Math 62 Lesson 3 GC - 1st

Math 72 Lessons 2 & 3 GC - 1st

Calculations on graphing calculator

ON/OFF
2nd functions
exponents
scientific notation
order of operations and extra parentheses
convert decimals to fractions
exact answers versus approximate answers

Name _____

Date _____

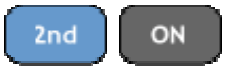
TI-84+ GC 1: On/Off, 2nd functions, Screen, Batteries, Error Messages, Order of Operations

Objectives: Find and use on and off, basic calculations, and 2nd functions
Raise and lower the brightness of the screen, use brightness to conserve batteries
Do multiple calculations at once using the order of operations
Recognize and respond to an error screen

In the lower left corner of the keypad: 

turns the calculator on. On the casing, above the 

, is OFF. Notice what color the letters of OFF are. (Might be blue, green, or other) This color is above most buttons. Any time you want to use a function that's this color, press 

(located in the upper left), then the key. To turn the calculator off, press 

.

To make the screen brighter, press: 

. You may have to do this more than once.

While you press 

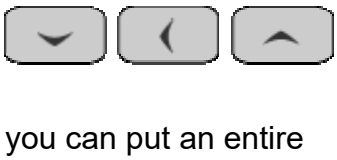
, notice that a number flashes in the upper-right corner of the screen. This number tells how high the brightness is. If it's too high, the screen will turn black.

To lower the brightness, press 

as many times as needed (or hold it down).

Fresh batteries make brightness level 1 easy to read. Nearly dead batteries make brightness level 7 faint and hard to read.
To use the batteries more slowly, lower the brightness as much as you can and still see easily.
As your batteries fade, increase the brightness.
Check your brightness before every exam – if the brightness is high but the screen is faint, be sure to change the batteries or bring new batteries. You'll need four AAA batteries.

Numbers, decimal point, and common operations are at the bottom right of the keypad.


is used as an equal sign. The key 
(on the right side, above the divide symbol), called a "caret", is for exponents. (Caret 
is not a directional key 
.) Graphing calculators use the order of operations correctly, so you can put an entire expression into the calculator at once.

If you type something wrong, you can back up using the 
key and type again.

Or you can delete using the 

key, and insert using INS, which is 

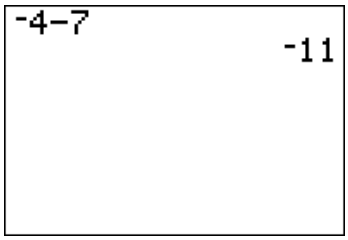
.

Or you can start over by pressing 

.

[—] means subtract. [(–)] is used before a number to make it negative. Do not mix these up or you'll get an error!

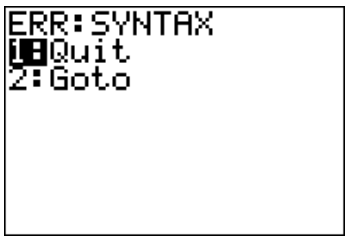
Example 1: $-4-7=-11$ [(–)] [4] [—] [7] [ENTER] Answer: -11



Notice on your screen that the negative [(–)] is smaller and higher than the subtract [—].

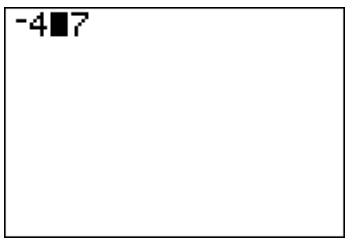
Try this calculation with a wrong key: [(–)] [4] [(–)] [7] [ENTER]

You'll get an error screen like this:



The calculator has several error screens. They all say "ERR:", an abbreviation for "Error", and then a word describing the type of error. "SYNTAX" means you typed something wrong.
The next lines are a menu.

If you press [2] for "Goto", the calculator will go to the error by putting the cursor on the entry you typed wrong, like this:



You can type the correct key and press enter to get the correct calculation: [—] [ENTER]

(If you press [1] for "Quit", it will exit the error menu without showing you the error.)

Calculate two ways: with and without the calculator. If you don't get the same result, figure out why!

1) $10.5+3(4)$ = {Remember: multiply before add.}

Answer: _____

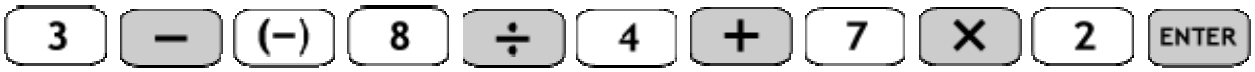
2) $-27\div 3^2$ = {Remember: exponents before divide.}

Answer: _____

{That's a negative number, not subtract!}

3) $3-(-8)\div 4+7\cdot 2$ {Remember: Subtract and add are the same priority, left to right, just as divide and multiply are the same priority, left to right.}

Answer: _____



4) $(4+1)^3\div 5$ {Remember: Grouping symbols before exponents.}

Answer: _____

5) $\sqrt{4}+\frac{\pi}{\pi}$ {Remember: Any number divided by itself is 1.}

Answer: _____

{Notice the 2nd functions: 

is square root and 

is π. Also notice that the calculator opened a set of parentheses that you must close.}

TI-84+ GC 1: On/Off, 2nd functions, Screen, Batteries, Error Messages, Order of Operations
page 4, Solutions

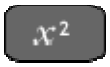
1) 22.5
2) -3
3) 19
4) 25
5) 3

Name _____

Date _____

TI-84+ GC 2: Exponents and Scientific Notation

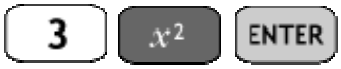
Objectives: Use the caret and square keys to calculate exponents
Review scientific notation
Input a calculation in scientific notation
Recognize an answer in scientific notation
Use scientific notation mode to display all results in scientific notation

The GC has two ways to do exponents. The caret key  can be used for any exponent by typing the base first, and then the caret and exponent. Because exponent 2 is used often, there's a shortcut key just for squaring:  .

Example 1: 2^3

Answer: 8

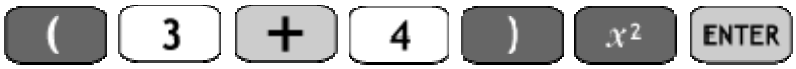
Example 2: 3^2



Answer: 9

Remember the order of operations: exponents before add, subtract, multiply or divide. If something should be added, subtracted, multiplied, or divided before the exponent, use parentheses.

Example 3: $(3+4)^2$



Answer: 49

Example 4: $2^{(3+4)}$

Answer: 128

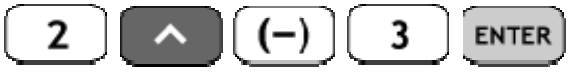
Remember also that any non-zero base raised to the zero power is 1.

Example 5: 10^0

Answer: 1

Remember also that a negative exponent in the numerator is equivalent to a positive exponent in the denominator and a negative exponent in the denominator is equivalent to a positive exponent in the numerator.

Example 6: $2^{-3} = \frac{1}{2^3} = \frac{1}{8}$



Answer: 0.125

Example 7: $\frac{1}{3^{-2}} = 3^2$

Answer: 9

Recall: Scientific notation is a way of writing any number by using significant figures multiplied by a power of ten: $a \times 10^b$, where
$1 \le a < 10$ (meaning that a has one nonzero digit to the left of the decimal point) and
b is an integer $\{...-3,-2,-1,0,1,2,3,...\}$.

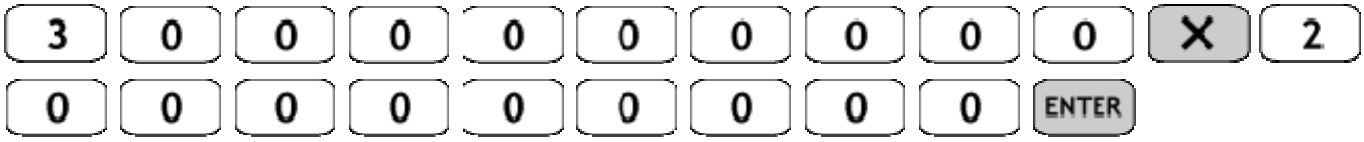
Example 8: $30{,}200$ is written in scientific notation as 3.02×10^4.

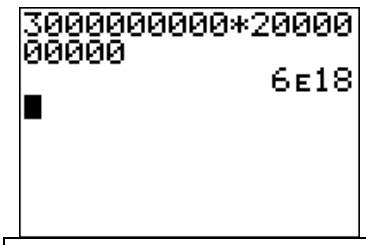
Example 9: 0.0004087 is written in scientific notation as 4.087×10^{-4}

Example 10: 3.901 is written in scientific notation as 3.901×10^0

The GC automatically displays results in standard notation unless the result is a very large or very small number. Then it will automatically display the result in scientific notation.

Example 11: $3{,}000{,}000{,}000 \times 2{,}000{,}000{,}000$





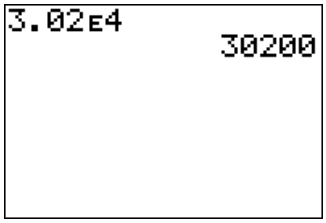
The GC uses its own abbreviation for scientific notation. **6E18** means 6×10^{18}

To input a number using scientific notation, use: [2nd] [,], the 2nd function EE which means 'multiply by a power of 10'. It appears as only E on the screen.

CAUTION: The notation E is not standard mathematical notation. Do not use it to write your final answers on papers or exams!

Example 12: 3.02×10^4

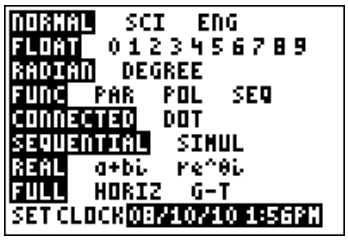
[3] [.] [0] [2] [2nd] [,] [4] [ENTER]



Answer: 30,200

To make the GC display all answers in scientific notation:

Press [MODE]. Your screen changes to the MODE menu:



Each row of this screen is a menu. We'll only use the top row now.

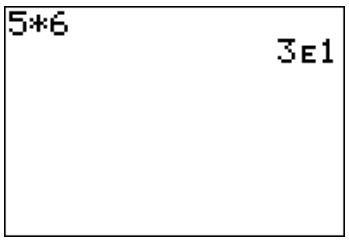
When we select SCI, every result will be shown in scientific notation.
This is sometimes very useful and sometimes not useful at all.

At the end of this exercise, we'll return to the NORMAL format.

Press [▶] to move the shaded region from NORMAL to SCI and [ENTER] to select SCI.

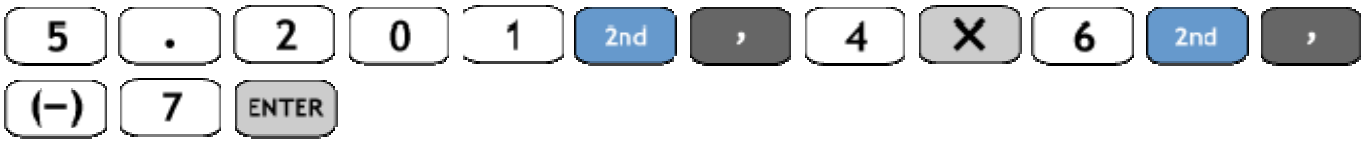
Then press [2nd] [MODE] (or [CLEAR]) to QUIT the MODE menu.

