Keys

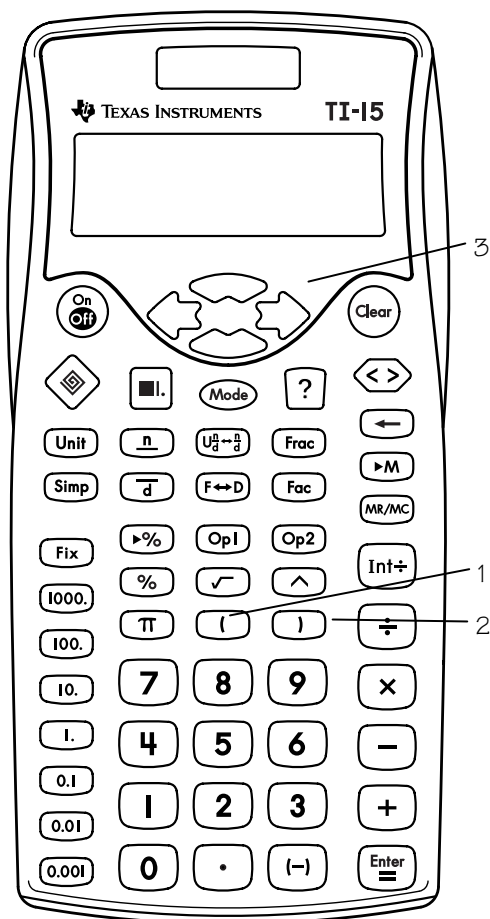
1. $($ opens a parenthetical expression. You can have as many as 8 parentheses at one time.
2. $)$ closes a parenthetical expression.
3. \leftarrow and \rightarrow move the cursor left and right.
 \uparrow and \downarrow move the cursor up and down through previous entries and results.

Notes

- The examples on the transparency masters assume all default settings.
- The EOS™ transparency master demonstrates the order in which the TI-15 completes calculations.
- When using parentheses, if you press Enter before pressing $)$, **Syn Error** is displayed.
- Operations inside parentheses are performed first. Use $($ or $)$ to change the order of operations and, therefore, change the result.

Example: $1 + 2 \times 3 = 7$
 $(1 + 2) \times 3 = 9$

- The first and second lines display entries up to 11 characters plus a decimal point, a negative sign, and a 2-digit positive or negative exponent. Entries begin on the left and scroll to the right. An entry will always wrap at the operator.
- Results are displayed right-justified. If a whole problem will not fit on the first line, the result will display on the second line.



Equation Operating System

EOS

<u>Priority</u>	<u>Functions</u>
1 (first)	$()$
2	Frac
3	\wedge $\sqrt{\quad}$
4	$(-)$
5	\times \div
6	$+$ $-$
7	$U_{\frac{n}{d}} \leftrightarrow \frac{n}{d}$ $F \leftrightarrow D$
8 (last)	Enter

Because operations inside parentheses are performed first, you can use $()$ to change the order of operations and, therefore, change the result.

Order of Operations

$$1 + 2 \times 3 =$$

Press

1 $\boxed{+}$ 2 $\boxed{\times}$ 3
 $\boxed{\text{Enter}}$

Display

1+2×3= 7

$$(1 + 2) \times 3 =$$

Press

$\boxed{(}$ 1 $\boxed{+}$ 2 $\boxed{)}$
 $\boxed{\times}$ 3 $\boxed{\text{Enter}}$

Display

(1+2)×3= 9

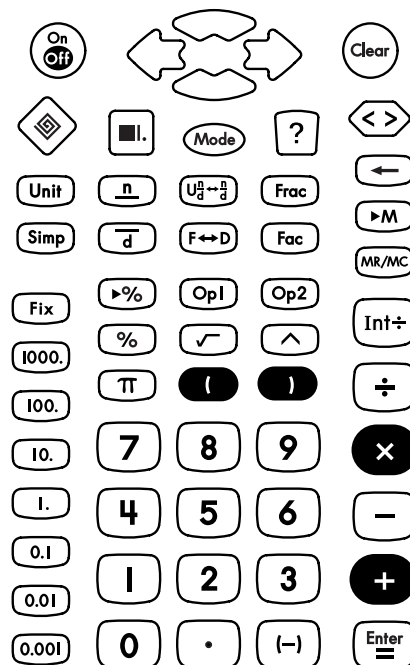
Add



Multiply






Parentheses






Clearing and Correcting

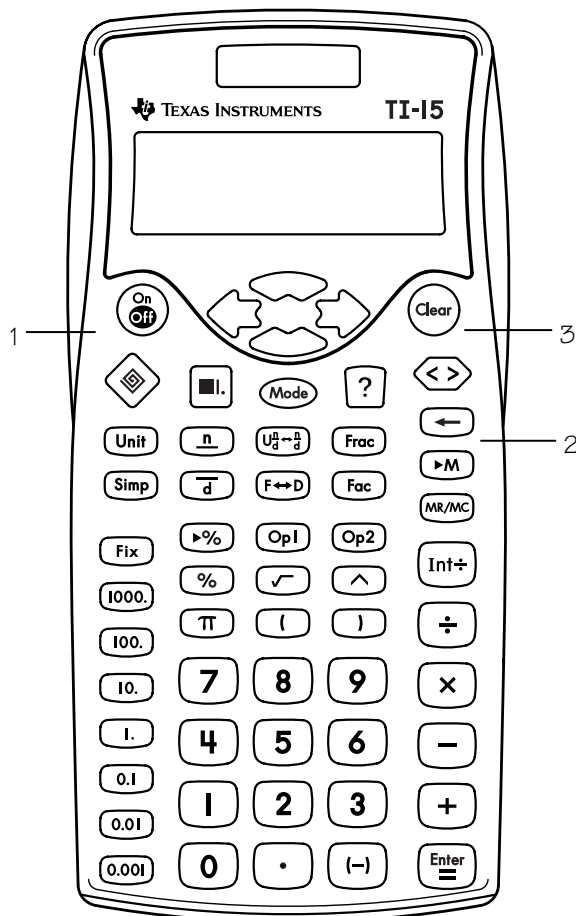
2

Keys

1.  turns the calculator on and off.
2.  clears the last digit you entered, allowing you to correct an entry without re-entering the entire number.
3.  clears the last entry, all pending operations, and any error conditions. You can then enter a new number and continue your calculation.

Notes

- The examples on the transparency masters assume all default settings.
- Pressing  and  simultaneously resets the calculator. Resetting the calculator:
 - Returns settings to their defaults.
 - Clears memory and constants.
- Pressing  does not affect the mode settings, memory, or constants.



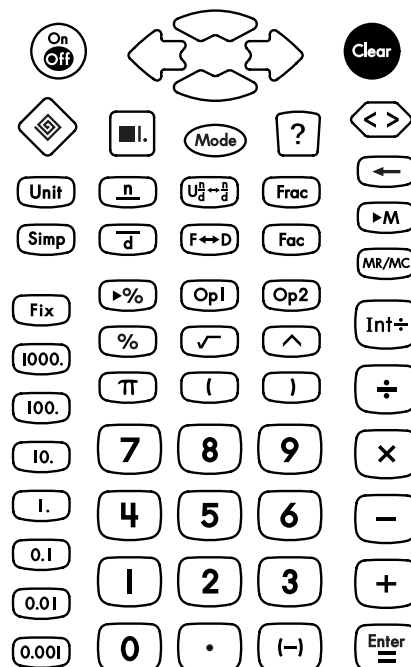
Clearing entries

1. Enter $335 + 10$.
2. Clear the entry and pending operation.
3. Enter $335 - 9$.
4. Complete the calculation.

Press	Display
335 $\boxed{+}$ 10	
$\textcircled{\text{Clear}}$ (clear the entry)	
335 $\boxed{-}$ 9	
$\boxed{\text{Enter}}$	

Note: $\textcircled{\text{Clear}}$ clears the screen, but not the history.

Clear









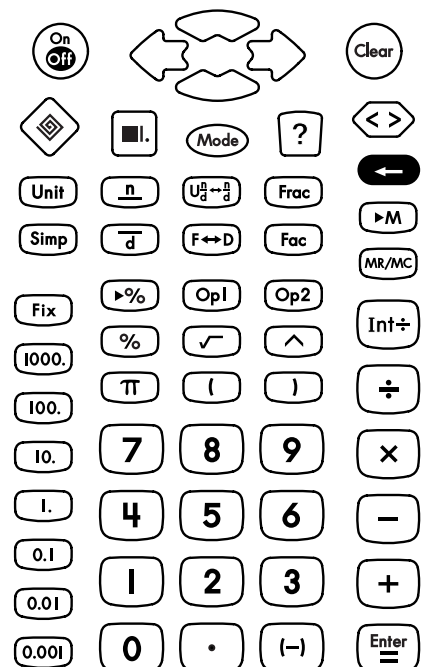
Correcting entry errors using

1. Enter $1569 + 3$.
2. Change the 9 to an 8.
3. Add 3.
4. Complete the calculation.

Backspace



Press	Display
1569  3	1569+3
   8	1568
 3	1568+3
	1568+3= 1571



Keys

See the tables on the next two pages for details about each mode setting option.

1. **Mode** displays the Calculator Mode menu, from which you can select the following options:

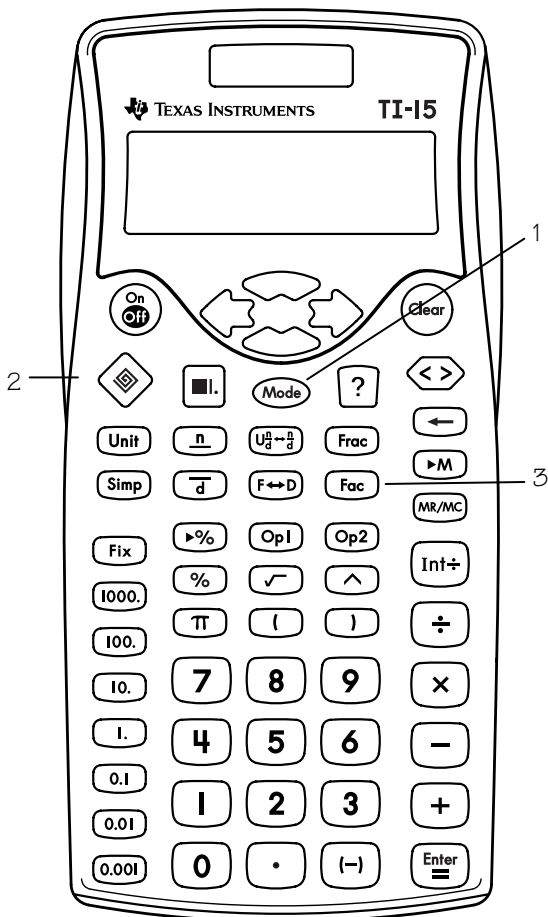
Setting	Options
Division (\div)	. n/d
Constants (Op)	+1 ?
Clear	Op 1 Op 2
RESET	N Y

2. **Mode** displays the Problem Solving Mode menu, from which you can select the following options:

Setting	Options
Mode	Auto Man
Level of difficulty	1 2 3
Operation	+ - x \div ?
Display option	11- 1-

3. **Frac** displays the Fractions menu, from which you can select the following options:

Setting	Options
Display	U n/d n/d
Simplify	Man Auto



Notes

- The examples on the transparency masters assume all default settings.
- You must be in Problem Solving (**Mode**) to see its menu when you press **Mode**. Otherwise, you will see the Calculator Mode menu.
- Press **Mode** to display the Calculator Mode menu, **Mode** to display the Problem Solving Mode menu, or **Frac** to display the Fractions Mode menu. Press **Enter** after you make your selection, then press **Mode** or **Frac** again to exit the menu.

Mode Menus (Continued)

3

Calculator Mode Menu

Setting	Option	Explanation	Example
Division (\div)	•	Displays division results as a decimal	.75
	n/d	Displays division results as a fraction	$\frac{3}{4}$
Constant Operations (OP)	+1	Shows the constant operation on the display	1x5 5
	?	Hides the constant operation	1 5
Clear	OP1	When selected, clears Op1	
	OP2	When selected, clears Op2	
Reset	N	No; does not reset the calculator.	
	Y	Yes; resets the calculator.	

Problem Solving Mode Menu

Setting	SubMenu	Option	Example
Auto	Level of difficulty	1 2 3	
	Operation	+ - x ÷ ? (add, subtract, multiply, divide, find the operation)	
Manual	Display option (for Problem Solving Place Value only)	11- . (Displays the number of ones, tens, hundreds, or thousands)	1234 For [100] : 12_ _
		1- . (Displays the digit that is in the ones, tens, hundreds, or thousands place)	1234 For [100] : _ 2 _ _

Fractions Menu

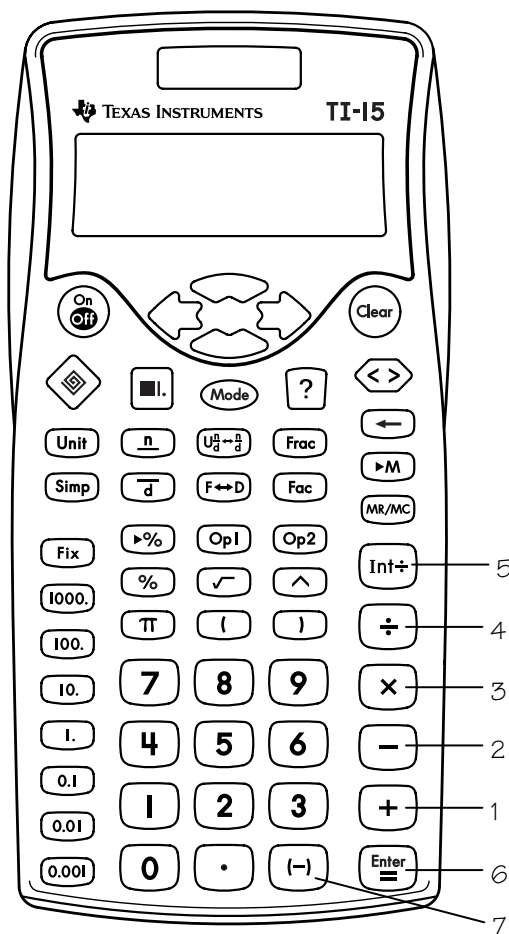
Setting	Option	Explanation	Example
Display	U n/d	Displays results as mixed numbers	$1\frac{3}{4}$
	n/d	Displays results as improper fractions	$\frac{7}{4}$
Simplify	Man	Allows manual simplification	$\frac{6}{8} = \frac{3}{4}$
	Auto	Automatically simplifies to most reduced form of fraction	$\frac{3}{4}$

Keys

1. $\boxed{+}$ adds.
2. $\boxed{-}$ subtracts.
3. $\boxed{\times}$ multiplies.
4. $\boxed{\div}$ divides. The result may be displayed as a decimal or fraction depending on the mode setting you have selected.
5. $\boxed{\text{Int}\div}$ divides a whole number by a whole number and displays the result as a quotient and remainder.
6. $\boxed{\text{Enter}}$ completes the operation.
7. $\boxed{(-)}$ lets you enter a negative number.

Notes

- The examples on the transparency masters assume all default settings.
- The result of Integer Divide $\boxed{\text{Int}\div}$ always appears as quotient and remainder ($_ \text{r} _$).
- The maximum number of digits for quotient or remainder (**r**) is 5. Quotient, remainder, and the **r** character cannot total more than 10 characters.
- If you use the result of integer division in another calculation, only the quotient is used. The remainder is dropped.
- All numbers used with $\boxed{\text{Int}\div}$ must be positive whole numbers.
- If you attempt to divide by 0, an error message is displayed.
- $\boxed{+}$, $\boxed{-}$, $\boxed{\times}$, $\boxed{\div}$, $\boxed{\text{Enter}}$, and $\boxed{\text{Int}\div}$ work with the built-in constants.