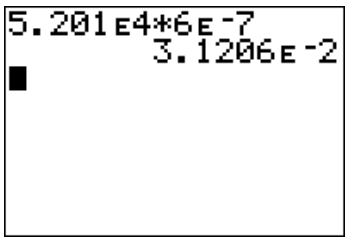
Example 13: Write 5×6 in scientific notation using GC in scientific notation mode.



Answer: 3×10^{1}

Example 14: Write $\left(5.201\times 10^{4}\right)\left(6\times 10^{-7}\right)$ in scientific notation using GC in scientific notation mode.





Answer: 3.1206×10^{-2}

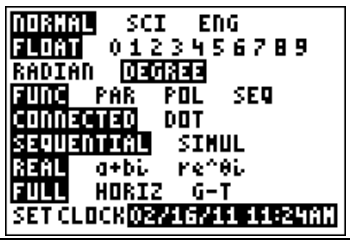
To leave scientific notation mode and return to normal mode, press:

to access the menu,

to move back to NORMAL,

to select NORMAL, and

to exit the menu.



Practice:

1) $(-9)^2$ {Negative before exponent.} Answer: _____

2) -9^2 {Exponent before negative.} Answer: _____

3) $\frac{3^2}{4}$ {Exponent before divide.} Answer: _____

4) $\left(\frac{3}{4}\right)^2$ {Divide before exponent.} Answer: _____

Write result in scientific notation.

5) $300{,}000{,}000{,}000{,}000{,}000{,}000{,}000 \times 7{,}000{,}000{,}000{,}000{,}000{,}000{,}000{,}000{,}000{,}000$
Answer: _____

6) $0.00000000005 \times 0.0000000000002$
Answer: _____

Write in standard notation by using your GC in standard display mode.

7) 3×10^5 Answer: _____

8) 2.116×10^{-3} Answer: _____

9) $6{,}000 \times 700{,}000$ Answer: _____

10) $0.000008 \times 0.000000003$ Answer: _____

Write in scientific notation by using the GC in scientific notation mode.

11) 0.36×9 Answer: _____

12) $0.025 \div 0.5$ Answer: _____

13) $0.00000008 \times 90{,}000{,}000$ Answer: _____

14) $\frac{0.00000000000008}{40{,}000{,}000{,}000{,}000}$ Answer: _____

15) $\frac{6{,}000{,}000{,}000{,}000}{0.0000002}$ Answer: _____

16) $\frac{0.000000008}{0.002}$ Answer: _____

17) $\frac{7000000000}{5000000}$ Answer: _____

TI-84+ GC 2: Exponents and Scientific Notation page 6 Solutions

1) 81

2) -81

3) 2.25

4) 0.5625

5) $\left(3\times10^{23}\right)\left(7\times10^{30}\right)=2.1\times10^{54}$

6) $\left(5\times10^{-11}\right)\left(2\times10^{-13}\right)=1\times10^{-23}$

7) $3\times10^{5}=300{,}000$

8) $2.116\times10^{-3}=0.002116$

9) $\left(6\times10^{3}\right)\left(7\times10^{5}\right)=4.2\times10^{9}=4{,}200{,}000{,}000$

10) $2.4\times10^{-13}=0.00000000000024$

11) $3.24\times10^{0}=3.24$

12) $5\times10^{-2}=0.05$

13) $7.2=7.2\times10^{0}$

14) $\dfrac{\left(8\times10^{-14}\right)}{\left(4\times10^{13}\right)}=2\times10^{-27}$

15) $\dfrac{\left(6\times10^{12}\right)}{\left(2\times10^{-12}\right)}=3\times10^{24}$

16) $\dfrac{\left(8\times10^{-9}\right)}{\left(2\times10^{-3}\right)}=4\times10^{-6}=0.000004$

17) $\dfrac{7\times10^{9}}{5\times10^{7}}=1.4\times10^{2}=140$

Name _____

Date _____

TI-84+ GC 3: Order of Operations, Additional Parentheses, Roots and Absolute Value

Objectives: Review the order of operations
Observe that the GC uses the order of operations
Use parentheses in GC commands to achieve correct calculations
Calculate 3rd, 4th, or other roots using the MATH menu
Calculate absolute value using the MATH menu

The order of operations is a list of rules about the order we do the parts of a calculation containing several parts. Some sources use the acronym PEMDAS. Graphing calculators have been programmed to follow the order of operations.

Step 1: Identify all grouping symbols and resolve them from the inside out. Grouping symbols include purely grouping symbols and grouping symbols which are also operators.

Parentheses ( ), Brackets [ ], and Braces { } -- grouping only
Fraction bars – horizontal line creates numerator and denominator groups before divide
For example: $\frac{2-3}{7-4}$ means $(2-3)\div(7-4)$.
Square Roots and other radicals: The radical symbol may enclose a group, before root
For example: $\sqrt{2\cdot 3+8}$ means $\sqrt{(2\cdot 3+8)}$
Absolute values: The vertical bars may enclose a group, before absolute value
For example: $|3-17\cdot 2|$ means $|(3-17\cdot 2)|$

Step 2: **E**xponents, roots, radicals. Work from left to right.

Step 3: **M**ultiply and **D**ivide. Work from left to right. Divide may come before multiply.

Step 4: **A**dd and **S**ubtract. Work from left to right. Subtract may come before add.

Example 1: $5-3+1$

Answer: 3

The GC does not have keys for brackets [ ] or braces { } as grouping symbols. So use parenthesis keys for all of these symbols, nesting if necessary.

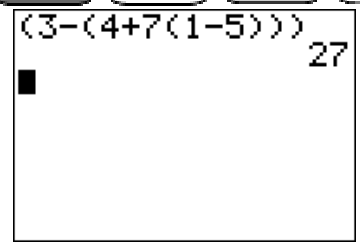
Note: You must have the same number of open 

as you have closed 

parentheses.

Example 2: $\{3-[4+7(1-5)]\}$

(3 − (4 + 7 (1 − 5))



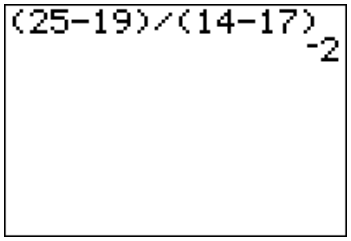
)) ENTER

Notice: three open, three closed.
Answer: 27

If a fraction bar appears in the problem, we must add parentheses around the numerator group and around the denominator group when we calculate on the GC.

Example 3: $\frac{25-19}{14-17}$ becomes $\frac{(25-19)}{(14-17)}$

(2 5 − 1 9) ÷ (1 4 −



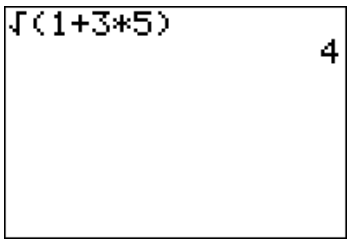
1 7) ENTER

Answer: -2

Recall: the square root is a 2nd function, above the x^2 key.
Caution: When calculating square roots, the TI-84+ will open the first parenthesis for you. But you will have to remember to close that set of parentheses.

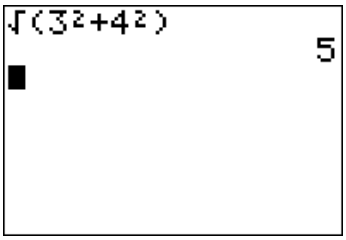
Example 4: $\sqrt{1+3\cdot 5}$ becomes $\sqrt{(1+3\cdot 5)}$

2nd x^2 1 + 3 × 5) ENTER



Answer: 4

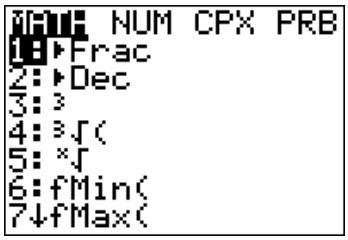
Example 5: $\sqrt{3^2+4^2}$ becomes $\sqrt{\left(3^2+4^2\right)}$



Answer: 5

To calculate 3rd, 4th, or higher roots, use the 

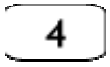
button, which opens a screen with four menus across the top: MATH, NUM, CPX, and PRB. You are automatically in the MATH menu, which is highlighted. We will use the NUM menu later.



Notice that the 4th option in the MATH menu is $\sqrt[3]{\ }$. Select this option one of two ways:

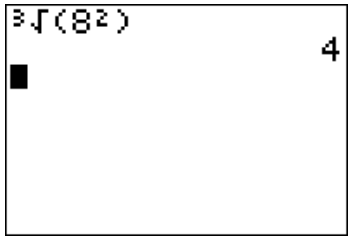
One way is to use the down arrow  to move to 4:, then press 

.

A quicker way is to press 

(at any time in this window) to select option 4.

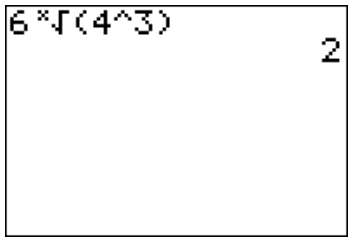
Example 6: $\sqrt[3]{8^2}$



Answer: 4

To calculate higher-order roots, we use the MATH menu again, but select option 5.
Caution: Option 5 uses "x" to show the type of root. We need to type this number before we use the MATH menu. Also note: this does not open parentheses, so we have to open them.

Example 7: $\sqrt[6]{4^3}$



Answer: 2

Important facts about absolute value:

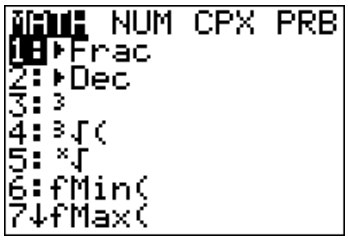
1. Absolute value returns a non-negative answer.

2. Absolute value is a grouping symbol. When evaluating, completely resolve the inside first.

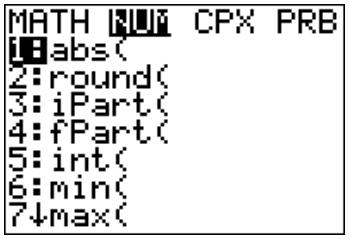
3. $|x|$ and x are not the same. A variable x can represent a positive, negative, or zero, but $|x|$ can't be negative. We cannot ignore or "remove" the absolute value.

To calculate absolute value, we use the MATH button again, but also move to the second menu, NUM (for number).

Press MATH



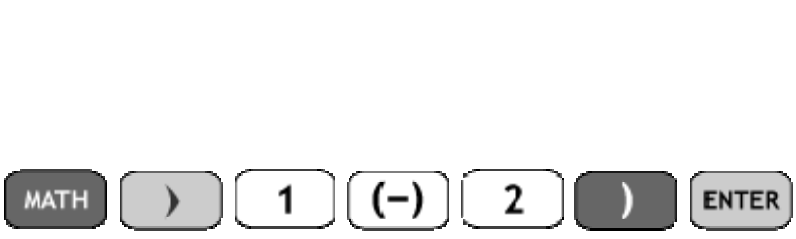
Press ▶ for the NUM menu:

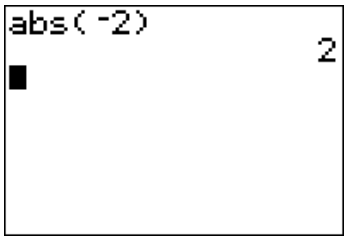


Press 1 or ENTER to select absolute value, abbreviated abs(

Caution: The GC absolute value opens parentheses. If you do not close them, the GC will take the absolute value of the entire expression.

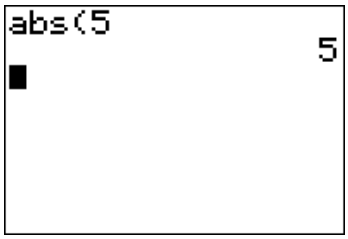
Example 8: $|-2|$





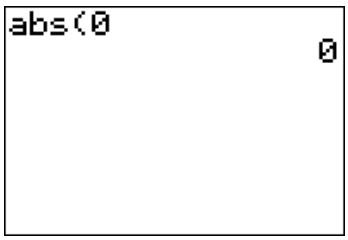
Answer: 2

Example 9: $|5|$



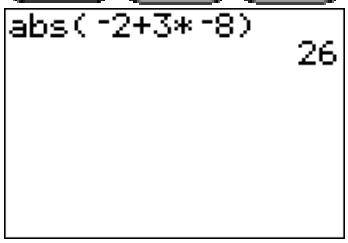
Answer: 5

Example 10: $|0|$



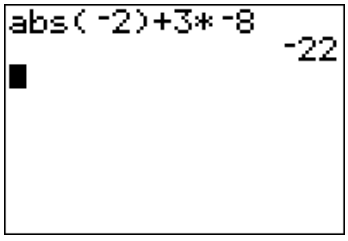
Answer: 0

Example 11: $|-2+3(-8)|$



Answer: 26

Example 12: $|-2|+3(-8)$



Answer: -22

Practice:

Calculate. Write the keystrokes you use in the blank boxes. Check by doing the problem yourself.

1) $5-(3+1)$ Answer: _____

2) $12\cdot 4+3$ Answer: _____

3) $12\cdot(4+3)$ Answer: _____

4) $12-9\div 3\cdot 6\div 2-3$ Answer: _____

5) $9-12\div 4-8$ Answer: _____

6) 2^3 Answer: _____

7) 3^2 Answer: _____

8) $2+3^2$ Answer: _____

9) $(2+3)^2$ Answer: _____

10) $9-12\div(4-6)$ Answer: _____

11) $(9-12)\div(4-6)$ Answer: _____

12) $9-12\div4-6^2$ Answer: _____

13) $(9-12)\div(4-6)^2$ Answer: _____

14) $18\div6\times2-3+9$ Answer: _____

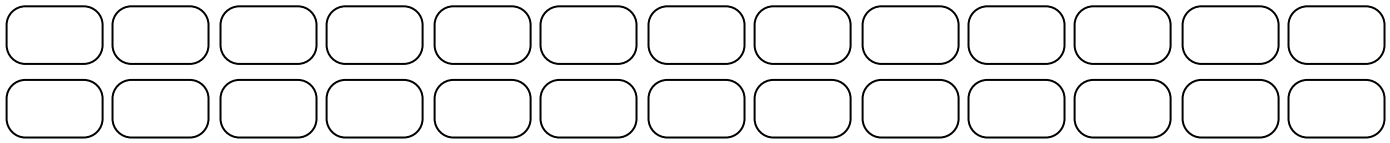
15) $\left\{3-\left[4+7(1-5)^2\right]\right\}$ Answer: _____

16) $\dfrac{9-12}{4-6}$ Answer: _____

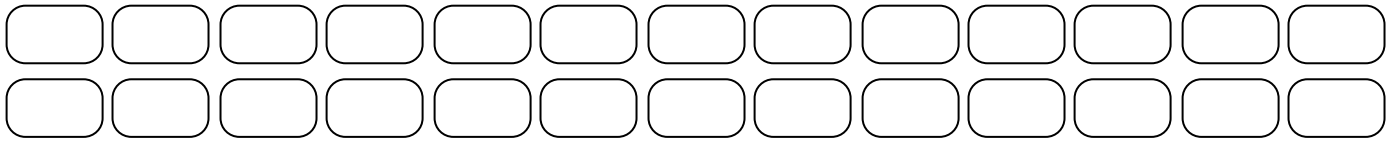
17) $\dfrac{3^2-2^2}{3\cdot2+2^2}$ Answer: _____

18) $\dfrac{(-2)^2+1}{-2-3}$ Answer: _____

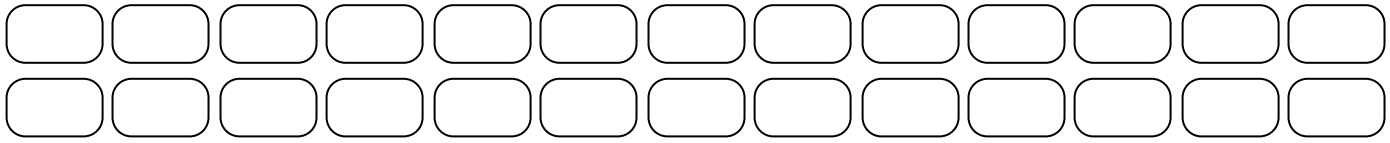
19) $\frac{-2^2+1}{-2-3}$ Answer: _____



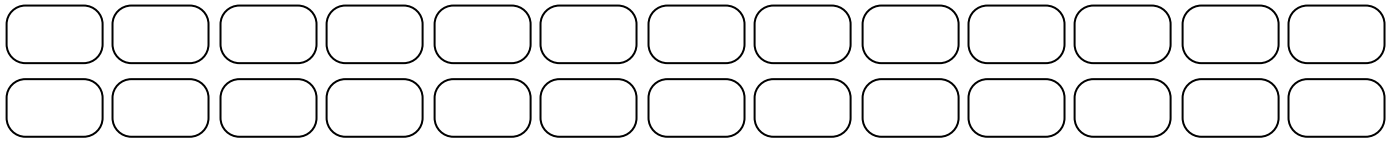
20) $(-2)^2+\frac{1}{-2}-3$ Answer: _____



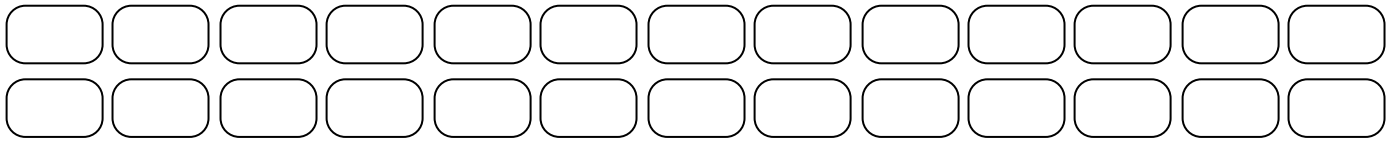
21) $-2^2+\frac{1}{-2}-3$ Answer: _____



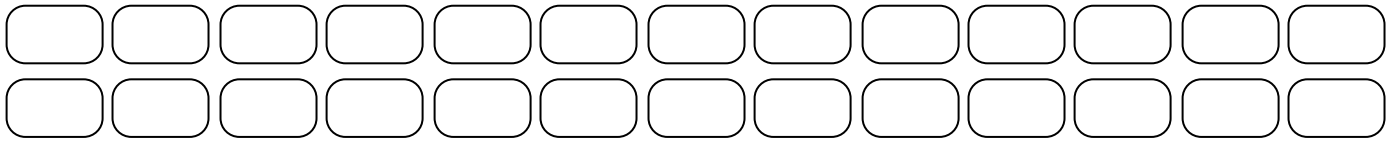
22) $(-2)^2+\frac{1}{-2-3}$ Answer: _____



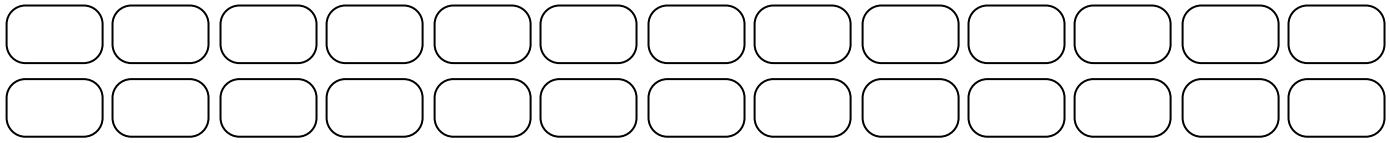
23) $-2^2+\frac{1}{-2-3}$ Answer: _____



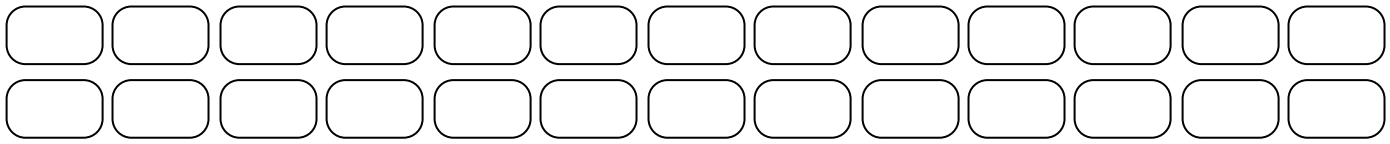
24) $\frac{(-2)^2+1}{-2}-3$ Answer: _____