Basic operations

$$2 + 54 - 6 =$$

Press

2 $\boxed{+}$ 54 $\boxed{-}$
6 $\boxed{\text{Enter}}$

Display

2 + 54 - 6 = 50

$$3 \times 4 \div 2 =$$

Press

3 $\boxed{\times}$ 4 $\boxed{\div}$ 2
 $\boxed{\text{Enter}}$

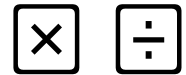
Display

3 x 4 ÷ 2 = 6

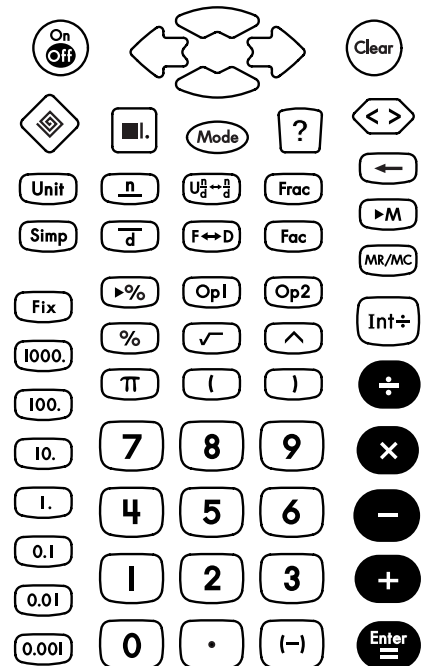
Add, Subtract



Multiply, Divide



Equals



Entering negative numbers

The temperature in Utah was -3°C at 6:00 a.m. By 10:00 a.m., the temperature had risen 12°C . What was the temperature at 10:00 a.m.?

Negative

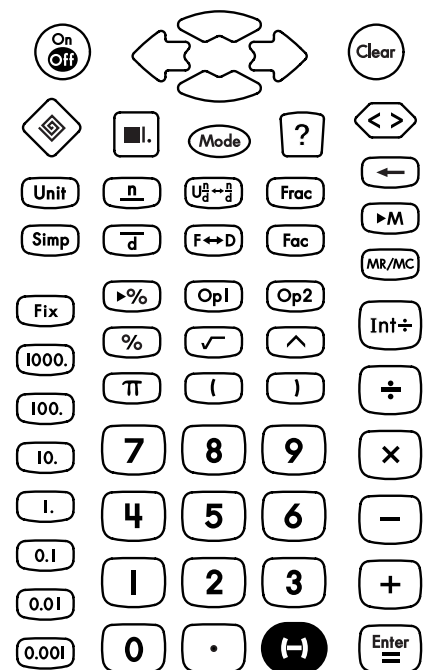


Press

Display

(-) 3 **+** 12
Enter

-3 + 12 = 9



Division with decimal result

Set the division display option to decimal and divide 27 by 6.

Press

Display

Mode **Enter**

· n/d

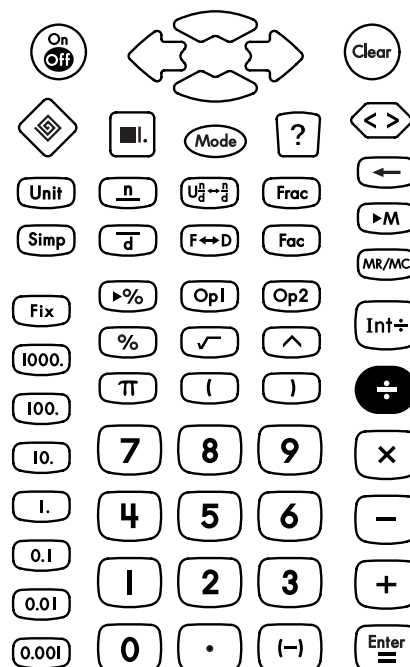
Mode

4

27 \div 6 **Enter**

27 \div 6= 4.5

Divide



Division with fractional result

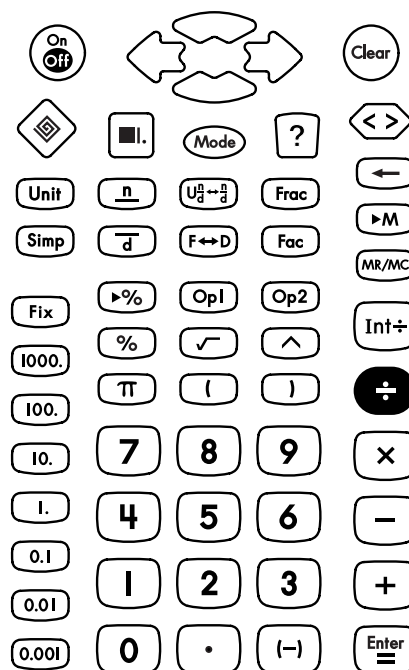
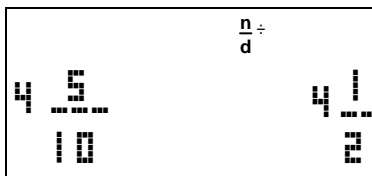
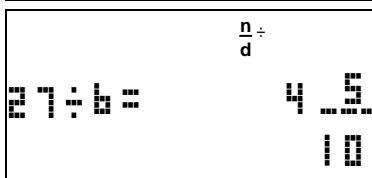
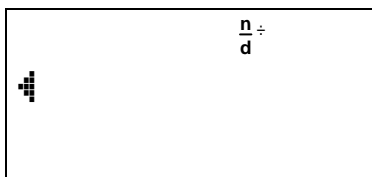
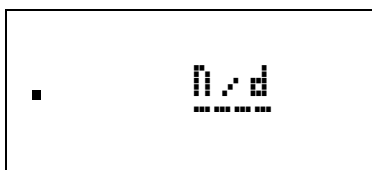
Set the division display option to fraction and divide 27 by 6.

Divide



Press

Display



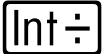

Calculating equivalent units of time

Sara ran 2 kilometers in 450 seconds. Convert her time to minutes and seconds.

450 seconds = ? minutes
 ? seconds

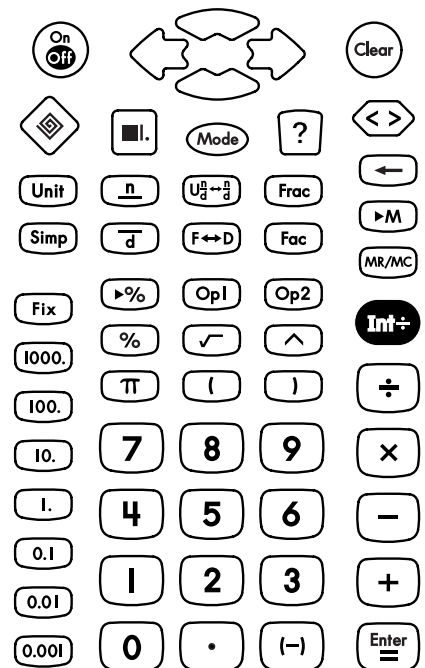
Press

Display

450  60


450 ÷ 60 = 7.30

Integer Divide



Constant Operations

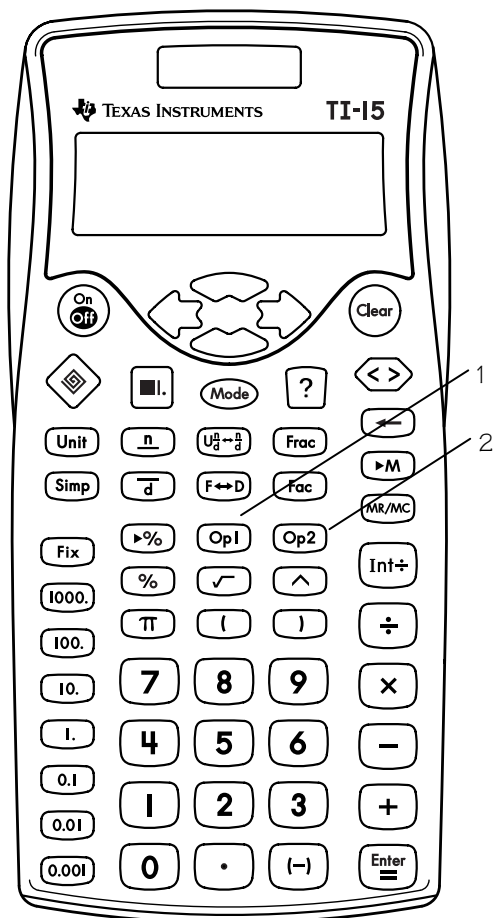
5

Keys

1. **[Op1]** lets you define or execute operation 1.
2. **[Op2]** lets you define or execute constant operation 2.

Notes

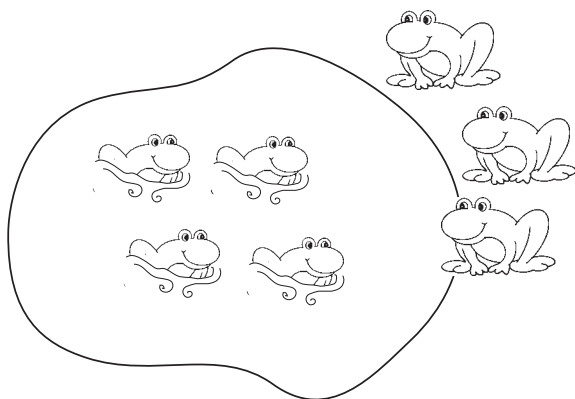
- The examples on the transparency masters assume all default settings.
- The constant memory is set in conjunction with **[Op1]** and **[Op2]** when you perform a calculation that uses **[+]**, **[-]**, **[x]**, **[÷]**, **[Int÷]**, and **[^]**.



- The constant function works with whole numbers, decimals, and fractions.
- When you use **[Op1]** or **[Op2]**, a counter appears at the left and the total appears on the second line at the right of the display. The counter shows how many times the constant has been repeated. If the number at the right exceeds 6 digits, the counter will not be shown. The counter returns to 0 after it reaches 99.
- When you use **[Int÷]** with the constant function, subsequent calculations are performed with the quotient portion of the result. The remainder is dropped.
- You can clear a stored constant by resetting the calculator (pressing **[On/Off]** and **[Clear]** simultaneously) or by pressing **[Mode]**, pressing \leftarrow to scroll to the CLEAR menu, selecting OP1 (or OP2) and pressing **[Enter]**. Pressing **[On/Off]** by itself does not clear the constant function.

Addition as “counting on”

There are 4 frogs in a pond. If 3 more frogs jump into the pond 1 at a time, how many frogs will be in the pond?



Constant Operations

Op1

Add

+

Press

Display

Op1 **+** 1 **Op1**

(stores operation)

Op1
+ |

4

(initialize using 4)

Op1
4

Op1

(add 1 one at a time)

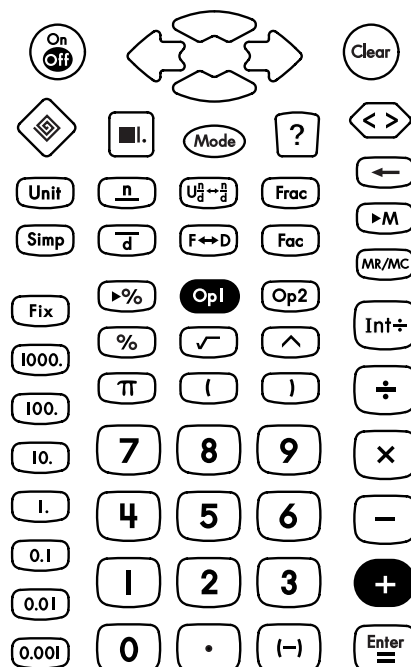
Op1
4 + |
| 5

Op1

Op1
5 + |
2 6

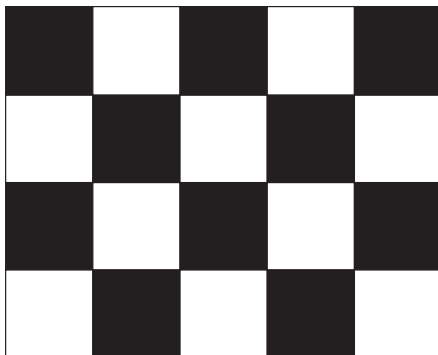
Op1

Op1
6 + |
3 7



Multiplication as “repeated addition”

Maria put new tile in her kitchen. She made 4 rows with 5 tiles in each row. Use repeated addition to find how many tiles she used. Before you begin, set the calculator to hide the constant operation.



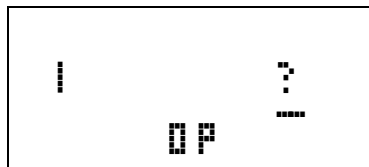
Constant Operations

Op1

Press

Display

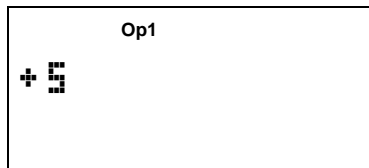
Mode
(hide constant operation)



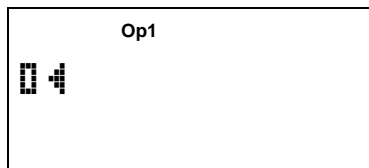
Mode



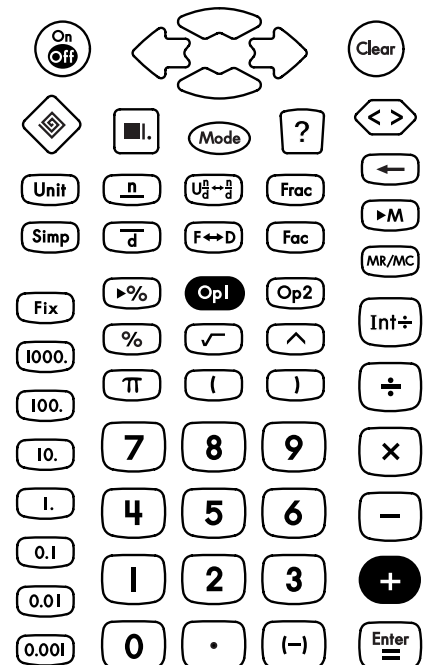
Op1 **+** 5 **Op1**
(store the operation)



0
(initialize using 0)



Continued



Multiplication as “repeated addition”

Continued

Press

Display

Op1

Op1
1 5

Op1

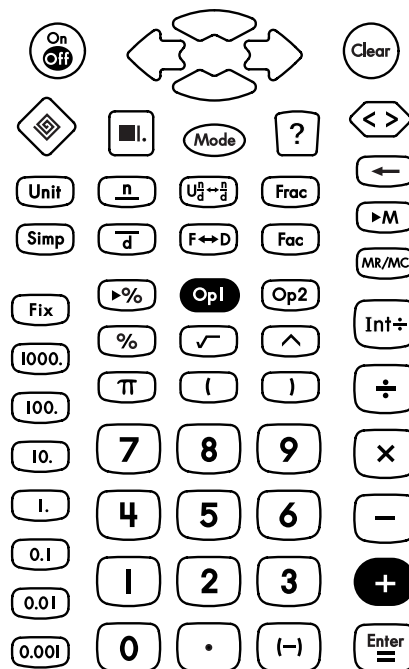
Op1
2 10

Op1

Op1
3 15

Op1

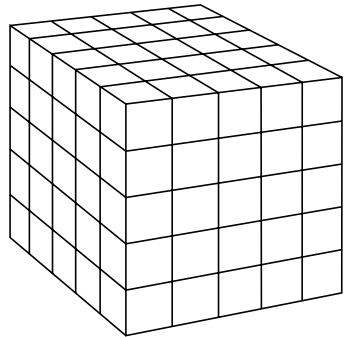
Op1
4 20



Powers as “repeated multiplication”

Use this formula and repeated multiplication to find the volume of a cube with a base of 5 meters.

$$V = l \times w \times h = 5 \times 5 \times 5 = 5^3$$



Constant Operations

Op1

Multiply

×

Press

Display

Op1 **×** 5 **Op1**

(store the operation)

Op1
× 5

1

(initialize using 1)

Op1
1 4

Op1

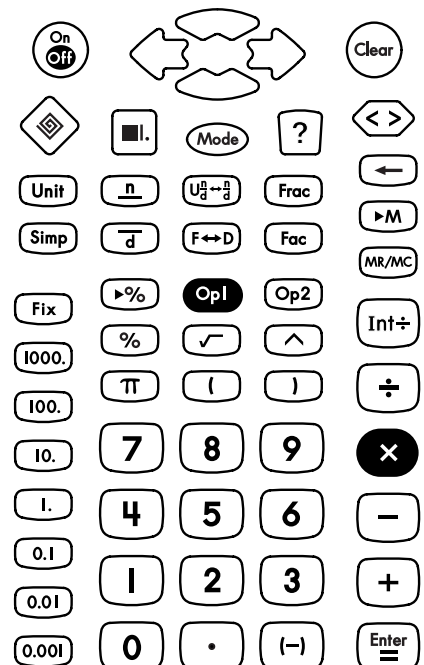
Op1
1 × 5
5

Op1

Op1
5 × 5
25

Op1

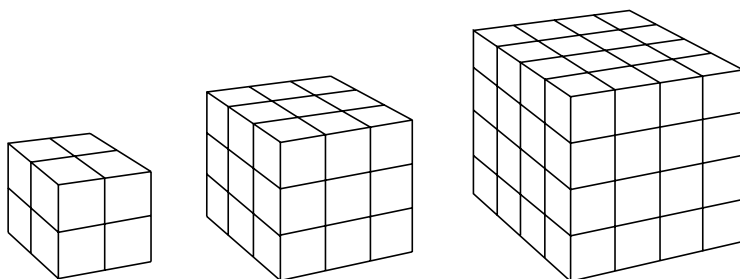
Op1
25 × 5
125



Using \square^{\wedge} as a constant

Use this formula to find the volume of each cube.

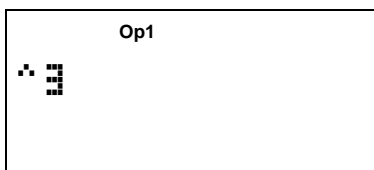
$$V = \text{base}^3$$



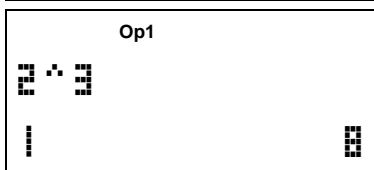
Press

Display

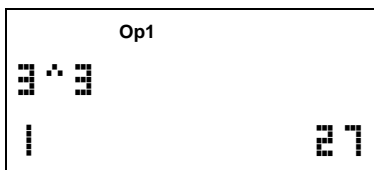
\square^{\wedge} 3 \square^{\wedge}



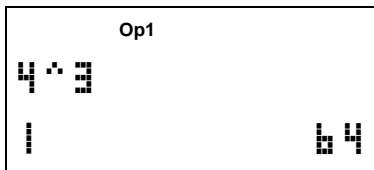
2 \square^{\wedge}



3 \square^{\wedge}



4 \square^{\wedge}

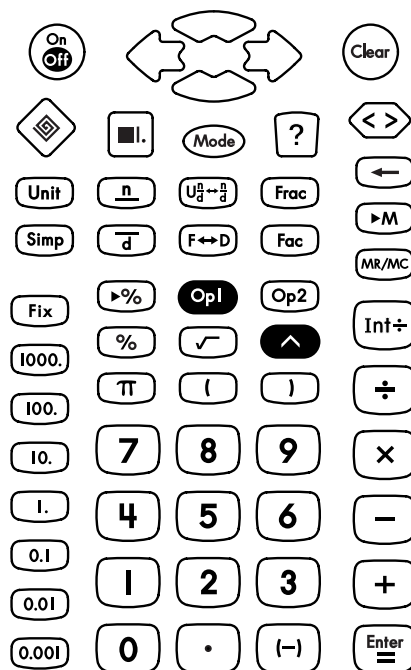


Constant Operations

\square^{\wedge}

Powers

\square^{\wedge}



Using OP 1 and OP 2 together

Ming received 5 stickers for each household job she completed. She gave her brother 2 stickers for helping with each job. If they completed 3 jobs, how many stickers does she have?

Constant Operations

Op1

Op2

Press

Display

Op1 + 5 Op1

Op1
+ 5

Op2 - 2

Op1 Op2
- 2

Op2

0

Op1 Op2
0 4

Op1

Op1 Op2
0 + 5
5

Op2

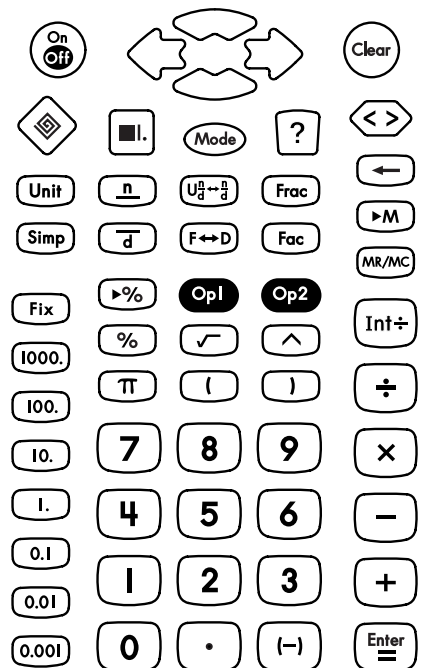
Op1 Op2
5 - 2
3

Op1 Op2

Op1 Op2
0 - 2
b

Op1 Op2

Op1 Op2
1 1 - 2
4



Clearing constant operations

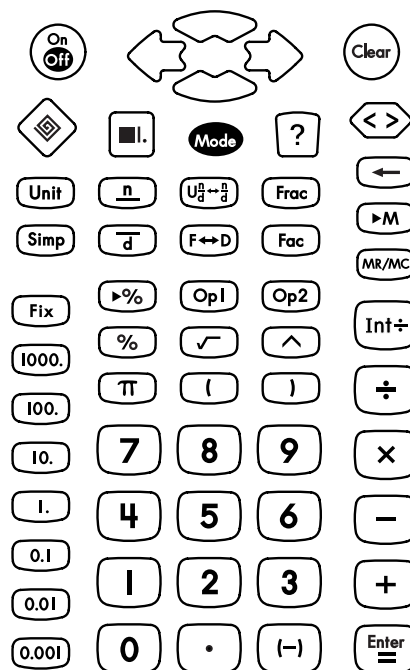
Before entering a new operation in OP1 or OP2, you must clear the current values.

Mode Menu

Mode

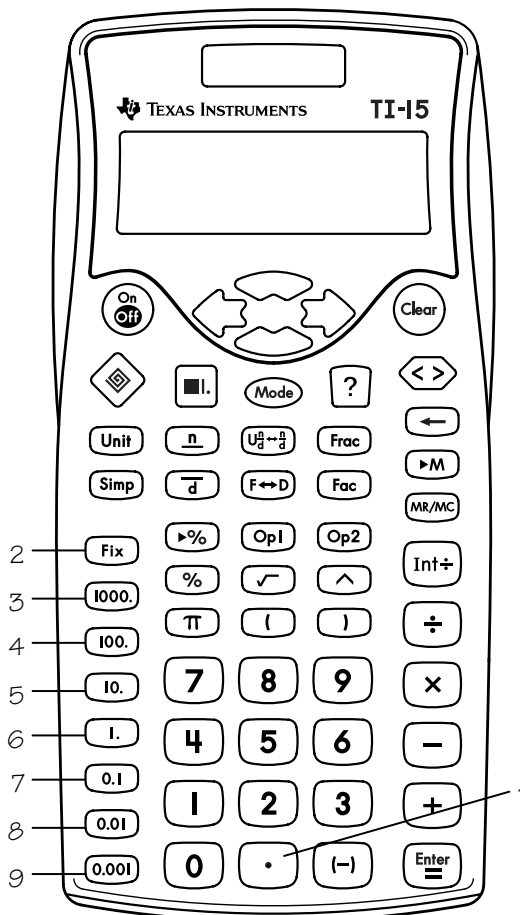
Press	Display
Mode	
Enter (clears OP1)	
Enter (clears OP2)	
Mode (exits Mode menu)	

Note: Pressing **Clear** does not clear constant operations.



Keys

1. \square enters a decimal point.
2. $\boxed{\text{Fix}}$ sets the number of decimal places in conjunction with the Place Value keys (3 through 9 on the illustration below). Only the displayed result is rounded; the internally stored value is not rounded. The calculated value is padded with trailing zeros if needed.
3. $\boxed{\text{Fix}} \boxed{1000.}$ rounds results to the nearest thousand.
4. $\boxed{\text{Fix}} \boxed{100.}$ rounds results to the nearest hundred.
5. $\boxed{\text{Fix}} \boxed{10.}$ rounds results to the nearest ten.
6. $\boxed{\text{Fix}} \boxed{1.}$ rounds results to the nearest one.
7. $\boxed{\text{Fix}} \boxed{0.1}$ rounds results to the nearest tenth.
8. $\boxed{\text{Fix}} \boxed{0.01}$ rounds results to the nearest hundredth.
9. $\boxed{\text{Fix}} \boxed{0.001}$ rounds results to the nearest thousandth.



$\boxed{\text{Fix}} \square$ removes the fixed-decimal setting.

You must press $\boxed{\text{Fix}}$ before a Place Value key each time you want to change the number of places for rounding.

Notes

- The examples on the transparency masters assume all default settings.
- The calculator automatically rounds the result to the number of decimal places selected. (Only the displayed value is rounded. The internally stored value is not rounded.)

Notes (Continued)

- All results are displayed to the fixed setting until you either clear the setting by pressing **Fix** **□** or reset the calculator.
- You can set 0 through 3 decimal places.
- If students are puzzled when they round .555 to the nearest whole number, for example, and the result is 1, you may need to remind them of the rules of rounding.
- You can use **□** to enter decimal numbers regardless of the fixed decimal setting.
- You must press **Enter** before **FIX** takes effect.
- You can apply the **FIX** setting to an individual value or to the result of an operation.

Setting the number of decimal places

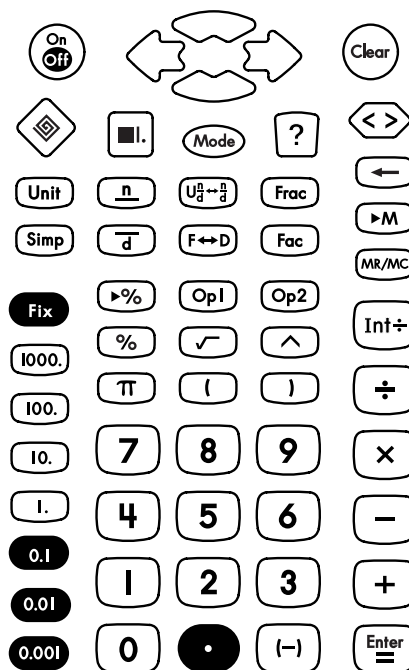
Round 12.345 to the hundredth's place, the tenth's place, the thousandth's place, and then cancel the Fix setting.

Press	Display
12 345 	12.345= 12.345
	Fix 12.345= 12.35
	Fix 12.345= 12.3
	Fix 12.345= 12.345

To cancel Fix:

	12.345= 12.345
--	-------------------

Fix decimal



Addition with money

José bought ice cream for \$3.50, cookies for \$2.75, and a large soda for \$.99. How much did he spend?

Press

Display

Fix **0.01** **Enter**

Fix

3 **.** 50 **+**

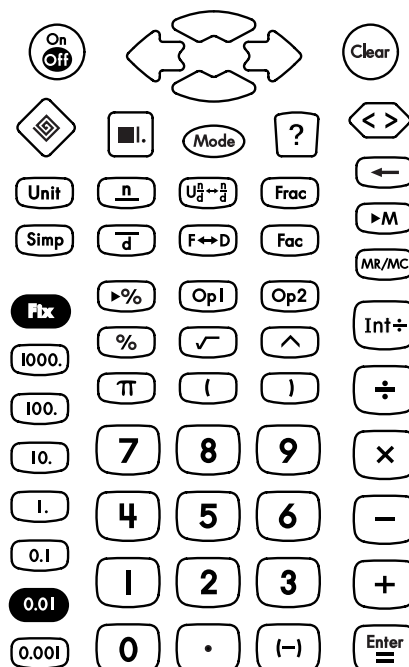
2 **.** 75 **+**

. 99 **Enter**

Fix
3.50+2.75
+.99= 7.24

Fix decimal

Fix



Converting decimals to fractions

Convert the decimal .5 to a fraction, and then view the decimal again after the conversion.

Fix decimal

Fix

Press

Display

\square . 5 \square Enter

.5 = 0.5

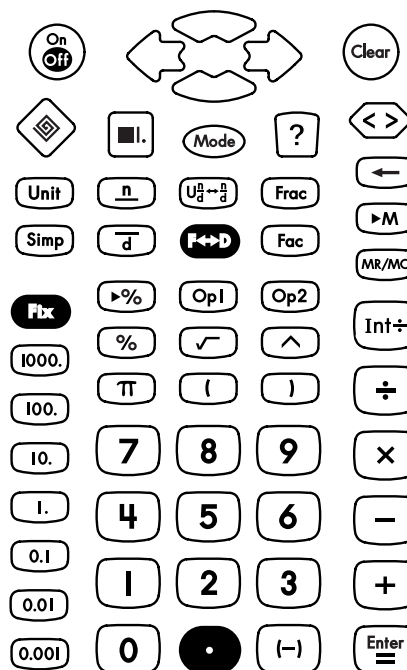
\square \leftrightarrow

.5 = $\frac{N}{D} \rightarrow \frac{n}{d}$
5
10

\square \leftrightarrow

(Return to decimal)

0.5



Keys

1. $\blacktriangleright M$ functions as shown below:

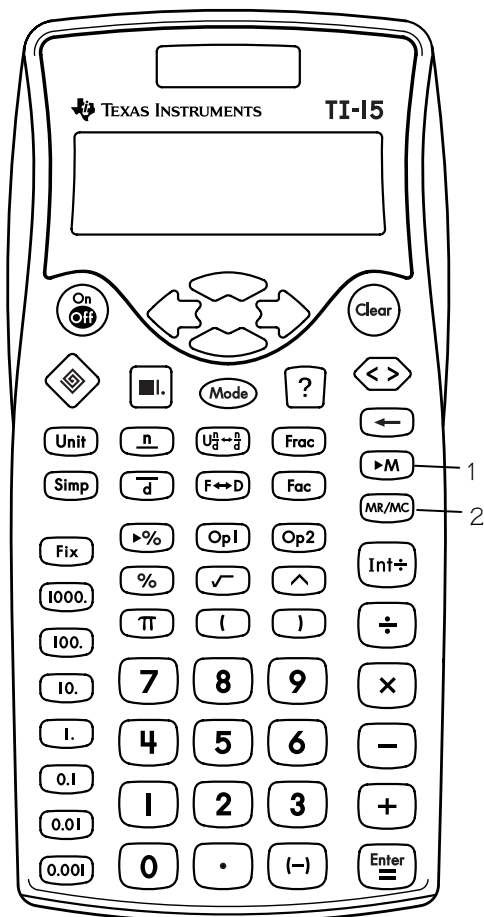
- $\blacktriangleright M$ Enter Stores displayed value over value in memory.
- $\blacktriangleright M$ $+$ Adds displayed value to memory.
- $\blacktriangleright M$ $-$ Subtracts displayed value from value in memory.
- $\blacktriangleright M$ \times Multiplies displayed value by value in memory.
- $\blacktriangleright M$ \div Divides value in memory by the displayed value.

$\blacktriangleright M$ $\text{Int}\div$ Performs integer division on value in memory using the displayed value. Only the quotient is stored and displayed.

2. MR/MC recalls the contents of memory to the display. When pressed twice, it clears the memory.

Notes

- The examples on the transparency masters assume all default settings.
- Results are stored to memory and not displayed. The display remains the same.
- You can store integers, fractions, and decimals in memory.
- **M** is displayed anytime a value other than 0 is in memory.
- To clear the memory, press MR/MC twice.



Using memory to add products

Hamburgers	2	\$1.19	=
Milk shakes	3	\$1.25	=
Coupon for each milk shake	3	\$.20	=
Total cost			=

Press

Display

2 \times 1 . 19
Enter

2 × 1.19 = 2.38

\blacktriangleright M Enter

M
2 × 1.19 = 2.38

3 \times 1 . 25
Enter

M
3 × 1.25 = 3.75

\blacktriangleright M +

(Add milk shakes
to memory.)

M
3 × 1.25 = 3.75

3 \times . 20
Enter

M
3 × .20 = 0.6

\blacktriangleright M -

(Deduct coupon
from memory.)