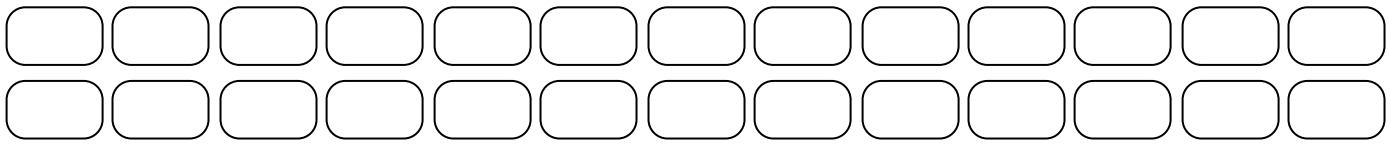
25) $\frac{-2^2+1}{-2}-3$ Answer: _____



26) $\frac{(-2+1)^2}{-2}-3$ Answer: _____



27) $\frac{(-2+1)^2}{-2-3}$ Answer: _____

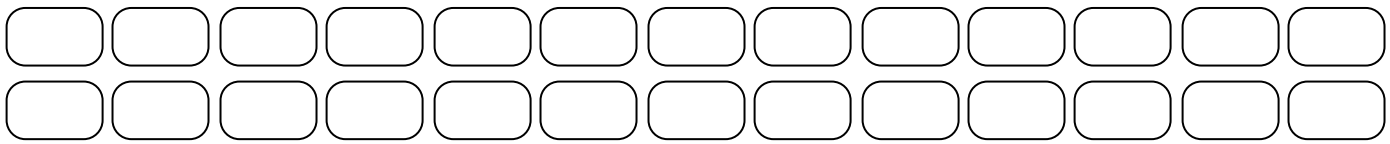


28) $\sqrt{6^2+8^2}$ Answer: _____

29) $\sqrt[3]{5+120}$ Answer: _____

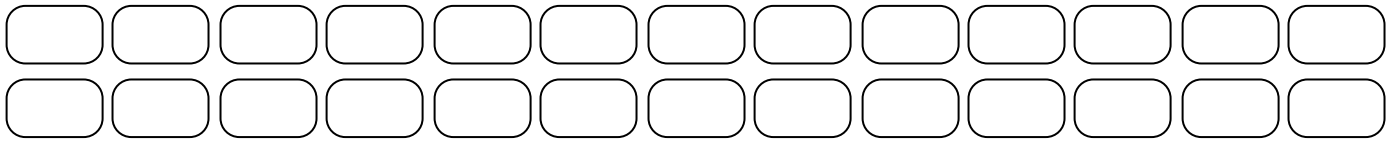
30) $\sqrt[5]{32}$ Answer: _____

31) $\sqrt[4]{5^3+5(10^2)}$ Answer: _____

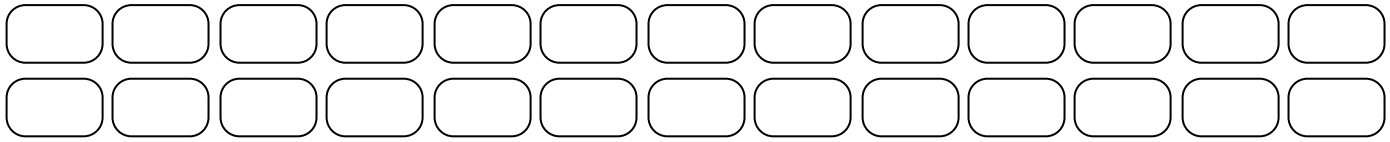


32) $|7+-3(5)|$ Answer: _____

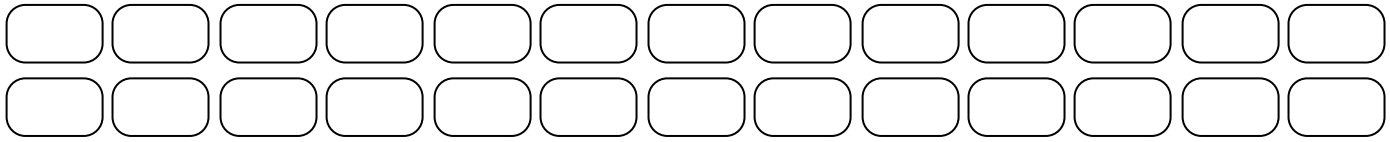
33) $|-1(12)|-3|-2|$ Answer: _____



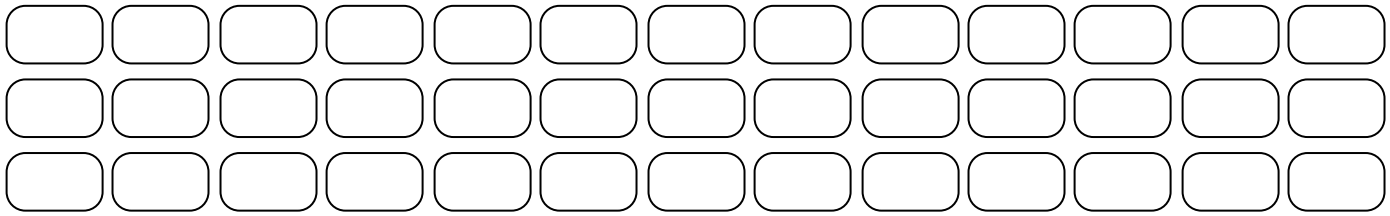
34) $\dfrac{-3+6}{|2-7|-|-2|}$ Answer: _____



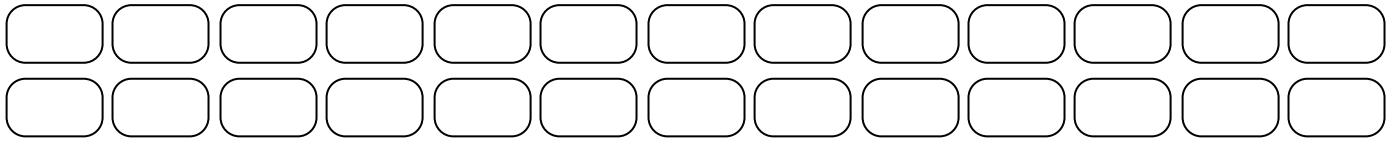
35) $\dfrac{2+3|5-(-1)|}{11+2(-3)}$ Answer: _____



36) $\dfrac{|7-11|}{|4-8|}-\dfrac{2|23-19|}{|-3-1|}$ Answer: _____



37) $\left|\dfrac{17-5}{2-5}\right|$ Answer: _____

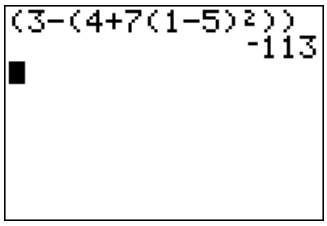


TI-84+ GC 3: Order of Operations, Additional Parentheses, Roots and Absolute Value

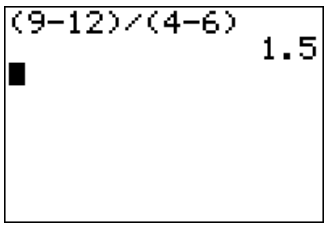
Solutions:

1) 1
2) 51
3) 84
4) 0
5) -2
6) 8
7) 9
8) 11
9) 25
10) 15
11) 1.5
12) -30
13) -0.75
14) 12

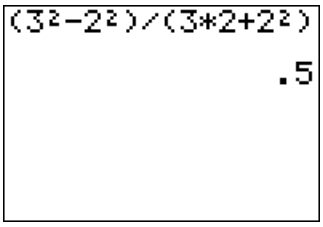
15) -113



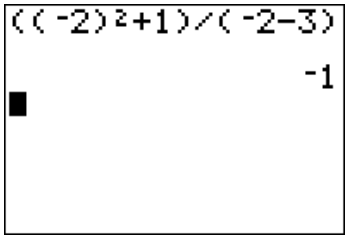
16) 1.5



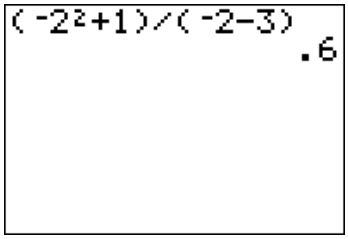
17) .5



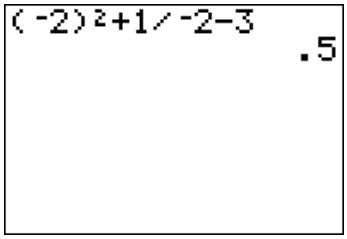
18) -1



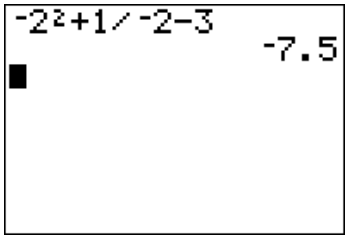
19) 0.6



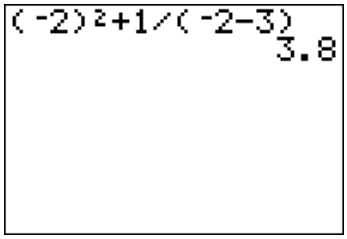
20) 0.5



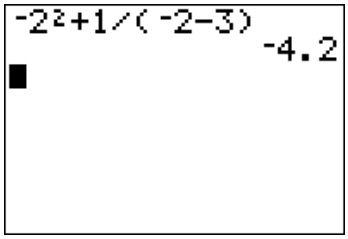
21) -7.5



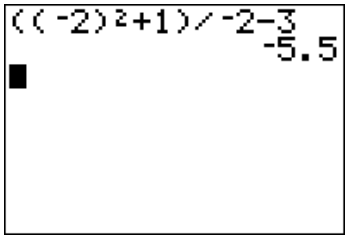
22) 3.8



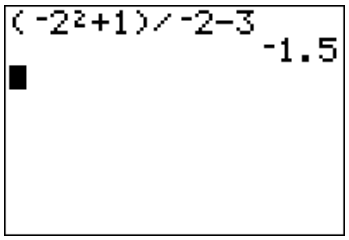
23) -4.2



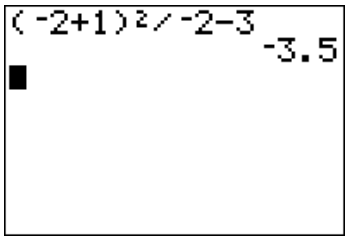
24) -5.5



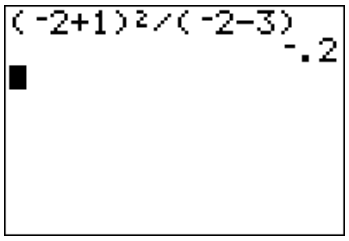
25) -1.5



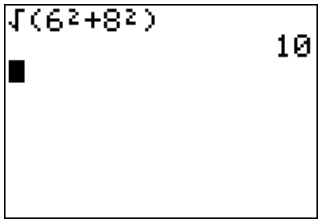
26) -3.5



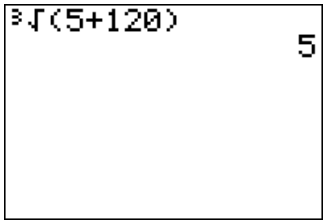
27) -0.2



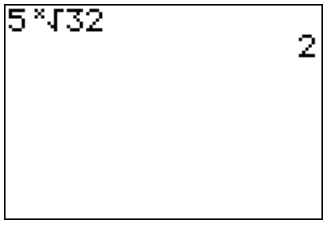
28) 10



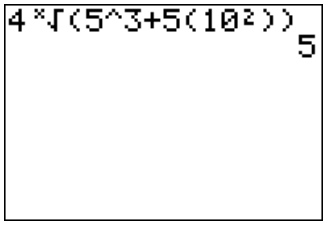
29) 5



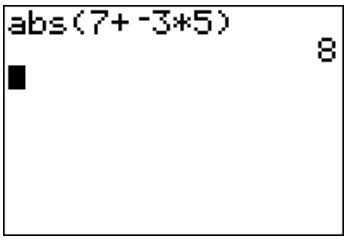
30) 2



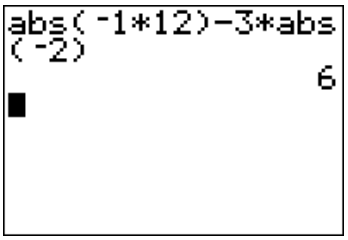
31) 5



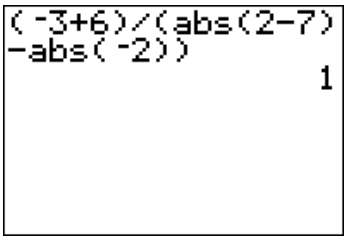
32) 8



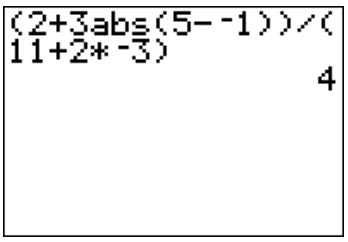
33) 6



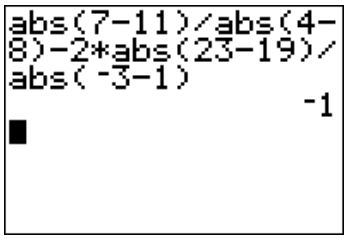
34) 1



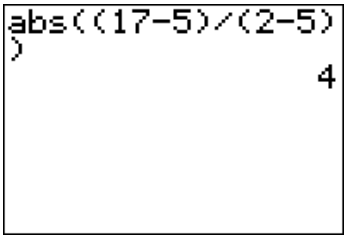
35) 4



36) -1



37) 4



Rev 12-2-11

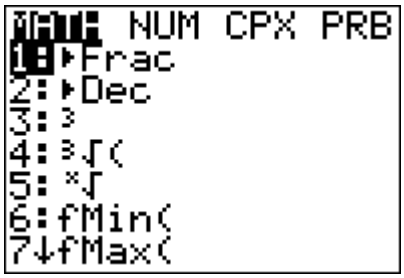
Name _____

Date _____

TI-84+ GC 4 Fractions, Decimals, Rational and Irrational Numbers

Objectives: Convert decimals to fractions on the GC, where possible
Use the 2nd function ANS to recall the previous GC result and continue
Review rational and irrational numbers
Understand the limitations of the GC's fraction capacity
Use >frac in calculations

The MATH button on your calculator opens a screen with four menus across the top: MATH, NUM, CPX, and PRB. You are automatically in the MATH menu, which is highlighted. We may use other menus later.