M
3 × .20 = 0.6

MR/MC

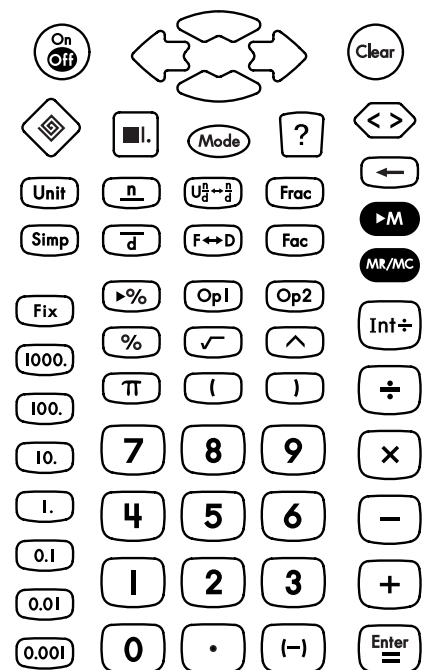
(Recall the total
cost.)

M
5.53

Store to Memory



Memory Recall



Using memory to find averages

Dai has test scores of 96 and 85.
He has weekly scores of 87 and 98.
Find the average for each group of
scores and the average of his
averages together.

Press	Display
96 $+$ 85 $\underline{\underline{Enter}}$	96+85= 181
\div 2 $\underline{\underline{Enter}}$	181 \div 2= 90.5
$\blacktriangleright M$ $\underline{\underline{Enter}}$	M 181 \div 2= 90.5
87 $+$ 98 $\underline{\underline{Enter}}$	M 87+98= 185
\div 2 $\underline{\underline{Enter}}$	M 185 \div 2= 92.5
$+$ $\boxed{MR/MC}$ $\underline{\underline{Enter}}$	M 92.5+90.5= 183
\div 2 $\underline{\underline{Enter}}$	M 183 \div 2= 91.5

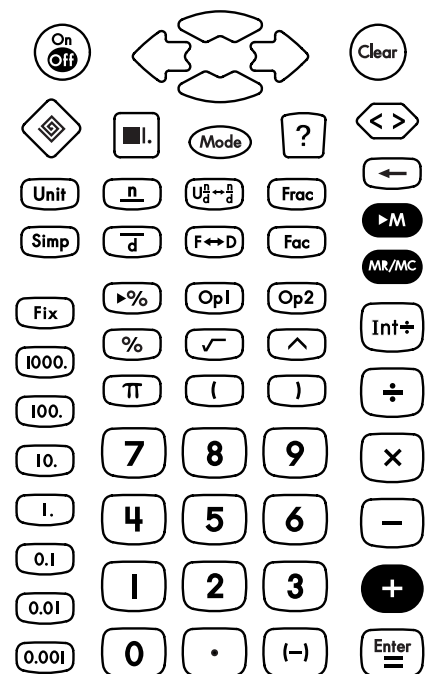
Store to Memory



Add



Memory Recall



Keys

1. **[Frac]** displays a menu of mode settings from which you can select how the fraction results will be displayed. You select 2 items.

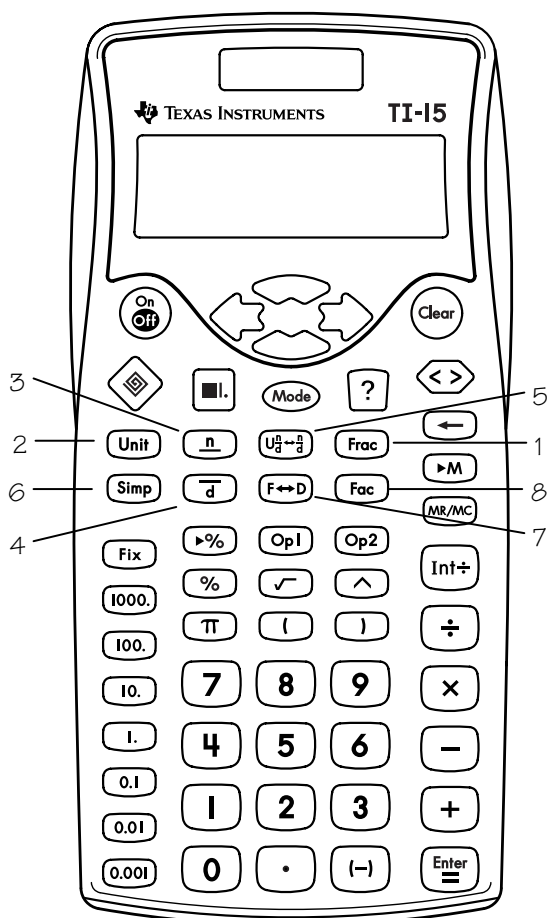
U n/d (default) displays mixed number results.

n/d displays fraction results.

Man (default) displays unsimplified fraction results so you can simplify them manually (step-by-step).

Auto displays fraction results simplified to lowest terms.

2. **[Unit]** lets you enter the whole-number part of a mixed number.
3. **[n]** lets you enter the numerator of a fraction.
4. **[d]** lets you enter the denominator of a fraction.
5. **[U_aⁿ ↔ n/d]** changes a mixed number to a fraction and vice versa.
6. **[Simp]** simplifies a fraction using the lowest common prime factor. If you want to choose the factor (instead of letting the calculator choose it), press **[Simp]**, enter the factor (an integer), and then press **[Enter]**. You must be in Manual mode to use this function.
7. **[F ↔ D]** changes a fraction to its decimal equivalent and vice versa.
8. **[Fac]** displays the factor (divisor) used to simplify the last fraction result. You must be in Manual mode to use this function.



Notes

- The examples on the transparency masters assume all default settings.

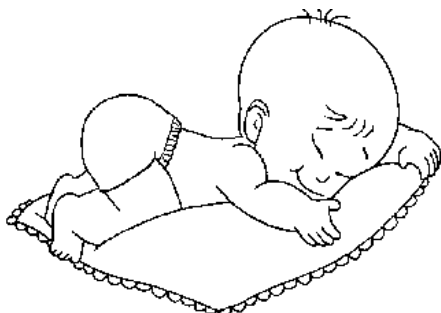
Notes (continued)

- Dividing a fraction by a fraction gives fractional results regardless of the division setting (decimal or fraction).
- The **Frac** mode settings provide 4 possible display options for computational results displayed in fraction form. For example, for $6 \div 4$, the displays would look like this:

manual simp/improper (n/d):	$\frac{6}{4}$
auto simp/improper (n/d):	$\frac{3}{2}$
manual simp/mixed number:	$1\frac{2}{4}$
(U n/d)	
auto simp/mixed number:	$1\frac{1}{2}$
(U n/d)	
- You can enter the denominator or numerator first.
- For operations, you can enter 1 to 1000 for the denominator. For conversions to decimal, you can enter 1 to 100,000,000 for the denominator.
- When you multiply or divide fractions and decimals, the result is displayed as a decimal. A decimal cannot be converted to a fraction if the result would overflow the display.
- Clearing with **←** in fractions occurs from right bottom to left top. If you accidentally press **□** (the denominator key) after entering the numerator, without entering a numeral for the denominator first, using **←** will not correct that error. You will need to clear and begin the entry again.
- If the decimal place is set to 0, the decimal equivalent for a fraction will not be displayed.

Adding mixed numbers

A baby girl weighed $4\frac{3}{8}$ pounds at birth. In the next 6 months, she gains $2\frac{3}{4}$ pounds. How much does she weigh?



Press

Display

4 **Unit** 8 **d**
3 **n** **+**

$$4\frac{3}{8} +$$

2 **Unit** 3 **n**

$$4\frac{3}{8} + 2\frac{3}{4} = 7\frac{1}{8}$$

4 **d** **Enter**

U_dⁿ ↔ ⁿ/_d

$$57\frac{1}{8}$$

Numerator Key



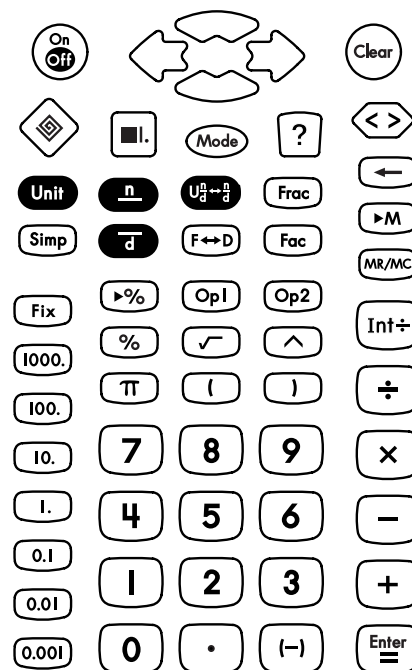
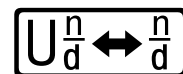
Denominator Key



Unit Key



Mixed to Improper Conversion



Simplifying fractions

Method 1: The calculator chooses a common factor

Simplify $\frac{18}{24}$.

Press

Display

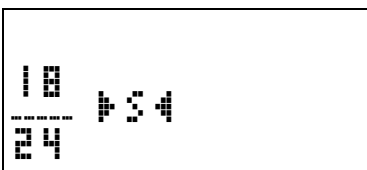
18 $\frac{n}{d}$ 24

(Enter the fraction.)



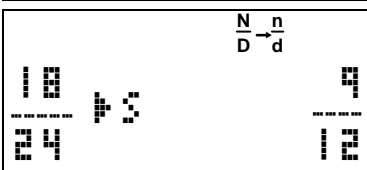
$\frac{Simp}{}$

(Prepare to simplify.)



$\frac{Enter}{}$

(Simplify the fraction.)



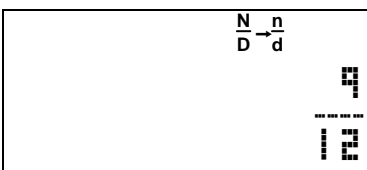
$\frac{Fac}{}$

(Optional: Check factor. You must be in Manual mode.)



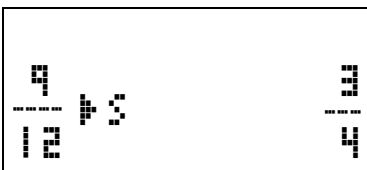
$\frac{Fac}{}$

(Return to the fraction.)



$\frac{Simp}{}$ $\frac{Enter}{}$

(Continue simplifying.)



Numerator Key



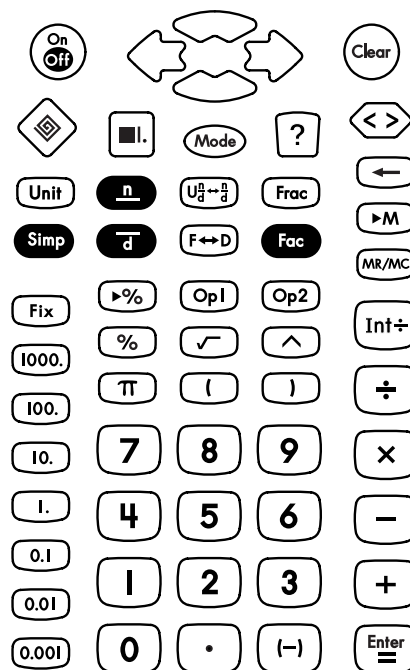
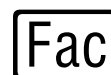
Denominator Key



Simplify



Factorial



Simplifying fractions

Method 2: You choose a common factor

Simplify $\frac{18}{24}$.

Press

Display

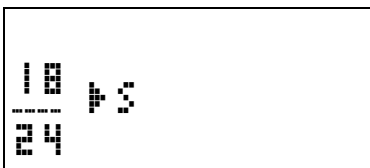
18 $\frac{n}{d}$ 24

(Enter the fraction.)



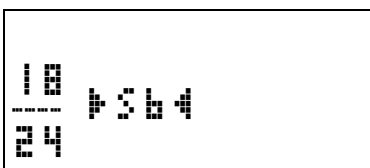
$\frac{Simp}{d}$

(Prepare to simply.)



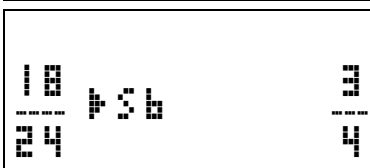
6

(Enter a common factor.)



$\frac{Enter}{=}$

(Simplify the fraction.)



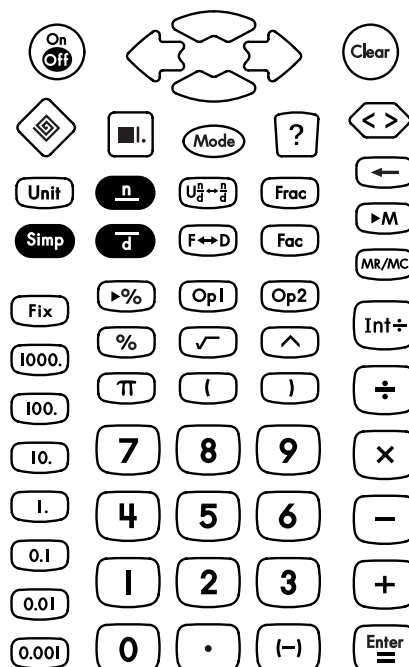
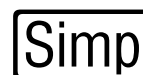
Numerator Key



Denominator Key



Simplify



Converting fractions to decimals

Convert the fraction $\frac{5}{10}$ to a decimal, and then view the original fraction after the conversion.

Press

Display

5 $\frac{n}{d}$ 10 Enter

$$\frac{5}{10} = \frac{5}{10}$$

$F \leftrightarrow D$

$$0.5$$

$F \leftrightarrow D$

(Return to fraction.)

$$\frac{5}{10}$$

$F \leftrightarrow D$

(Return to decimal.)

$$0.5$$

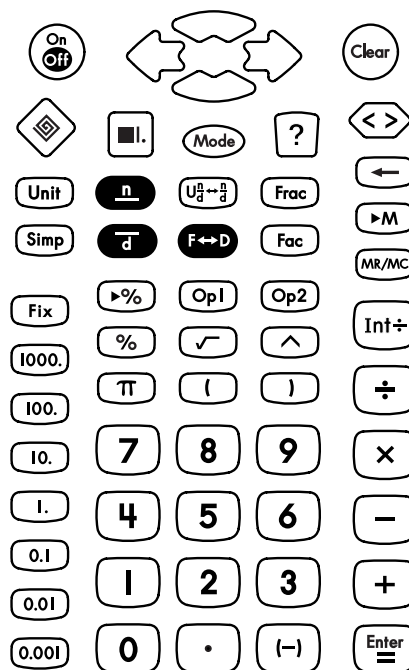
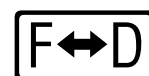
Numerator Key



Denominator Key



Fraction to Decimal



Converting decimals to fractions

Convert the decimal .5 to a fraction, and then view the decimal again after the conversion.

Press	Display
\square 5 \square Enter	.5 = 0.5
\square F \leftrightarrow D	.5 = $\frac{5}{10}$
\square F \leftrightarrow D (Return to decimal.)	0.5

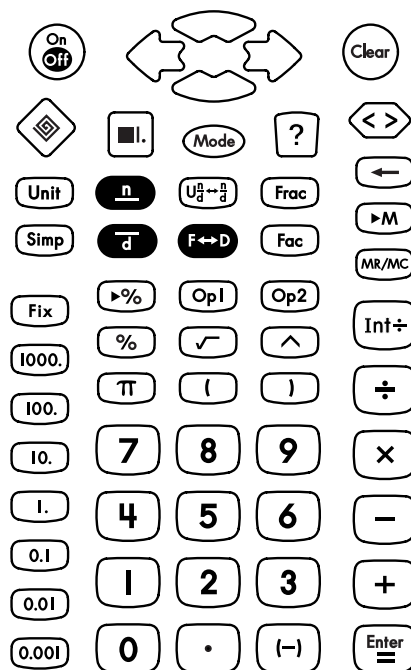
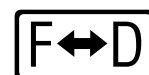
Numerator Key



Denominator Key



Fraction to
Decimal



Converting between fractions and mixed numbers

Convert the improper fraction $\frac{6}{4}$ to a mixed number.