Each option in any menu is numbered. To use options in any menu, move with the ▼ or ▲ until the desired option number is highlighted, then press ENTER. Or, you can select an option by typing its number. When you open a menu, the first option is automatically highlighted.

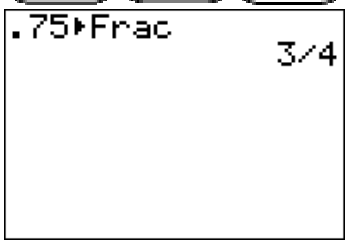
Pressing MATH ENTER will select option 1, > FRAC. Press ENTER again to find the fraction.

Remember: A <u>rational number</u> is a number that can be written as a fraction (or ratio) of two integers.

In the MATH menu, option 1, >FRAC will convert an existing answer to a fraction, if
a) the decimal is a rational number AND
b) the decimal is in the calculator's database of fractions

Example 1: Convert .75 to a fraction.

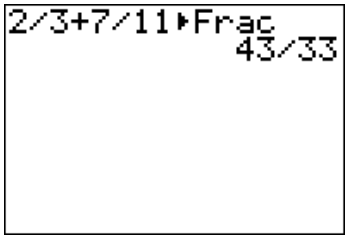
. 7 5 MATH ENTER ENTER



Answer: $\frac{3}{4}$

Example 2: Calculate and convert to fraction using the GC: $\frac{2}{3}+\frac{7}{11}$

[2] [÷] [3] [+] [7] [÷] [1] [1] [MATH] [ENTER] [ENTER]



Answer: $\boxed{\frac{43}{33}}$

The GC temporarily keeps the value of your last calculation in a special memory location called Answer. If you mistakenly press ENTER before converting it to a fraction, you can retrieve the answer and keep going by using Answer, ANS, which is [2nd] [(−)]. Sometimes you can type the operation, and the GC will automatically insert Ans for you.

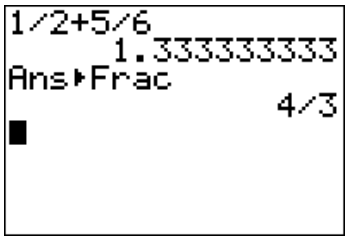
Example 3: (calculation, but forget to convert to fraction) $\frac{1}{2}+\frac{5}{6}$

[1] [÷] [2] [+] [5] [÷] [6] [ENTER]

Answer: $1.\overline{3}$

Example 4: (recall previous answer and convert to fraction)

Recall previous answer: [2nd] [(−)] Convert to fraction [MATH] [ENTER] [ENTER]



Answer: $\boxed{\frac{4}{3}}$

Recall: Irrational numbers cannot be written as a fraction of two integers.
("ir" means "not", so "ir" + "rational" = "not rational")

Example 5: $\sqrt{2}$ is irrational, and so it cannot be written as a fraction of two integers.

Example 6: π is irrational, and so it cannot be written as a fraction of two integers.

Sometimes >Frac does not give a fraction answer. There are two reasons why this happens.

1. The number you typed is irrational (not a rational number) and cannot be written as a fraction. In this case, you need to use your brain to recognize irrational numbers.

2. The number can be written as a fraction, but it's not a fraction in the GC's database. In this case, you need to use your brain to recognize rational numbers. See Example 7.

CAUTION: You cannot tell from your calculator if the decimal is a rational number that's not in the database or if the decimal is a rounded irrational number. In either case, the GC will return the approximate decimal. You must know whether it's a rational or irrational answer!

Example 7: Calculate the fraction $\frac{12357}{12379}$ as a decimal. Then ask the GC to convert it to fraction.

Calculate the decimal by dividing [1] [2] [3] [5] [7] [÷] [1] [2] [3] [7] [9] [ENTER] then convert to fraction [2nd] [(−)] [MATH] [ENTER] [ENTER]

```
12357/12379
      .9982227967
Ans▸Frac
      .9982227967
```

Answer: The fraction is $\boxed{\frac{12357}{12379}}$, but we know it from thinking, not by GC.

The fraction $\frac{12357}{12379}$ is not in the GC database of fractions and decimal equivalents.

Example 8: Calculate $\sqrt{2}$ and attempt to convert it to fraction.

Calculate $\sqrt{2}$: [2nd] [x^2] [2] [)] [ENTER]

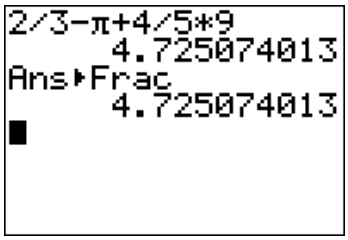
Attempt to convert to fraction: [MATH] [ENTER] [ENTER]

```
√(2)
      1.414213562
Ans▸Frac
      1.414213562
```

Answer: $\sqrt{2}$ cannot be written as a fraction, no matter who's trying. It's irrational.

Example 9: Calculate $\frac{2}{3}-\pi+\frac{4}{5}(9)$ exactly.

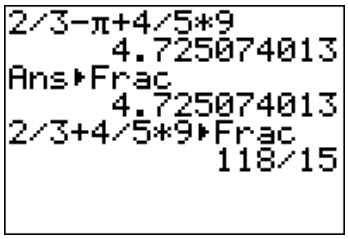
Wrong method: The entire calculation, with the π and without thinking:



Because there's a π in the expression, it's irrational.

Correct method:

Simplify the other fractions that do not contain π:



Then subtract with common denominator (by hand) to get a single fraction:

$$\frac{118}{15}-\pi=\frac{118}{15}-\frac{15\pi}{15}=\frac{118-15\pi}{15}$$

Answer: Irrational

Answer: $\boxed{\frac{118-15\pi}{15}}$

TI-84+ GC 4 Fractions, Decimals, Rational and Irrational Numbers, page 5

Practice: Calculate and convert to fraction. If the GC gives a fraction, write the fraction. Identify if the result is rational or irrational. If the GC did not give a fraction, find the exact answer.

1) $\frac{1}{3}+\frac{7}{8}\left(\frac{5}{6}-\frac{1}{9}\right)$ Circle: Rational – Irrational Answer: _____

2) $3\left(\frac{5}{7}-\frac{1}{3}\cdot\frac{8}{9}\right)$ Circle: Rational – Irrational Answer: _____

3) $\dfrac{\frac{1}{5}-\frac{2}{7}}{\frac{5}{4}+\frac{3}{8}}$ Circle: Rational – Irrational Answer: _____

4) $\left(\frac{4}{9}\right)^2-\left(\frac{2}{5}\right)^2$ Circle: Rational - Irrational Answer: _____

5) $0.002-75(0.025)$ Circle: Rational - Irrational Answer: _____

6) $\frac{2}{3}-7.25+\frac{4}{5}(9)$ Circle: Rational - Irrational Answer: _____

7) $\frac{4}{9}^2-\frac{2}{5}^3$ Circle: Rational - Irrational Answer: _____

8) $\frac{\sqrt{2}}{2}+\frac{\sqrt{3}}{3}+\frac{\sqrt{4}}{4}$ Circle: Rational - Irrational Answer: _____

9) $\frac{2079}{2081}+\frac{1}{2081}$ Circle: Rational - Irrational Answer: _____

10) $\frac{\sqrt{9}}{2}+\frac{\sqrt{16}}{3}+\frac{\sqrt{4}}{4}$ Circle: Rational - Irrational Answer: _____

11) $\frac{316}{79}\cdot\frac{367}{2213}+\frac{743}{2213}$ Circle: Rational - Irrational Answer: _____

12) $\frac{2}{2014}-\frac{1}{4028}$ Circle: Rational - Irrational Answer: _____

13) $\frac{\pi}{3}-\frac{\pi}{6}$ Circle: Rational - Irrational Answer: _____

14) $\frac{\pi}{4}+3\left(\frac{\pi}{8}\right)$ Circle: Rational - Irrational Answer: _____

TI-84+ GC 4 Fractions, Decimals, Rational and Irrational Numbers, page 6

Practice: Calculate. Give integer or fraction answers, not decimals.

15) $\dfrac{|2-9|-|-8|}{-6}$ Answer: _____

16) $\dfrac{4(-5+2)}{3}-\dfrac{-5(3-8)}{6-(-7)}$ Answer: _____

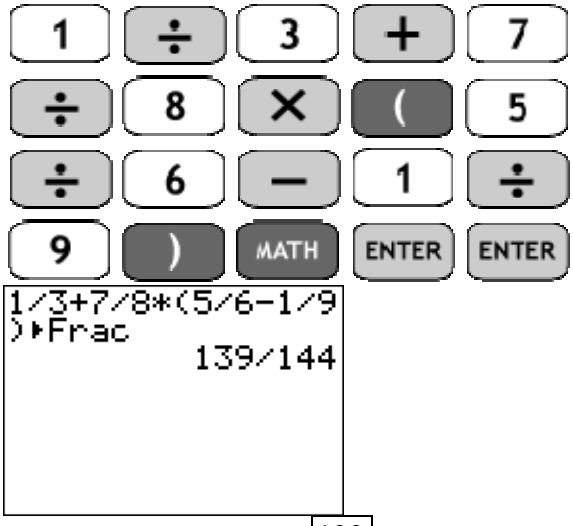
17) $\dfrac{-3\sqrt{60+4}+(-3)^2}{2^3+|4(-7)|}$ Answer: _____

18) $\dfrac{(-3)^4+4\sqrt{125-44}}{5^2+|6(-3)|}$ Answer: _____

19) $\dfrac{\frac{1}{4}\cdot 15-3}{7+\frac{1}{3}\cdot 8}$ Answer: _____

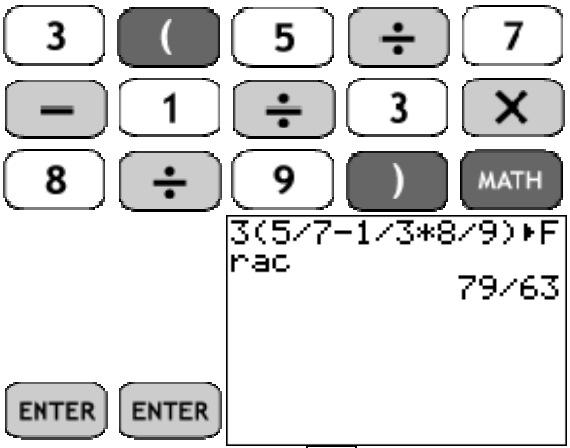
Solutions:

1)



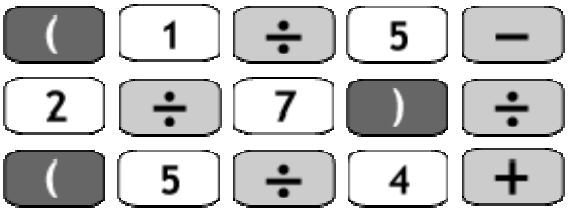
Rational, Answer: $\frac{139}{144}$

2)

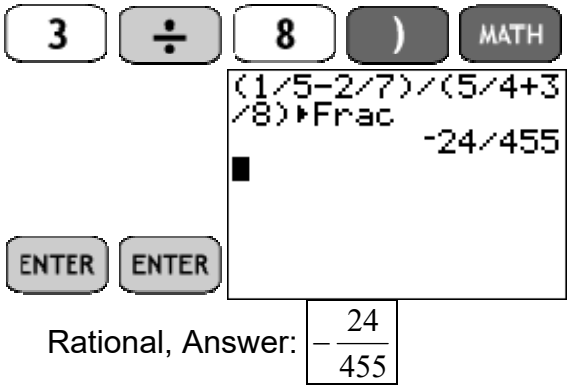


Rational, Answer: $\frac{79}{63}$

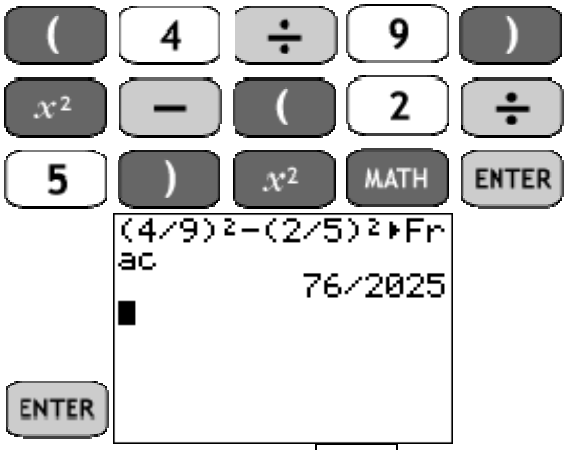
3)



4)

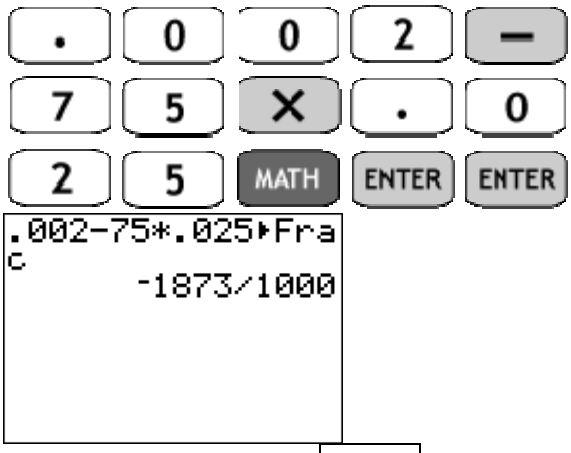


Rational, Answer: $-\frac{24}{455}$



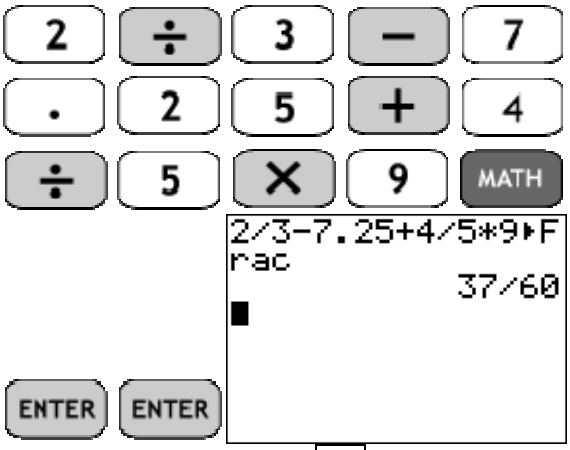
Rational, Answer: $\frac{76}{2025}$

5)

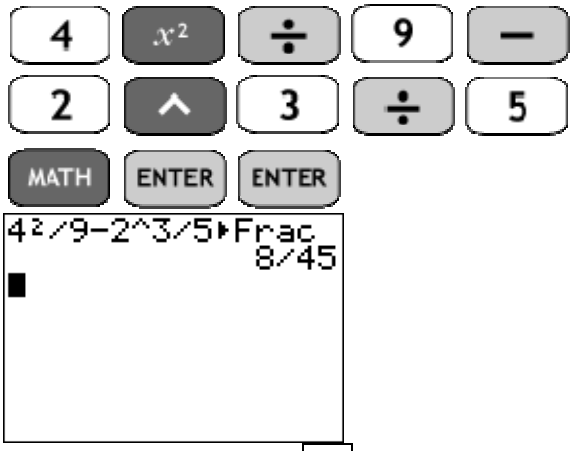


Rational, Answer: $-\frac{1873}{1000}$

TI-84+ GC 4 Fractions, Decimals, Rational and Irrational Numbers, page 8 Solutions

6) 

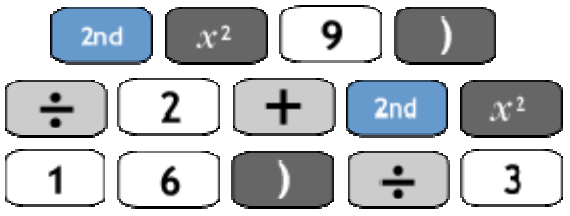
Rational, Answer: $\boxed{\frac{37}{60}}$

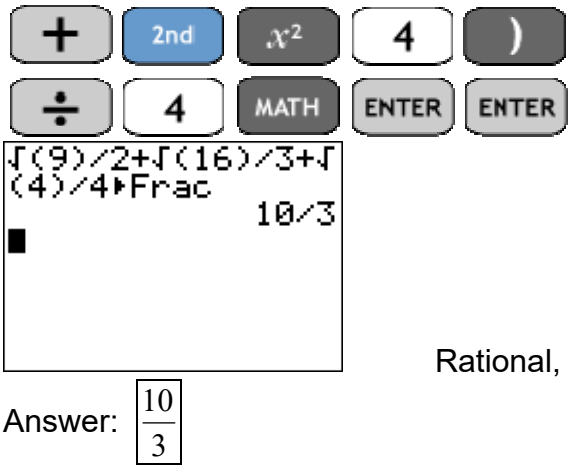
7) 

Rational, Answer $\boxed{\frac{8}{45}}$

8) Irrational, $\frac{\sqrt{2}}{2}+\frac{\sqrt{3}}{3}+\frac{\sqrt{4}}{4}=\frac{\sqrt{2}}{2}+\frac{\sqrt{3}}{3}+\frac{2}{4}=$ $\frac{\sqrt{2}}{2}+\frac{\sqrt{3}}{3}+\frac{1}{2}=\frac{3\sqrt{2}}{6}+\frac{2\sqrt{3}}{6}+\frac{3}{6}=$ Ans: $\boxed{\frac{3\sqrt{2}+2\sqrt{3}+3}{6}}$

9) Rational, $\frac{2079}{2081}+\frac{1}{2081}=$ Answer: $\boxed{\frac{2080}{2081}}$

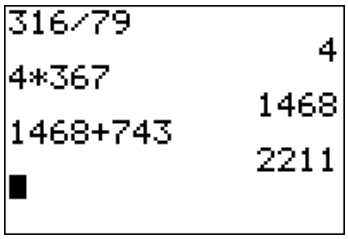
10) 



Rational,

Answer: $\boxed{\frac{10}{3}}$

11) Rational, $\frac{316}{79}\cdot\frac{367}{2213}+\frac{743}{2213}=$ $4\cdot\frac{367}{2213}+\frac{743}{2213}=\frac{1468}{2213}+\frac{743}{2213}=$ Answer:



$\boxed{\frac{2211}{2213}}$

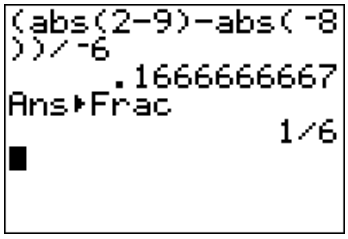
12) Rational, $\frac{2}{2014}-\frac{1}{4028}=\frac{4}{4028}-\frac{1}{4028}=$ Answer: $\boxed{\frac{3}{4028}}$

13) Irrational, $\frac{\pi}{3}-\frac{\pi}{6}=\frac{2\pi}{6}-\frac{\pi}{6}=$ Answer: $\boxed{\frac{\pi}{6}}$

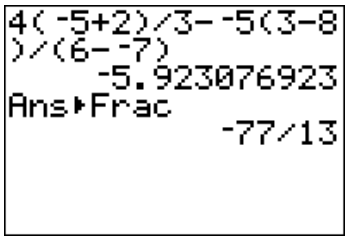
14) Irrational, $\frac{\pi}{4}+3\left(\frac{\pi}{8}\right)=\frac{2\pi}{8}+\frac{3\pi}{8}=$ Answer: $\boxed{\frac{5\pi}{8}}$

TI-84+ GC 4 Fractions, Decimals, Rational and Irrational Numbers, page 9 Solutions

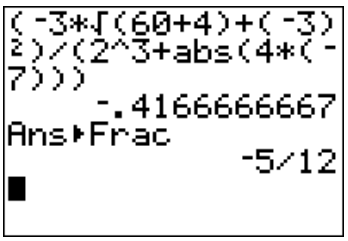
15) $\frac{1}{6}$



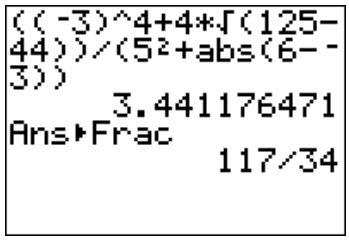
16) $-\frac{77}{13}$



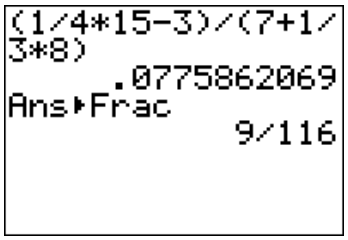
17) $-\frac{5}{12}$



18) $\frac{117}{34}$



19) $\frac{9}{116}$



Rev 12-2-11

Name _____

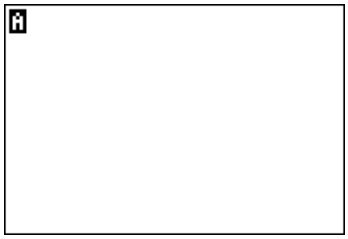
Date _____

TI-84+ GC 5 Memory Locations and Editing Using Answer, Entry, Delete, and Insert

Objectives: Use memory locations for repeated calculations with different variables
Use the GC's automatic recall of the previous answer, ANS
Recall a previous calculation using Entry (ENTRY = 2nd ENTER)
Edit a previous calculation using Delete (DEL) and Insert (INS = 2nd DEL)

The GC has the ability to store numbers in memory so that they can be used again later. Memory locations are letters A through Z, which we access using the ALPHA button in the upper-left under the 2nd key. Usually the ALPHA button is the same color as the letters A through Z, which appear above your regular GC buttons next to the 2nd functions.