Press	Display
Frac	$\frac{n}{d}$ $\frac{n}{d}$
	MAN AUTO
Frac 6 n 4 Enter	$\frac{6}{4} = 1 \frac{2}{4}$
Simp Enter	$1 \frac{2}{4} \rightarrow 1 \frac{1}{2}$
U$\frac{n}{d}$ ↔ $\frac{n}{d}$	$\frac{3}{2}$

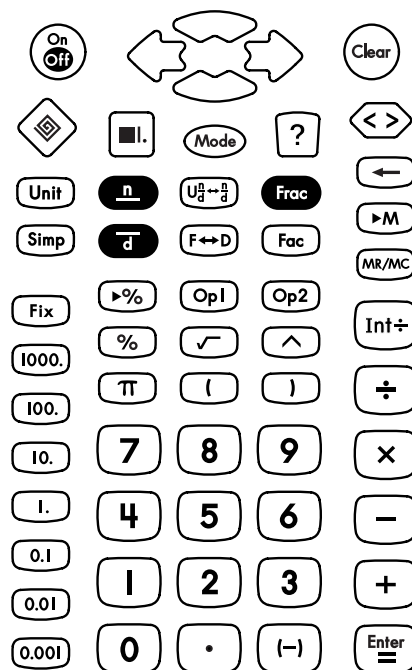
Numerator Key



Denominator Key



Fraction Modes



Comparing fractions and decimals

Linda swims 20 laps in 5.72 minutes. Juan swims 20 laps in $5\frac{3}{4}$ minutes. Who swims faster? Compare the time as decimals and fractions.

To compare the times as decimals:

Press	Display
5 Unit 3 $\frac{n}{d}$ 4 Enter	$5\frac{3}{4} = 5\frac{3}{4}$
F↔D	5.75
F↔D	$5\frac{75}{100}$

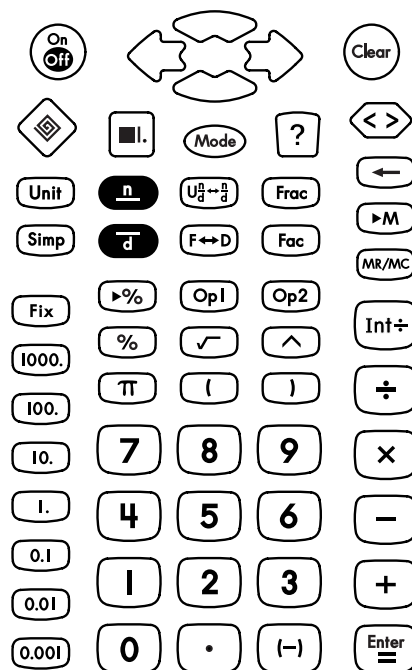
Continue to compare as fractions:

5 . 72 Enter	$5.72 = 5.72$
F↔D	$5\frac{72}{100}$

Numerator Key



Denominator Key

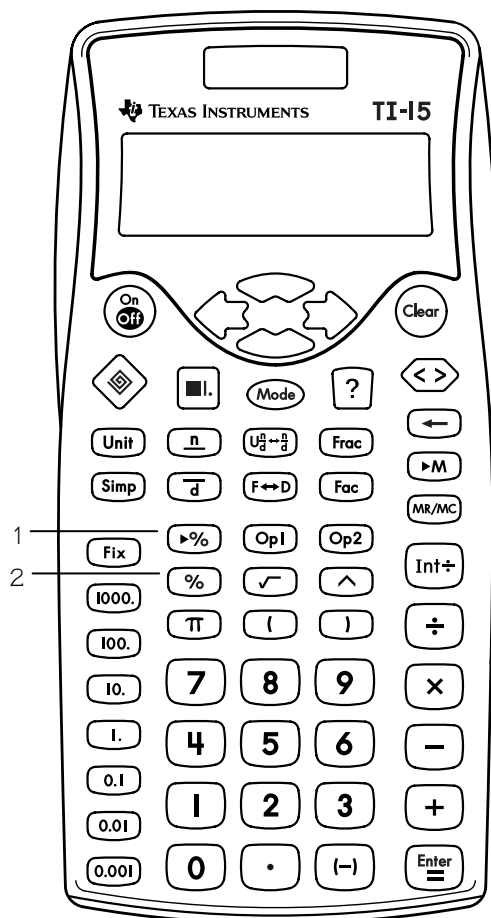


Keys

1. $\blacktriangleright\%$ converts to a percent.
2. $\%$ enters a percent.



Notes

- The examples on the transparency masters assume all default settings.







Converting with percent



Convert 25% to a decimal.

Press	Display
25  	25% = 0.25

Convert $\frac{25}{100}$ to a percent.

Press	Display
25  100   	$\frac{25}{100}$ % = 25%

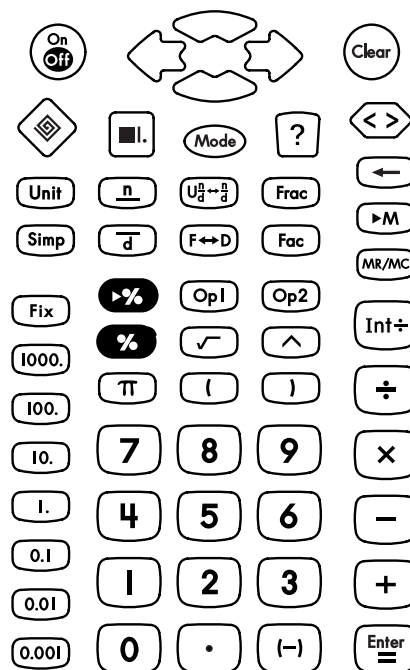
Convert 3 to a percent.

Press	Display
3  	3% = 300%

Percent



Convert to Percent



Converting with fractions, decimals, and percent

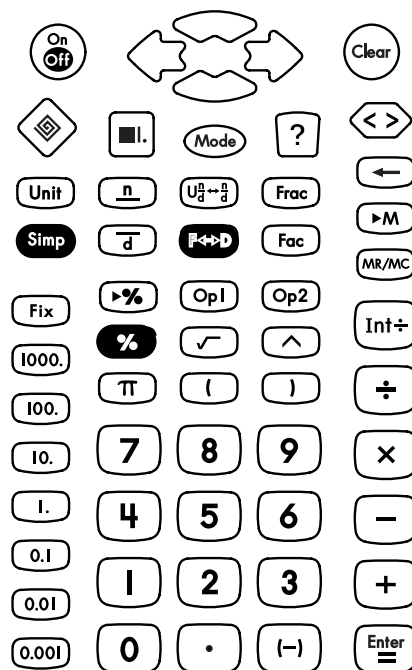
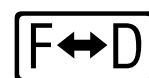
Convert 25% to a fraction, simplify to lowest terms, and then convert the fraction to a decimal.

Press	Display
25 [%] [Enter]	25% = 0.25
[F↔D]	N/D→n/d 25 100
[Simp] [Enter]	N/D→n/d $\frac{25}{100} \rightarrow \frac{5}{20}$
[Simp] [Enter]	N/D→n/d $\frac{5}{20} \rightarrow \frac{1}{4}$
[F↔D]	0.25
[▶%]	0.25% = 25%

Percent



Fraction to
Decimal

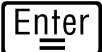


Calculating tips

The Chen family went to a restaurant for dinner. Their bill was \$31.67. How much was the tip if they left 15% of their bill? How much was the total including the tip?

Press

Display

31.67 

31.67= 31.67


 

Fix
31.67= 31.67

 15 



Fix
31.67×15%=
4.75

31.67 

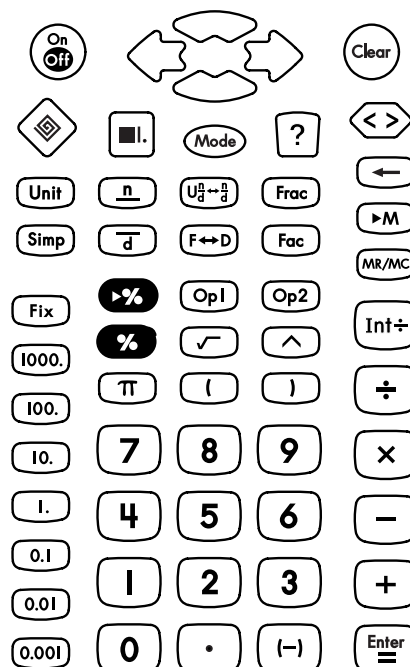
4.75 

31.67+4.75=
36.42

Percent



Convert to
Percent

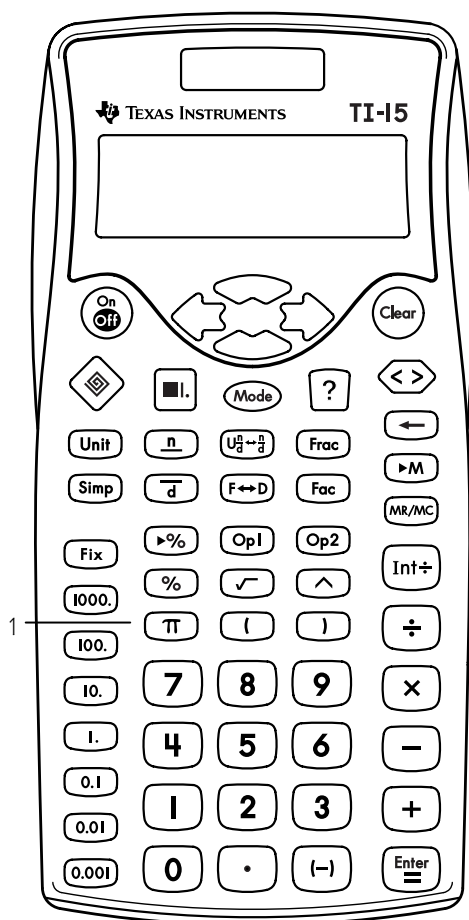


Keys

1. $\boxed{\pi}$ enters π .

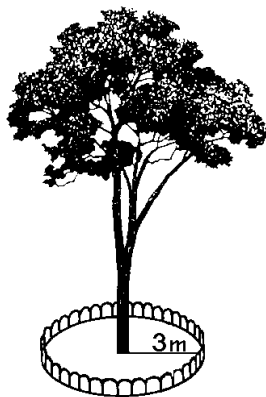
Notes

- The examples on the transparency masters assume all default settings.
- Internally, pi is stored to 13 digits (3.141592653590). Only 9 decimal places are displayed.
- To convert from π to a decimal value, press $\boxed{F \leftrightarrow D}$. Nine decimal places are displayed.



Using pi to find circumference

Use this formula to find the amount of border you need to buy if you want to put a circular border around a tree at a distance of 3 meters from the tree.



$$C = 2\pi r = 2 \times \pi \times 3$$

Pi



Press

Display

2 \times π

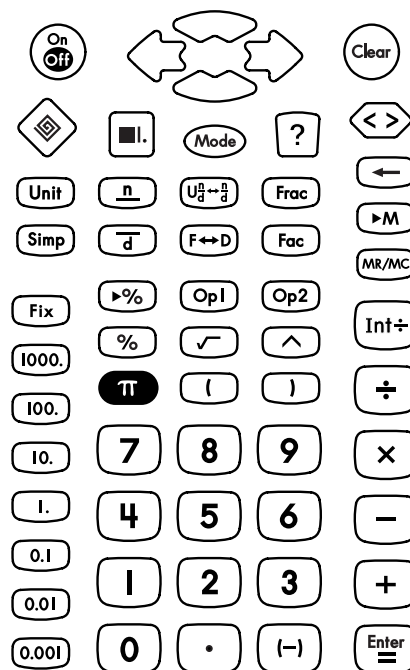
2 × π

\times 3 Enter

2 × π × 3 = 6π

$\text{F} \leftrightarrow \text{D}$

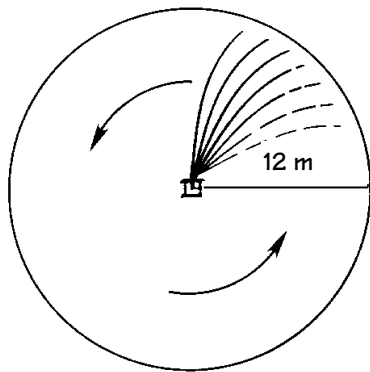
18.84955592



Using pi to find area

Use this formula to find how much of the lawn would be covered by a sprinkler with a radius of 12 meters.

$$A = \pi r^2 = \pi \times 12^2$$



Pi



Press

Display

π \times

$\pi \times$

12 \wedge 2

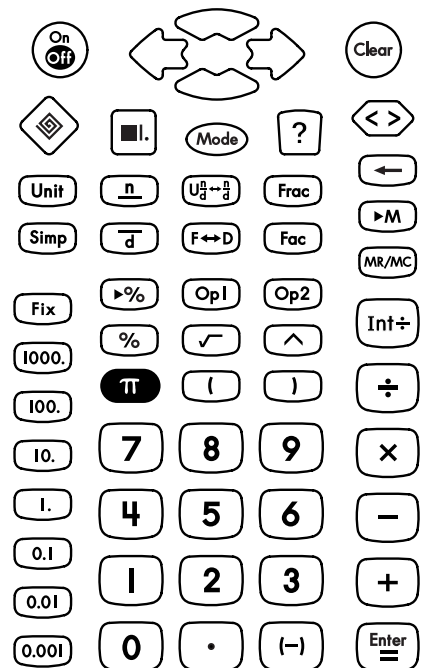
$\pi \times 12^2$

Enter

$\pi \times 12^2 = 144\pi$

F \leftrightarrow D

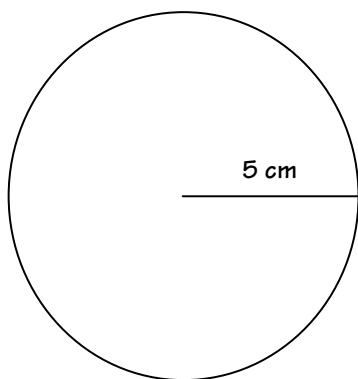
452.3893421



Using pi to find volume

Use this formula to find how much space a ball occupies.

$$V = \frac{4\pi r^3}{3}$$



Pi



Press

Display

4 \times π \times

4 × π ×

5 \wedge 3

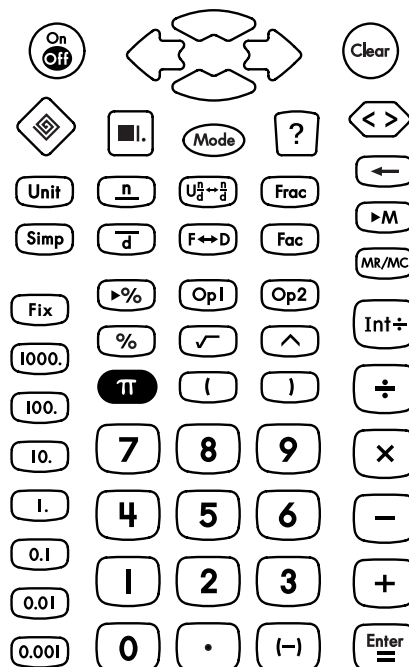
4 × π × 5 ^ 3

\div 3

4 × π × 5 ^ 3 ÷ 3

$\underline{\underline{=}}$

4 × π × 5 ^ 3 ÷ 3 =
523.5987756

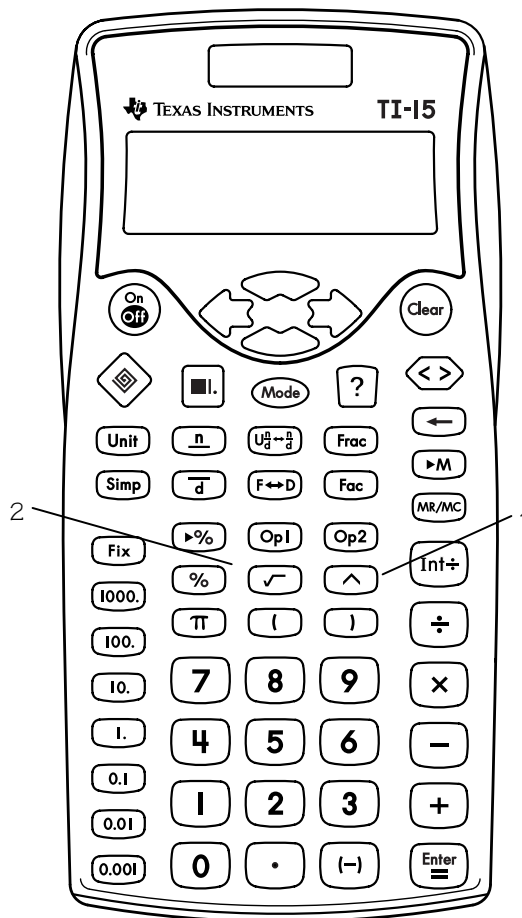


Keys

1. \square^{\square} lets you specify a power for the value entered. When you press Enter , the value is displayed if it is within the range of the calculator.
2. $\sqrt{\square}$ calculates the square root of positive values, including fractions.