Notice after you press the ALPHA [ALPHA] key, the GC cursor changes to the letter A to indicate that your next keystroke will be an alphabetical memory location.
(If you pressed ALPHA by mistake, press it again to return the cursor to normal.)

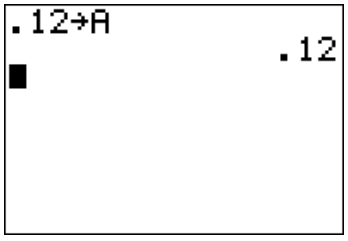


To store a number in memory, type or calculate the number, then press [STO▶] [ALPHA] and the letter name of the location. To retrieve it, press [ALPHA] and the letter name of the location.

Example 1: Store 0.12 in location A, which is above the MATH key:

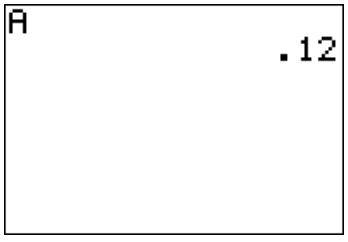
[.] [1] [2] [STO▶] [ALPHA] [MATH] [ENTER]

Answer:



Example 2: Retrieve the number stored in memory location A: [ALPHA] [MATH] [ENTER]

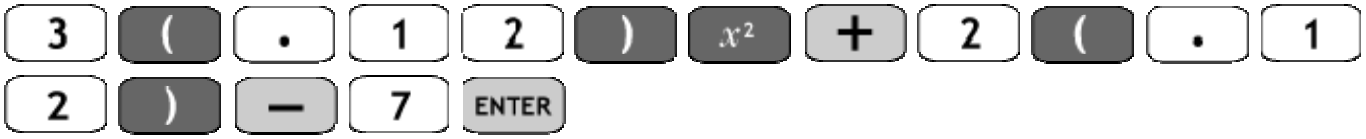
Answer:

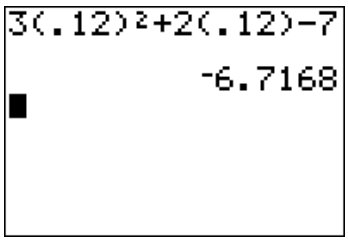


Example 3: Evaluate $3A^2+2A-7$ when $A=0.12$.

Recall: "Evaluate" means to substitute 0.12 in place of A, then do the resulting arithmetic.

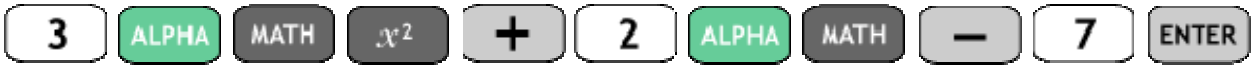
Method 1: Substitute $3(0.12)^2+2(0.12)-7$, then use the calculator:

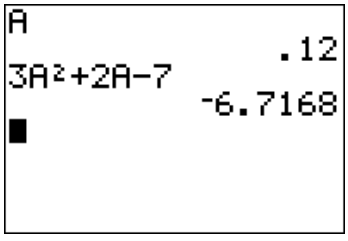




Answer: -6.7168

Method 2: If you did not store 0.12 in A, do it now. After we type the expression $3A^2+2A-7$, the GC will automatically substitute the value 0.12 for each A in the expression and do the arithmetic.

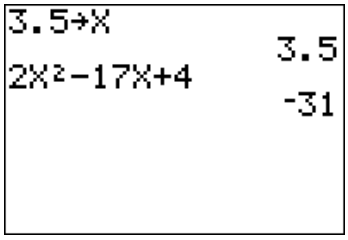




Answer: -6.7168

Example 4: Evaluate $2x^2-17x+4$ when $x=3.5$

Note: Use ALPHA STO▸ for memory location x, not the graphing variable X,T,Θ,n.



Answer: -31

Memory locations can be used for several variables simultaneously.

Example 5: Evaluate $5x^3 - 3xyz + 2x^2y - 7yz^2 - y^3 + z^3$ when $x = 3.5$, $y = -1.7$, and $z = 2.9$.

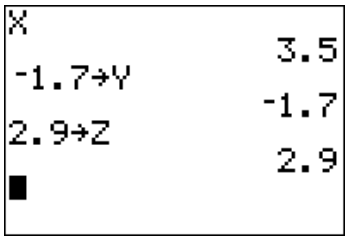
If you are tempted to skip this example because it's long and ugly, don't! The next example uses this same expression, but if you do it now, you'll only have to type it once.
Take a deep breath; here we go!

Step 1: Store all the values of the variables.

Check that x is still the same value from Example 4: ALPHA STO› ENTER

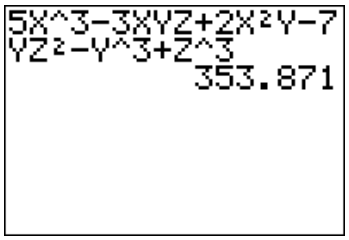
Store the value for y: (−) 1 . 7 STO› ALPHA 1 ENTER

Store the value for z: 2 . 9 STO› ALPHA 2 ENTER



Step 2: Type the expression.

5 ALPHA STO› ^ 3 − 3 ALPHA STO› ALPHA 1 ALPHA
2 + 2 ALPHA STO› x^2 ALPHA 1 − 7 ALPHA 1
ALPHA 2 x^2 − ALPHA 1 ^ 3 + ALPHA 2 ^
3 ENTER



Step 3: Round the result. Answer: 353.871

That last expression was pretty nasty-looking, and most people would rather not type it again. Fortunately, the GC keeps the last fifteen calculations, which we can access using ENTRY, the 2nd function above ENTER. To get the most recent entry, type [2nd] [ENTER]. To see the entry before the most recent entry, press [2nd] [ENTER] again. On newer models of the TI-84+, you can use the directional arrows [▲] [▼] to move to the desired entry, then press ENTER.

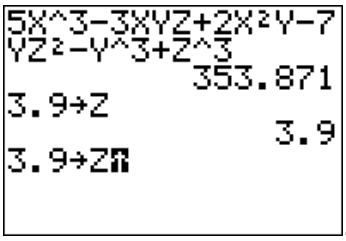
Example 6: Evaluate $5x^3 - 3xyz + 2x^2y - 7yz^2 - y^3 + z^3$ when $x = 3.5$, $y = -1.7$, and $z = 3.9$
Notice that this expression is identical to the previous question, only the value for z is changed.

Step 1: Store the new value of z. (We don't need to store x and y again; they're still there.)

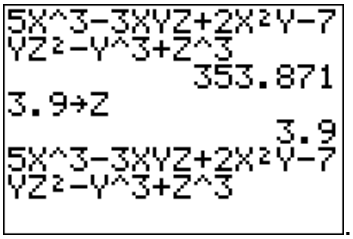
[3] [.] [9] [STO▸] [ALPHA] [2] [ENTER]

Step 2: Use ENTRY to avoid re-typing. The previous entry is now what we just did, storing the new z value, so we want two entries back.

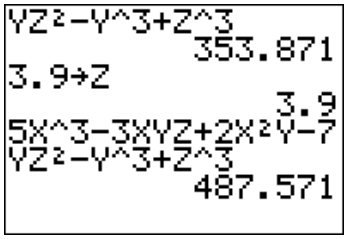
[2nd] [ENTER] gives the first most recent entry



We type again: [2nd] [ENTER] to get the second most recent entry



We press [ENTER] to execute this command.



Step 3: Round the result.

Answer: 487.571

Notice, the GC used the new value for z, so the answer is different from the answer in Example 5.

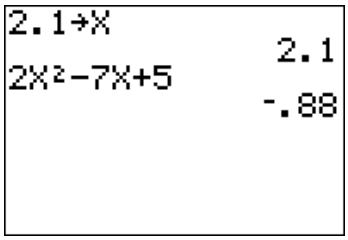
Not only can we use the previous entries, but we can edit them by typing over or using delete [DEL] or using insert (INS is [2nd] [DEL]). In this way, we can avoid re-typing similar entries.

Example 7: (no editing yet): Evaluate $2x^2 - 7x + 5$ when $x = 2.1$.

Store value in x: [2] [.] [1] [STO▶] [ALPHA] [STO▶] [ENTER]

Type the expression:

[2] [ALPHA] [STO▶] [x^2] [−] [7] [ALPHA] [STO▶] [+] [5] [ENTER]



Answer: -.88

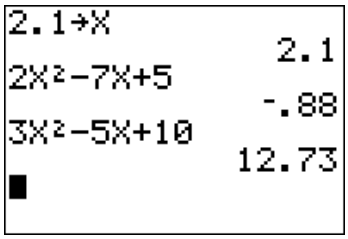
Example 8: (type over the previous): Evaluate $3x^2 - 5x + 10$ when $x = 2.1$

Step 1: Retrieve the previous entry. [2nd] [ENTER]

Step 2: Edit the previous entry.

Use the left arrow to move the cursor on top of the 2, and type 3 instead. Similarly, use the right arrow to move to the 7 and change it to 5, and to the 5 and change it to 10.

[◀] (8 times) [3] [▶] (3 times) [5] [▶] [▶] [1] [0]



Step 3: Check the expression on your screen, and press [ENTER].

Answer: 12.73

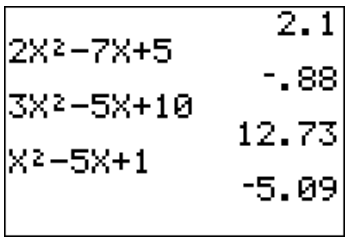
Example 9: (delete from previous): Evaluate $x^2 - 5x + 1$ when $x = 2.1$

Step 1: Retrieve the previous entry. [2nd] [ENTER]

Step 2: Use the left arrow to move the cursor on top of the 3 and delete it. Then move on top of the 0 and delete it.

[◄] (9 times) [DEL] [►] (7 times) [DEL] [ENTER]

Step 3: Check the expression on your screen and press [ENTER]



Answer: -5.09

Example 10: (using insert, which is 2nd DEL): Evaluate $37x^2 - 58x + 146$ when $x = 2.1$

Note: INSERT puts typed text in front of the cursor's location.