Notes

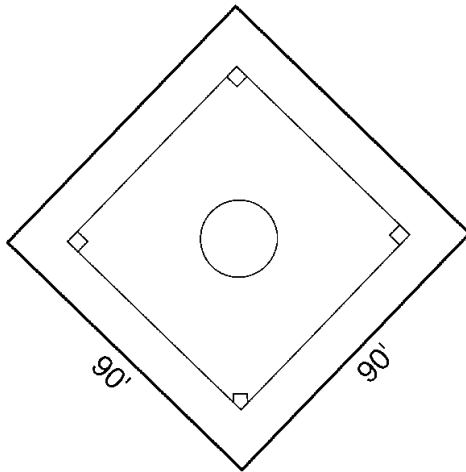
- The examples on the transparency masters assume all default settings.



Finding the area of a square

Use this formula to find the size of the tarpaulin needed to cover the entire baseball infield.

$$A = x^2 = 90^2$$



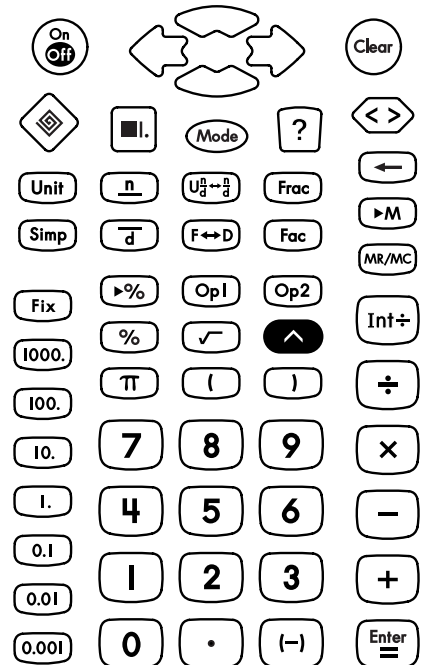
Press

Display

90 \square^{\wedge} 2
 Enter

90[^]2= 8100

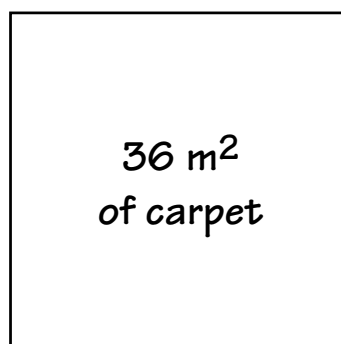
Powers



Finding the square root

Use this formula to find the length of the side of a square clubhouse if 36 square meters of carpet would cover the floor.

$$L = \sqrt{x} = \sqrt{36}$$



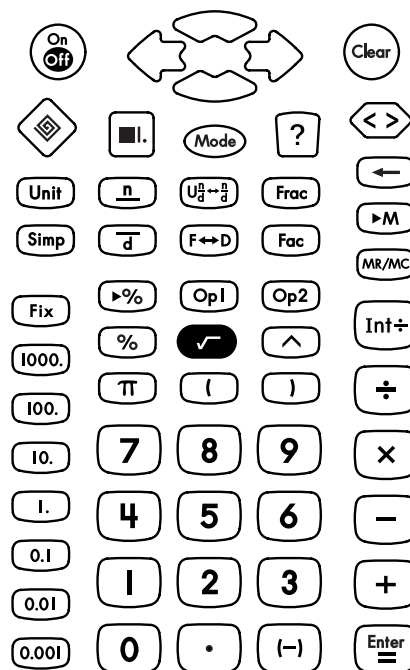
Press

Display

$\sqrt{\quad}$ 36 $)$
 Enter

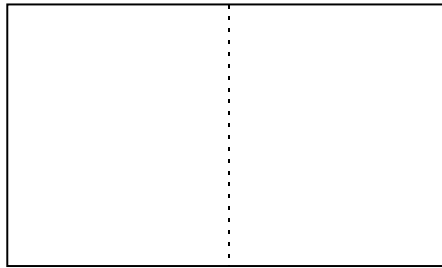
$\sqrt{(36)} = 6$

Square Root



Calculating powers

Fold a piece of paper in half, in half again, and so on until it is not possible to physically fold it in half again. How many sections are there after ten folds?



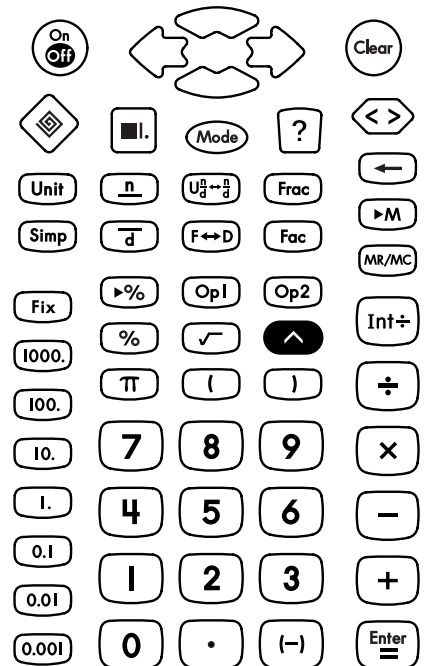
Press

2 \wedge 10 Enter

Display

$2^{10} = 1024$

Powers



Calculating negative powers

Find the standard numerals for the following powers:

$$2^{-3} =$$

$$-2^{-3} =$$

$$.2^{-3} =$$

$$(1/2)^{-3} =$$

Powers



Negative



Press

Display

2 \wedge (-) 3
Enter

$2^{-3} = 0.125$

(-) 2 \wedge
(-) 3 Enter

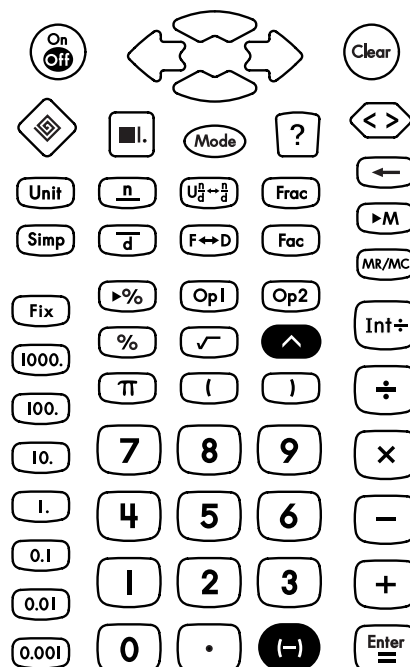
$-2^{-3} = -0.125$

. 2 \wedge (-) 3
Enter

$.2^{-3} = .125$

1 $\frac{\square}{\square}$ 2 \wedge (-)
3 Enter

$\frac{1}{2}^{-3} = 8$



Using powers of 10

$$1.3 \times 10^3 = ?$$

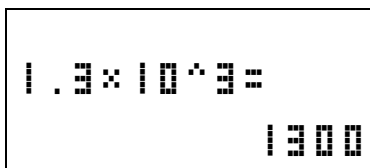
Powers



Press

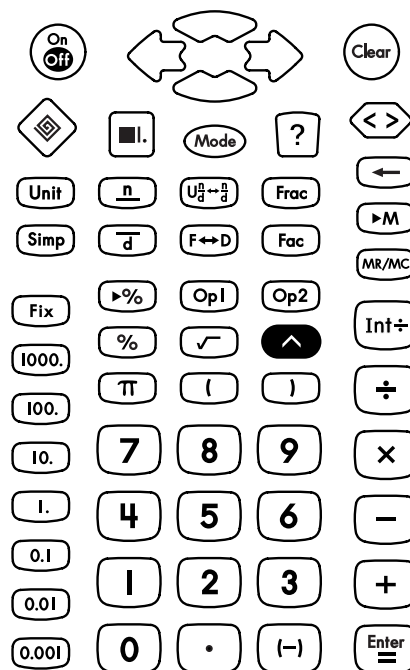
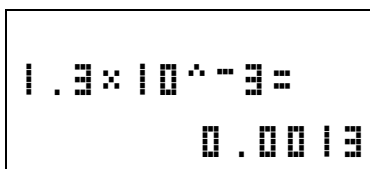
Display

1 \cdot 3 \times
10 \wedge 3 Enter





$$1.3 \times 10^{-3} = ?$$

1 \cdot 3 \times
10 \wedge (-) 3
 Enter





Keys

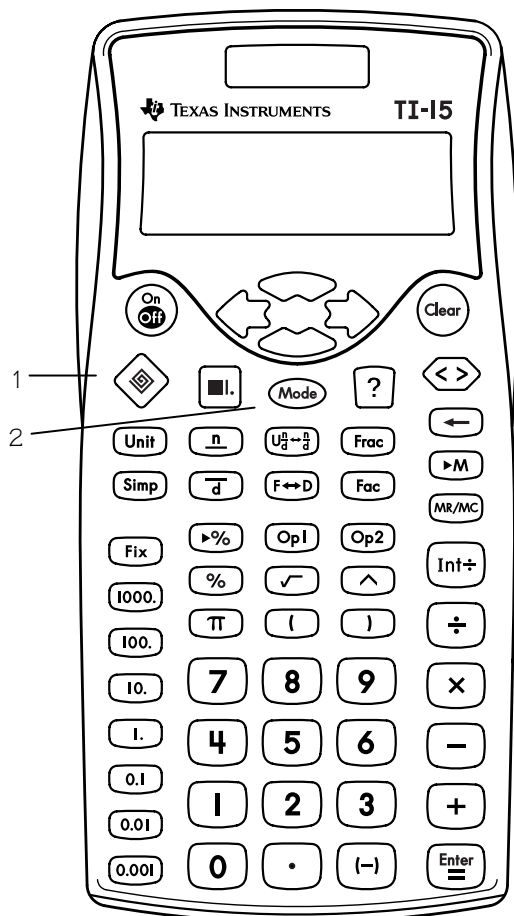
-  activates the Problem Solving tool.
 In Auto mode, this function provides a set of electronic exercises to challenge the student's skills in addition, subtraction, multiplication, and division.
-  (**Mode**) displays the menu to select mode, level of difficulty, and type of operation.

Mode:	Auto		Man (Manual)	
Level:	1	2	3	
Type:	+	-	x	÷ ?

Auto, Level 1, and Addition are the default mode settings.

Notes

- The examples assume all default settings.
- In Auto mode (default), the TI-15 presents problems with one element missing (for example $5+2=?$ or $5+?=7$ or $5?2=7$).
- If the answer is not correct, the TI-15 displays "no" and gives a hint in the form of " $<$ " or " $>$ ".
- After you enter three incorrect answers, the TI-15 provides the correct answer.
- After every fifth problem, the TI-15 displays a Scoreboard that tallies the student's correct and incorrect answers.
- Teachers can check a student's progress at any time by pressing **Mode** to display the Scoreboard. You can also press  to review previous problems.
- In Problem Solving, you can view the history, but you cannot edit.
- To exit Problem Solving, press  again. The Scoreboard is cleared when you exit.

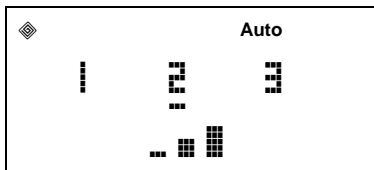
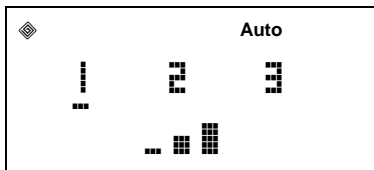
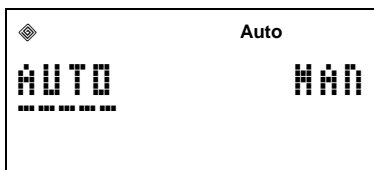


Select level of difficulty

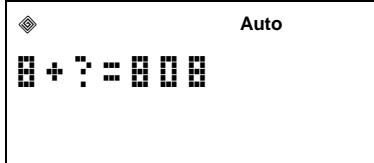
Choose the level of difficulty.

Press

Display



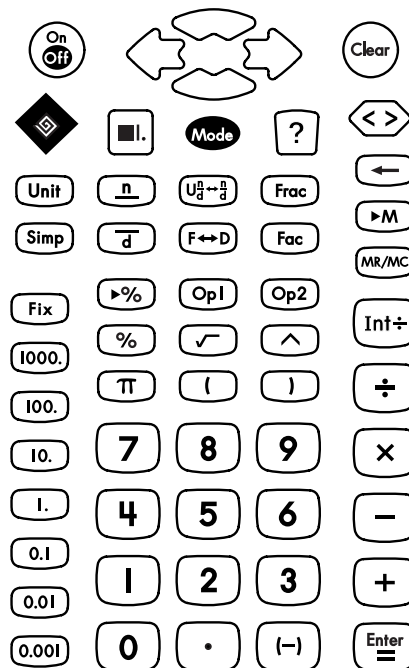
Mode
(to exit)



Problem Solving



Mode



Select type of operation

Choose the type of operation:

- addition
- subtraction
- multiplication
- division
- find the operator

Problem Solving

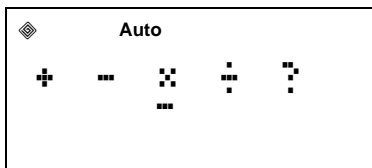
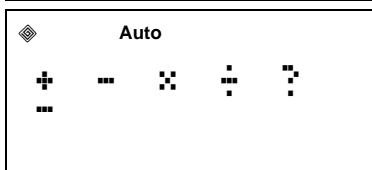
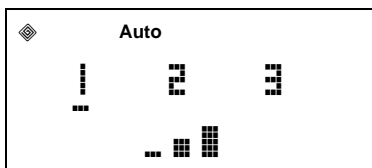
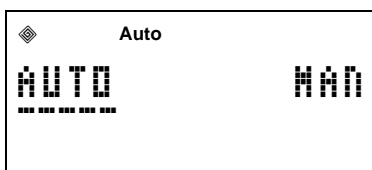


Mode

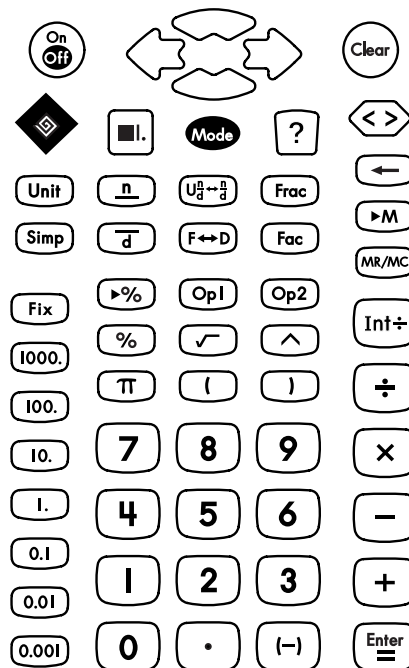


Press

Display



Mode
(to exit)



Test your skills

Enter solutions to the problems that the calculator presents.
(Problems are random.)

Press

Display

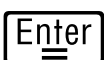
Auto
AUTO MAN



Auto
8 + 3 = ?

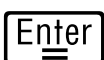
11 

Auto
8 + 3 = 11
YES

4 

Auto
2 + ? = 7

Auto
2 + 4 = 7
NO

5 

Auto
2 + 4 < 7

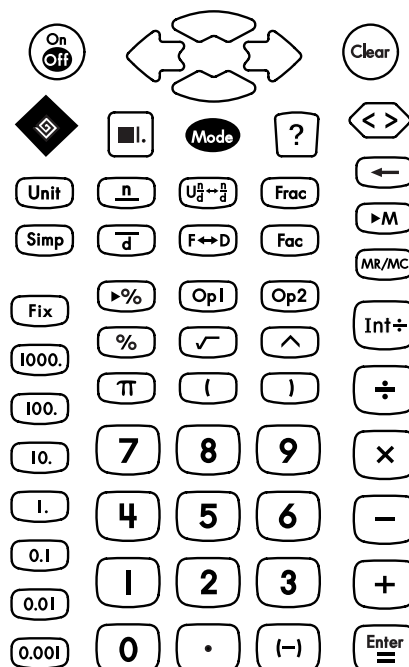
Auto
2 + 5 = 7
YES

Problem Solving



Mode





View the Scoreboard

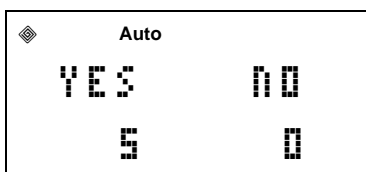
After every fifth problem, the calculator displays a score board that tallies your right and wrong solutions.

You can also display the scoreboard at any time by pressing **Mode**.

Press

Display

Mode

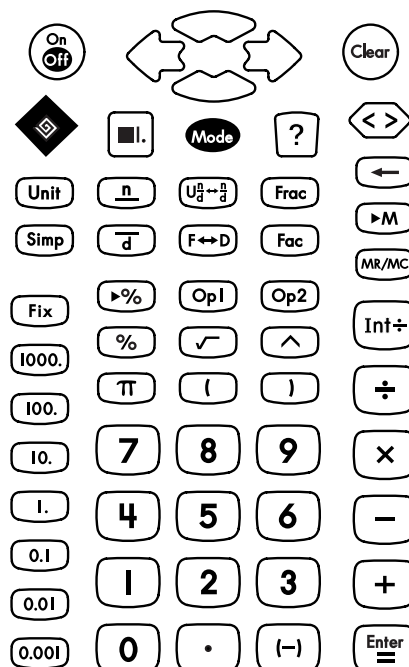


Problem Solving



Mode

Mode

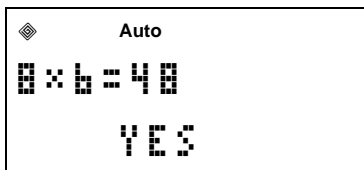
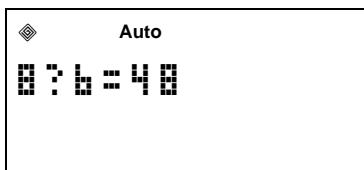
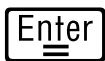
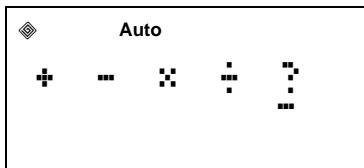
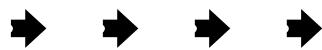
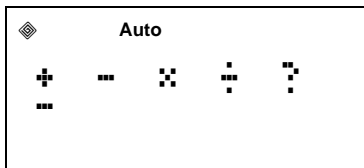
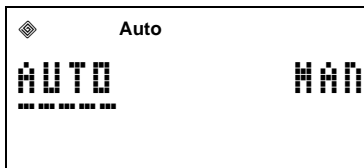


Find the operator

Change the type of operation to “find the operator” (?) and solve the problems the calculator presents.

Press

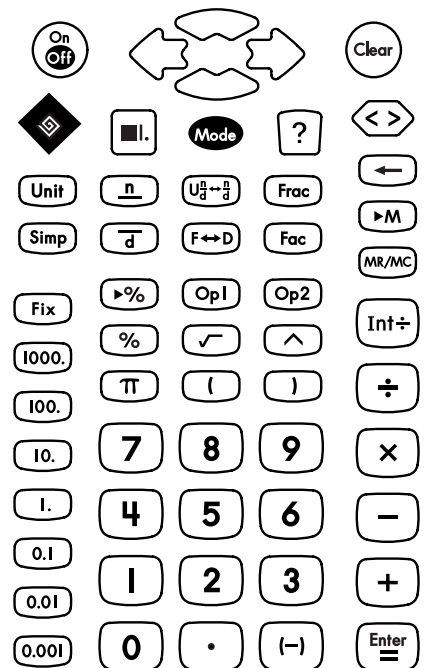
Display





Problem Solving



Mode





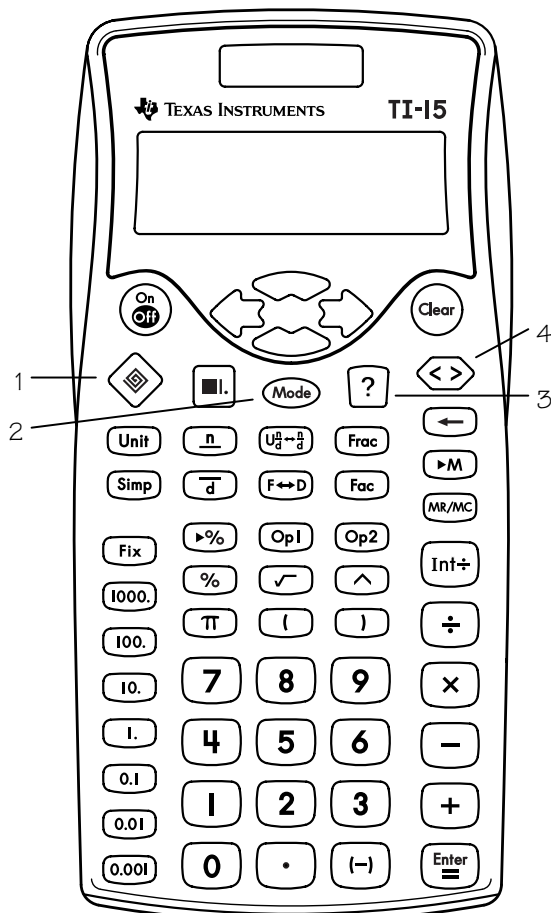
Keys

1.  activates Problem Solving.
2.  displays the menu for selecting mode, level of difficulty, and type of operation.





Mode: **Auto** **Man** (Manual)
 Display: **11-** **-1-**.

In Manual mode, the student composes his or her own problems.

3.  lets the student indicate a missing element in Manual mode.
4.  lets the student test inequalities.



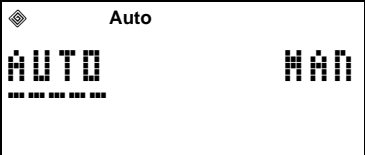


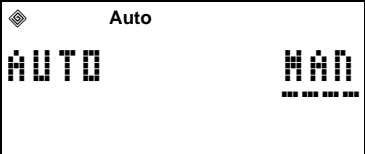




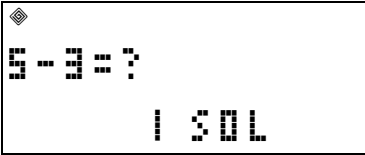




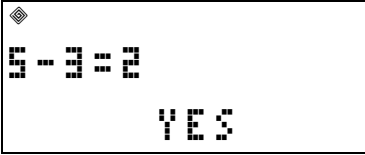



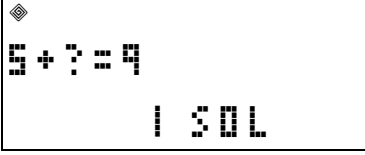

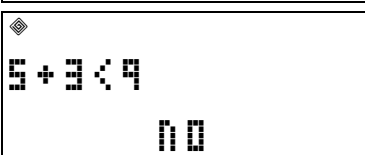

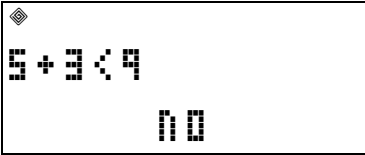

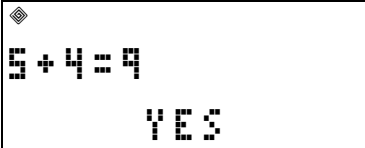


Notes

- The examples on the transparency masters assume all default settings.
- Teachers can check a student's progress at any time by pressing  to display the Scoreboard. You can also press  to review previous problems.
- When you first press , the display shows the Scoreboard for a moment before showing the menu.
- In Manual mode, for all operations except inequalities, the calculator accepts only integers.
- You can enter no more than 11 characters on the display.
- You can enter a problem that has one solution, multiple solutions, or no solution. For example:
 1 solution: $2+5=?$, $2+?=7$, $2?5=7$
 Multiple solutions: $?+?=1$, $?+?=6$
 0 solutions: $3\div 2=?$
 (Answer is not an integer.)
- When a problem has no solution, the calculator will display "no" and will continue to present the problem until cleared manually.
- Problems with two missing elements may have multiple solutions. ($?x?=24$ has 8 solutions.) They must be in the form of $?operator?=number$.
- In Problem Solving, you can view the history, but you cannot edit.
- To exit Problem Solving, press .

Problems with one solution

Problems with one solution are equations with one missing element (for example $7+2=?$ or $7+?=9$). Enter a problem and find a solution.

Press	Display
 	
 	
	
5  3 	
 	
2 	
5   	
9 	
3 	
4 	

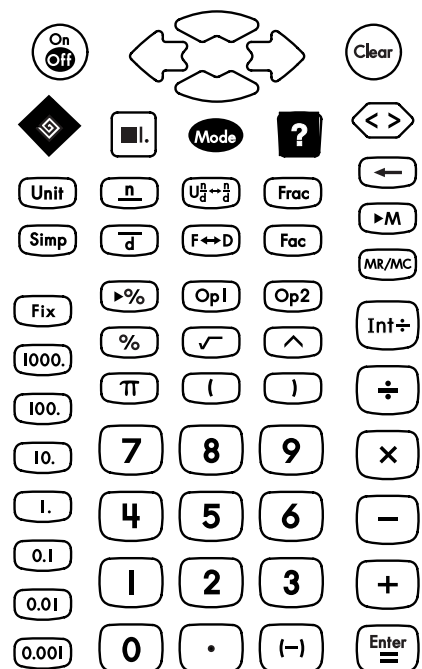
Problem Solving



Mode

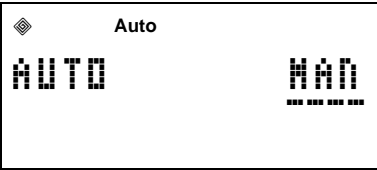

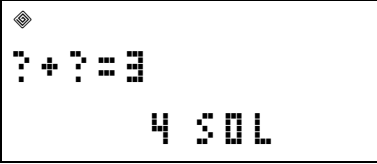

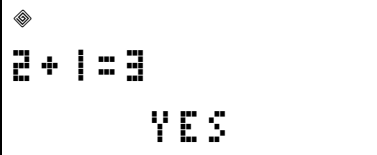


Missing element



Problems with more than one solution

Problems with two missing elements may have more than one solution. Enter a problem, find the number of solutions, and then find a solution.

Press	Display
Mode → Enter	
Mode	
? + ? Enter 3 Enter	
2 Enter	
1 Enter	

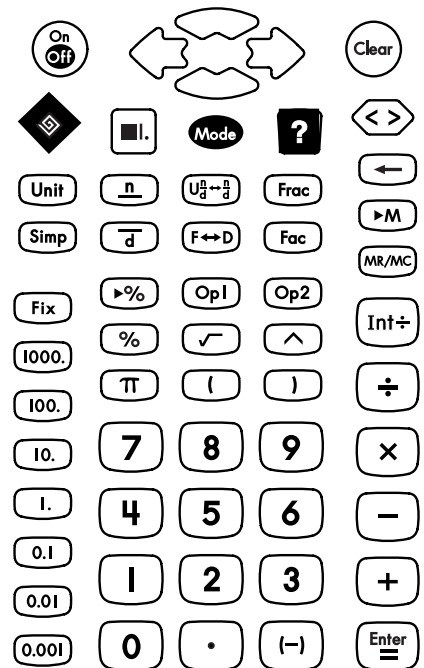
Problem Solving



Mode



Missing element



Problems with no solution

The TI-15 calculator is not designed to handle certain types of problems. These will result in a 0 SOL (no solution) response from the calculator.

Problem Solving



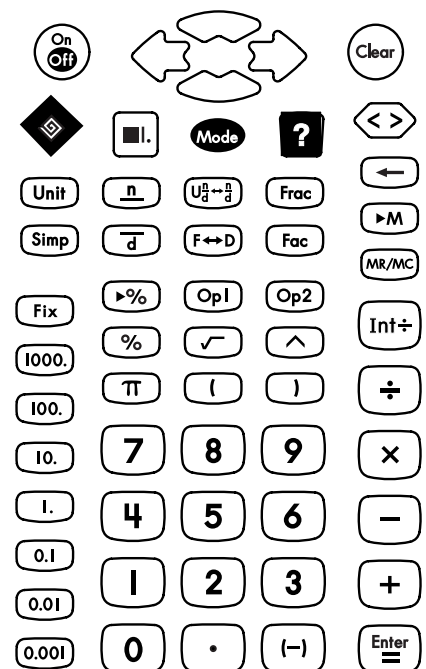
Mode



Missing element



Press	Display
(Mode) → 	Auto AUTO MAD
(Mode)	
1 2 	 1-2=0 0 SOL
(Clear)	



Less than, greater than, equals

You can test inequalities and equalities using Problem Solving.

Press	Display
→ 	
2 1 1 2	
5 4 10 	
5 50	

Problem Solving



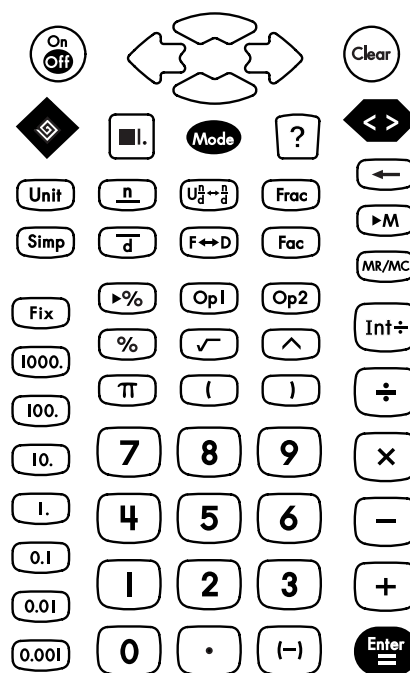
Mode



Equals



Greater Than,
Less Than



View Scoreboard


After every fifth problem, the calculator displays a scoreboard that tallies your right and wrong solutions.

You can also display the scoreboard at any time by pressing **Mode**.

Press

Mode

Display

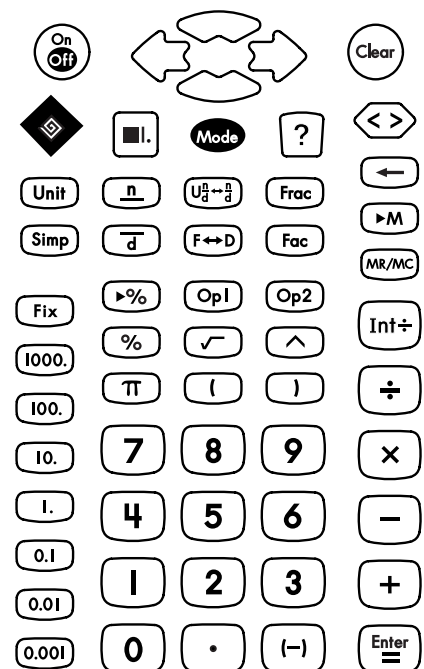
	
YES	NO
5	0

Problem Solving



Mode

Mode



Keys

1. activates Problem Solving.
2. lets you set the mode and display option for Place Value.

Mode: **Auto Man** (Manual)

Display: **11-** **-1-**

Example:

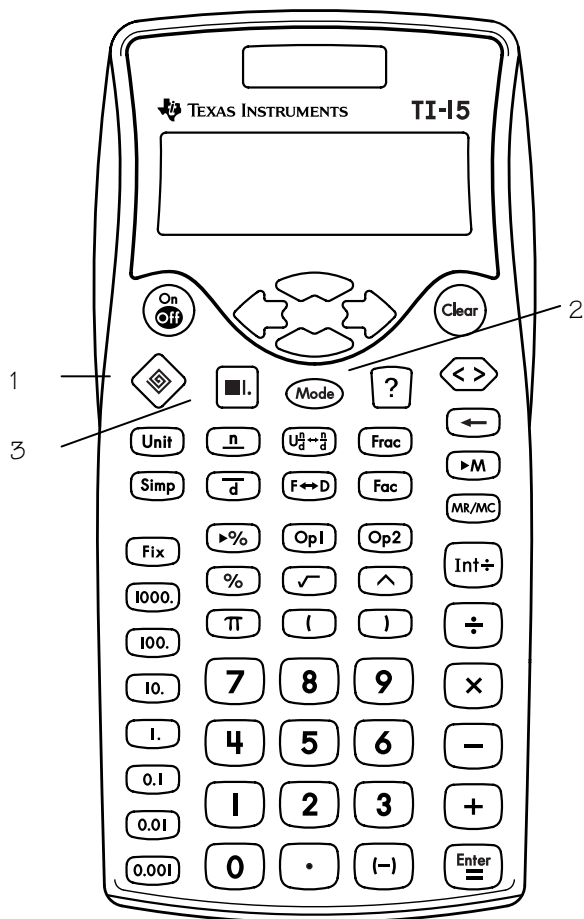
Enter 1234.56
 Press 123_._ (using 11-)
 3._ (using -1-)

3. activates the place value function in Manual mode. It also works in conjunction with these keys:

Key	Displays
	Number of thousands
	Number of hundreds
	Number of tens
	Number of ones
	Number of tenths
	Number of hundredths
	Number of thousandths

Example:

Enter 123.456
 Press 4 ___4___
 4 → .01












Notes







- The examples on the transparency masters assume all default settings.
- The Place Value features work only if you are in Problem Solving Manual mode.
- To exit Problem Solving completely, press .

How to Use the Place Value Function

When you use the place value function, you can determine the place value of a specific digit OR the number of ones, tens, hundreds, etc. in a given number.

- The  mode setting must be **Manual** and the display option **11-**.









To determine:	Follow these steps:	Example:
Place Value	Enter the number, press  , and press the digit.	Page 108
How Many?	Enter the number, press  , and press  ,  ,  ,  ,  ,  , or  .	Page 110


- When determining How Many?, be sure to explain to students that $12_ _ _ . _ _ _$ (after you press  on page 110) represents 12 hundreds in the number 1234.567, or that $123456 . _$ (after you press ) represents 123,456 hundredths in the number 1234.567.
- When a number includes a repeated digit, the calculator first analyzes its occurrence in the right-most position. To find the place value of other instances, press the digit again. (See page 109 for an example.)
- Once  is active, it is not necessary to press this key before each digit. To enter a new number, however, you must press , enter the number, and then press  again.
- To exit Place Value, press  and the TI-15 returns to Problem Solving, Manual mode.

How to Use What's the Digit Function

Another way to display place value is to show the digit that is in the ones place, the tens place, etc.

- The  mode setting must be **Manual** and the display option **-1-**.

To determine:	Follow these steps:	Example:
What's the Digit?	Enter the number, press  , and press  ,  ,  ,  ,  ,  , or  .	Page 111

- To exit Place Value, press  and the TI-15 returns to Problem Solving, Manual mode.

Determine place value

Enter 1234.567. Determine the place value of 7 and 4.

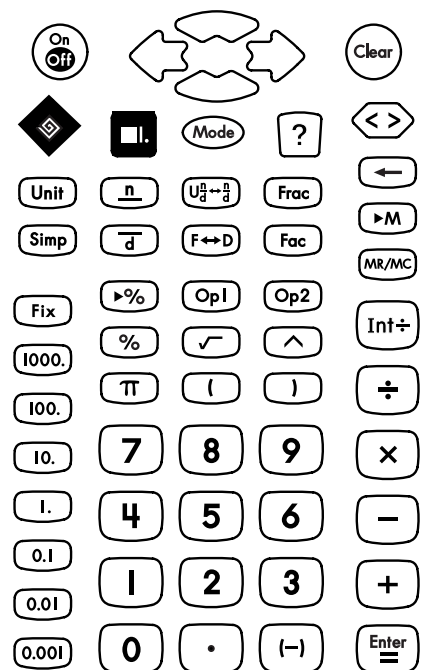
Problem Solving



Place Value



Press	Display
(Mode) →	AUTO MAN -----
(Mode)	♦ ♦
1234 567 	♦ ■ 1234.567
7	♦ ■ 1234.567 ----- . 7
	♦ ■ 1234.567 7->0.001
4	♦ ■ 1234.567 4.-----
	♦ ■ 1234.567 4->1



Repeated digits

Enter 123.43. Determine the place value of each 3.

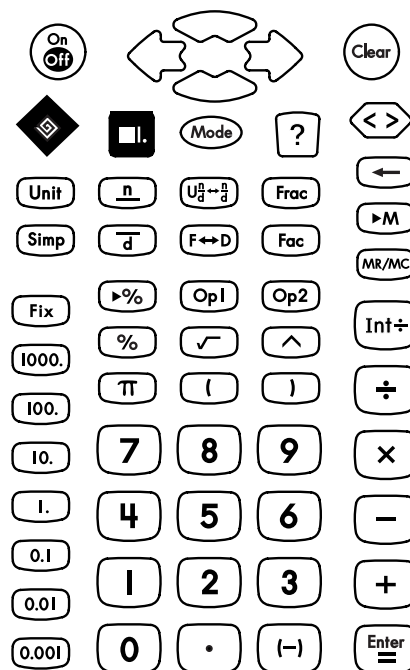
Problem Solving



Place Value



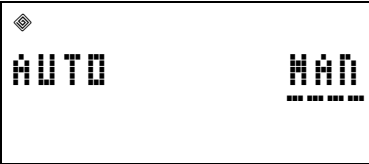


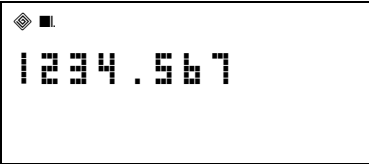



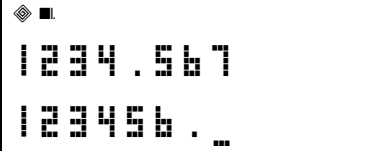




Press	Display
Mode →	AUTO MAN -----
Enter Mode	 4
123 43	 123.43
	 123.43 ... 3
3	 123.43 3 → 0.01
33	 123.43 ... 3 ...
	 123.43 3 → 1



How many?

How many hundreds are in 1234.567? How many hundredths?

Press	Display
 (Mode) → 	
(Mode)	
1234  567	
	
	
	

Problem Solving



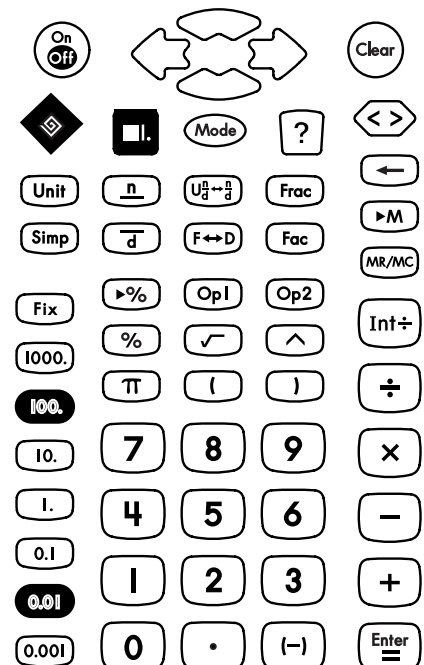
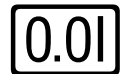
Place Value



Hundreds



Hundredths

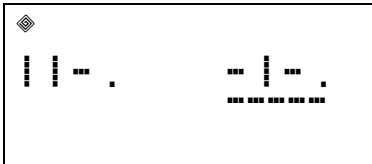
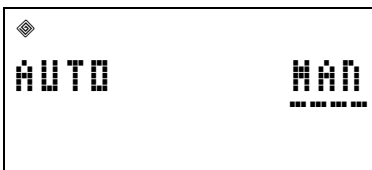
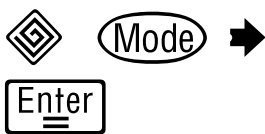


What's the digit?

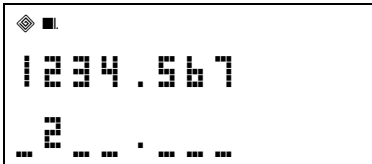
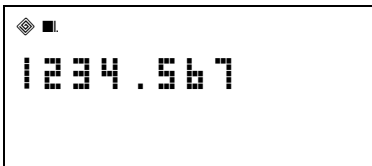
What digit is in the hundreds place in 1234.567?

Press

Display



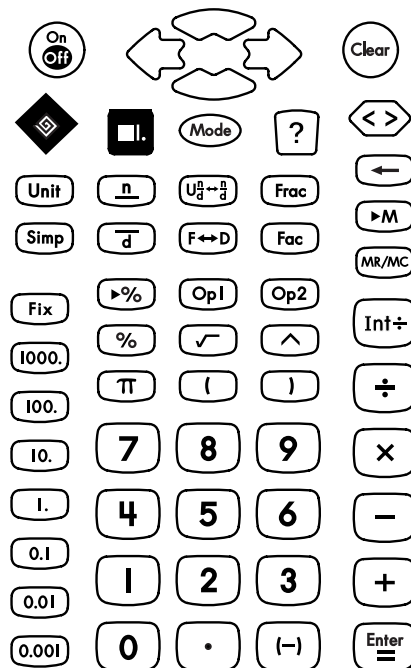
1234 . 567



Problem Solving














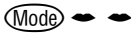













Place Value



Quick Reference to Keys

A

Key	Function
	Turns on the calculator. If already on, turns the calculator off.
	Clears display and error condition.
	To reset the calculator, hold down  and  simultaneously for a few seconds and release. MEM CLEARED shows on the display. This will completely clear the calculator, including all mode menu settings, all previous entries in history, all values in memory, and the display. All default settings will be restored.
 	Moves the cursor right and left, respectively, so you can scroll the entry line or select a menu item.
 	Moves the cursor up and down, respectively, so you can see previous entries or access menu lists.
	Deletes the character to the left of the cursor before  is pressed.
	Displays menu to select format of results of division: . n/d
	Displays menu to show or hide (?) in Op1 or Op 2: +1 Op ?
	Displays menu to clear Op1 or Op2: Op1 Clear Op2
	Displays menu to reject or accept Reset: N Y
	Enters the numerals 0 through 9.
	Adds.
	Subtracts.
	Multiplies.
	Divides.
	Completes operations. Enters the equal sign or tests a solution in Problem Solving.
	Inserts a decimal point.
	Enters a negative sign. Does not act as an operator.
	Opens a parenthetical expression.
	Closes a parenthetical expression.

Quick Reference to Keys (Continued)

A

Key	Function
$\boxed{\text{Int} \div}$	When you divide a positive whole number by a positive whole number using $\boxed{\text{Int} \div}$, the result is displayed in the form Q r R , where Q is the quotient and R is the remainder. If you use the result of integer division in a subsequent calculation, only the quotient is used; the remainder is dropped.
$\boxed{\text{n}}$	When pressed after entering a number, designates the numerator of a fraction. The numerator must be an integer. To negate a fraction, press $\boxed{(-)}$ before entering numerator.
$\boxed{\text{d}}$	When pressed after entering a number, designates the denominator of a fraction. The denominator of a fraction must be a positive integer in the range 1 through 1000. If you perform a calculation with a fraction having a denominator greater than 1000, or if the results of a calculation yield a denominator greater than 1000, the TI-15 will convert and display the results in decimal format.
$\boxed{\text{Unit}}$	Separates a whole number from the fraction in a mixed number.
$\boxed{\text{Frac}}$	Displays a menu of settings that determine how fraction results are displayed. <ul style="list-style-type: none"> • U n/d (default) displays mixed number results. • n/d displays results as a simple (improper) fraction. <p>If N/d \rightarrow n/d is displayed after you convert a fraction to a mixed number, you can further simplify the fractional portion of the mixed number.</p>
$\boxed{\text{Frac}} \leftarrow$	Displays a menu to select the method of simplifying fractions: <ul style="list-style-type: none"> • Man (default) allows you to simplify manually (step-by-step). • Auto automatically reduces fraction results to lowest terms.
$\boxed{\text{Simp}}$	Enables you to simplify a fraction.
$\boxed{\text{Fac}}$	Displays the factor that was used to simplify a fraction.
$\boxed{\text{U} \frac{\text{n}}{\text{d}} \leftrightarrow \frac{\text{n}}{\text{d}}}$	Converts a mixed number to an improper fraction or an improper fraction to a mixed number.
$\boxed{\text{F} \leftrightarrow \text{D}}$	Converts a fraction to a decimal, or converts a decimal to a fraction, if possible. Converts π to a decimal value.
$\boxed{\%}$	Enters a percentage.
























Quick Reference to Keys (Continued)

A

Key	Function
	Converts a decimal or a fraction to a percent.
	Calculates the square root of a number.
	Raises a number to the power you specify.
	Enters the value of π . It is stored internally to 13 decimal places (3.141592653590). In some cases, results display with symbolic π , and in other cases as a numeric value.
	Stores the displayed value for later use. If there is already a value in memory, the new one will replace it. When memory contains a value other than 0, M displays on the screen. (Will not work while a calculation is in process.)
	Recalls the memory value for use in a calculation when pressed once. When pressed twice, clears memory.
 	Each can store one or more operations with constant value(s), which can be repeated by pressing only one key, as many times as desired. To store an operation to Op1 or Op2 and recall it: <ul style="list-style-type: none"> • Press (or) , enter the operator and the value, and press (or) to save the operation. • Press (or) to recall the stored operation. <p>To clear the contents of Op1 or Op2, press , select Op1 or Op2, and press . New operations can now be stored for repeated use.</p>
	Rounds off results to the nearest thousand.
	Rounds off results to the nearest hundred.
	Rounds off results to the nearest ten.
	Rounds off results to the nearest one.
	Rounds off results to the nearest tenth.
	Rounds off results to the nearest hundredth.
	Rounds off results to the nearest thousandth.
	Removes fixed-decimal setting and returns to floating decimal.




Quick Reference to Keys (Continued)

A

Key	Function
	Provides a set of electronic flash cards to challenge your skills in addition, subtraction, multiplication, and division.
 Mode	Displays menu list to select Auto or Manual operation: Auto Man
 Mode 	Displays menu list to select level of difficulty: 1 2 3
 Mode  	Displays menu list to select type of problem: + - × ÷ ?
 Mode 	Displays menu to select display options for Place Value: 11- -1- . (This option available only if Man mode is selected.)
	While in  function, manual problem solving mode, lets you indicate a missing element in an equation.
	While in the  function, manual problem solving mode, lets you test inequalities. Press once to enter < . Press twice to enter > .
	While in  function, you can determine the place value of a particular digit of given number or, in conjunction with place value keys, can determine how many thousands, hundreds, etc., a number contains or what digit is in a given place.
 <i>d</i>	Determines the place value of digit <i>d</i> of given number.
 1000	Tells how many thousands a given number contains or what digit is in the thousands place.
 100	Tells how many hundreds a given number contains or what digit is in the hundreds place.
 10	Tells how many tens a given number contains or what digit is in the tens place.
 1	Tells how many ones a given number contains or what digit is in the ones place.
 0.1	Tells how many tenths a given number contains or what digit is in the tenths place.
 0.01	Tells how many hundredths a given number contains or what digit is in the hundredths place.
 0.001	Tells how many thousandths a given number contains or what digit is in the thousandths place.

Display Indicators

B

Indicator	Meaning
	Calculator is in Problem Solving mode.
	Calculator is in place-value mode.
Fix	The calculator is rounding to a specified number of places.
M	Indicates that a value other than zero is in memory.
►M	Value is being stored to memory. You must press $\boxed{+}$, $\boxed{-}$, $\boxed{\times}$, $\boxed{\div}$, or $\boxed{\text{Enter}}$ to complete the process.
Op1, Op2	An operator and operand is stored.
Auto	In calculator mode, Auto simplification of fractions to lowest terms is selected. In  , Problem Solving function is in Auto mode.
I	Integer division function has been selected (appears only when cursor is over division sign).
n/d ÷	Division results will be displayed as fractions.
N//d→n/d	The fraction result can be further simplified.
↑ ↓	Previous entries are stored in history, or more menus are available. Press \blacktriangleleft to access history. Press \blacktriangleleft and \blacktriangleleft to access additional menu lists.
← →	You can press \blacktriangleleft and \blacktriangleright to scroll and select from a menu. You must press $\boxed{\text{Enter}}$ to complete the selection process.

Error Messages

C

Message	Meaning
Arith Error	Arithmetical error. You entered an invalid entry or an invalid parameter; for example, $\sqrt{-5}$.
Syn Error	Syntax error. You entered an invalid or incorrect equation; for example, 5++2 or missing parenthesis.
÷ 0 Error	Divide by 0 error. You attempted to divide by 0.
Op Error	Error following steps for using Op1 or Op2.
Overflow Error	Overflow. The result is too large to fit within the boundaries of the display.
Underflow Error	Underflow. Result is too small.

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