Step 1: Retrieve the previous entry. [2nd] [ENTER]

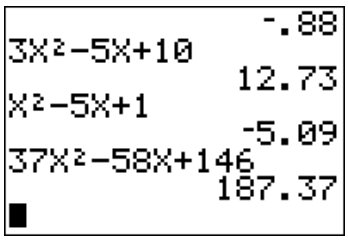
Step 2: Use the left arrow to move the cursor on top of the x of x^2 and insert 37:

Press [◄] (7 times) [2nd] [DEL] [3] [7].

Move on top of the x and insert 8. [►] [►] [►] [►] [2nd] [DEL] [8].

Move to the right of 1 and type 46 to get 146. [►] (3 times) [4] [6] [ENTER]

Step 3: Check the expression on your screen and press [ENTER]



Answer: 187.37

Practice:

1) Evaluate $7B^2+4B-11$ when $B=35.2$. Answer: _____

2) Evaluate $-2C^2+5C+9$ when $C=0.109$. Round to the nearest ten-thousandth.

Answer: _____

3) Evaluate $-2A^2+5A+9$ when $A=0.109$. Round to the nearest tenth.

Answer: _____

4) Does changing the name of the variable (or the name of the memory location) change the result?

Answer: _____

5) Evaluate $A^2+B^2+C^2$ when $A=0.109$, $B=35.2$, and $C=7.06$. Round to the nearest tenth.

Answer: _____

6) Evaluate $2D^3-3E^2+4F$ when $D=17$, $E=18$ and $F=19$ Answer: _____

7) Evaluate $5x^3-3xyz+2x^2y-7yz^2+4xz^2-y^3+z^3$ when $x=3.5$, $y=-1.7$, and $z=4.1$.

Answer: _____

8) Evaluate $5x^3-3xyz+2x^2y-7yz^2+4xz^2-y^3+z^3$ when $x=-3.5$, $y=-1.7$, and $z=4.1$.

Answer: _____

9) Evaluate $5x^3-3xyz+2x^2y-7yz^2+4xz^2-y^3+z^3$ when $x=-3.5$, $y=1.9$, and $z=4.3$.
Note: both the y and z changed. This means the expression will be three entries back.

Answer: _____

10) Evaluate $4x^2+8x+13$ when $x=2.1$. Answer: _____

11) Evaluate $372x^2+589x+1460$ when $x=2.1$ Answer: _____

12) Evaluate $7x^2+9x-1$ when $x=2.1$ Answer: _____

13) Evaluate $72x^2+9x-13$ when $x=7.3$ Answer: _____
Note: the x-value changed, too.

14) Evaluate $-35x^2+x-2$ when $x=-8.1$ Answer: _____

15) Evaluate $-3x^2+9x-23$ when $x=-5.3$ Answer: _____

TI-84+ GC 5 Memory Locations and Editing Using Answer, Entry, Delete, and Insert, solutions

1) 7 ALPHA APPS x^2 + 4 ALPHA APPS − 1

```
B
                    35.2
7B²+4B−11
                  8803.08
```

1 ENTER

Answer: 8803.08

2) . 1 0 9 STO▸ ALPHA PRGM ENTER (−) 2 ALPHA PRGM x^2 + 5 ALPHA PRGM + 9 ENTER

```
.109→C
                    .109
-2C²+5C+9
                  9.521238
■
```

Answer: 9.5212

3) same calculation as the previous question, only rounded differently.
Answer: 9.5

4) No. Changing the name does not change the result when evaluating variables at given values.

5) Store the values: . 1 0 9 STO▸ ALPHA MATH ENTER 3 5 . 2 STO▸ ALPHA APPS ENTER 7

. 0 6 STO▸ ALPHA PRGM ENTER

Type the expression: ALPHA MATH x^2 + ALPHA APPS x^2 + ALPHA PRGM x^2 ENTER

```
B                    .109
                     35.2
7.06→C
                     7.06
A²+B²+C²
                1288.895481
```

Answer: 1288.9

6) Store the values: 1 7 STO▸ ALPHA x^{-1} ENTER 1 8 STO▸ ALPHA SIN ENTER 1 9 STO▸ ALPHA COS ENTER

Type the expression: 2 ALPHA x^{-1} ^ 3 − 3 ALPHA SIN x^2 + 4 ALPHA COS ENTER

```
                     17
18→E
                     18
19→F
                     19
2D^3−3E²+4F
                   8930
■
```

Answer: 8930

TI-84+ GC 5 Memory Locations and Editing Using Answer, Entry, Delete, and Insert, solutions

7) Store the values: [3] [.] [5] [STO▸] [ALPHA] [STO▸] [ENTER] [(−)] [1]

[.] [7] [STO▸] [ALPHA] [1] [ENTER] [4] [.] [1] [STO▸] [ALPHA]

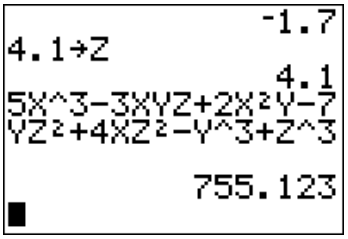
[2] [ENTER] Type the expression: [5] [ALPHA] [STO▸] [^] [3] [−] [3]

[ALPHA] [STO▸] [ALPHA] [1] [ALPHA] [2] [+] [2] [ALPHA] [STO▸] [x^2]

[ALPHA] [1] [−] [7] [ALPHA] [1] [ALPHA] [2] [x^2] [+] [4]

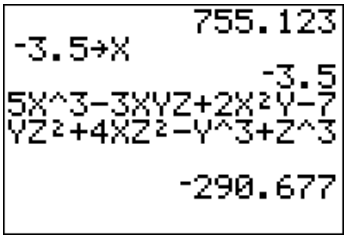
[ALPHA] [STO▸] [ALPHA] [2] [x^2] [−] [ALPHA] [1] [^] [3] [+]

[ALPHA] [2] [^] [3] [ENTER]



Answer: 755.123

8) Store the new x value: [(−)] [3] [.] [5] [STO▸] [ALPHA] [STO▸] [ENTER] Back two entries: [2nd] [ENTER] [2nd] [ENTER] [ENTER]

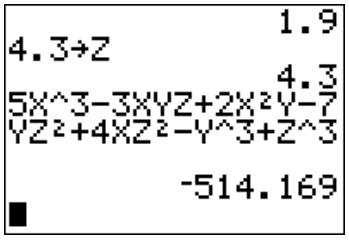


Answer: -290.677

9) Store new values for y and z: [1] [.] [9] [STO▸] [ALPHA] [1] [ENTER] [4]

[.] [3] [STO▸] [ALPHA] [2] [ENTER] Back three entries: [2nd] [ENTER] [2nd]

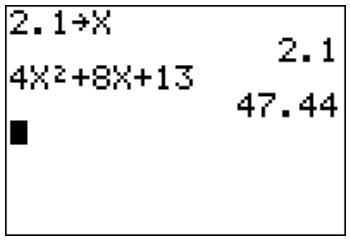
[ENTER] [2nd] [ENTER] [ENTER]



Answer: -514.169

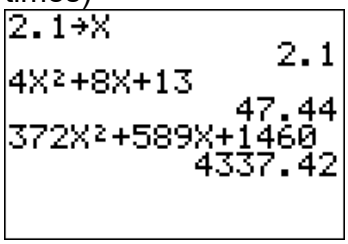
TI-84+ GC 5 Memory Locations and Editing Using Answer, Entry, Delete, and Insert, solutions

10) 2 . 1 STO▸ ALPHA STO▸ ENTER 4 ALPHA STO▸ x^2 + 8 ALPHA STO▸ + 1 3 ENTER



Answer: 47.44

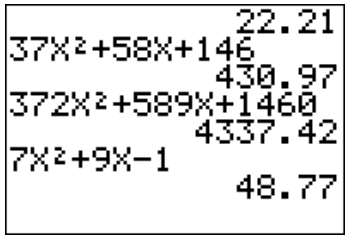
11) 2nd ENTER ◂ (9 times) 2nd DEL 7 2 ▸ (3 times) 5 2nd DEL 8 9 ▸ (3 times) 4 6 0 ENTER



Answer: 4337.42

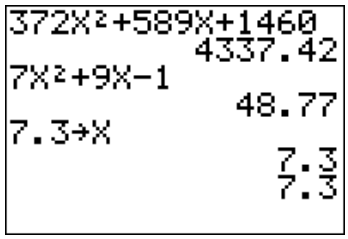
12) 2nd ENTER ◂ (15 times) DEL ▸ DEL ▸ (3 times) DEL DEL ▸ ▸ −

▸ DEL DEL DEL ENTER

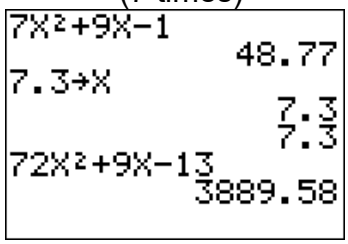


Answer: 48.77

13) New value of x: 7 . 3 STO▸ ALPHA STO▸ ENTER

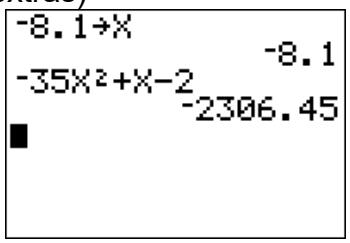


Back two entries: 2nd ENTER 2nd ENTER ◂ (7 times) 2nd DEL 2 ▸ (7 times) 3 ENTER



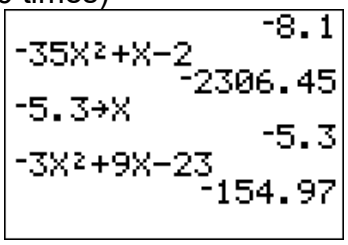
Answer: 3889.58

14) New value of x: (−) 8 . 1 STO▸ ALPHA STO▸ ENTER. Back two entries: 2nd ENTER 2nd ENTER ◂ (10 times) 2nd DEL (insert) (−) 3 5 (delete extras) DEL DEL ▸ (3 times) DEL ▸ ▸



2 DEL ENTER Answer: -2306.45

15) New value of x: (−) 5 . 3 STO▸ ALPHA STO▸ ENTER Back two entries: 2nd ENTER 2nd ENTER ◂ (6 times) DEL ▸ (3 times) 2nd DEL ▸ 9 ▸ (3 times) 3 ENTER



Answer: -154.97

Name _____

Date _____

TI-84+ GC 6 Exact vs. Approximate Results with Fractions and Decimals

Objectives Learn the meaning of "exact" and "approximate"
Use exact forms and approximate forms of fractions correctly
Recognize that the GC display can be an approximate answer

An exact answer has no error. If we use an exact result to perform additional calculations, we'll continue to get exactly the right answer. If we perform the same calculation to different versions of an exact answer, we'll always get the same, exact final result. We use the symbol = to show that the result is exactly equal.

An approximate answer is close to the exact answer, but is a "near miss". We usually find approximate answers by rounding or approximating. If we start with an approximate answer and perform additional calculations, we'll get approximate final results. We use the symbol $\approx$ to show that the result is approximately equal.

CAUTION: You should always give an EXACT answer unless the instructions tell you to round.

Example 1: Write the number $\frac{9}{7}$ several ways and identify if each is exact or approximate.

Exact answers: $\frac{9}{7} = 1\frac{2}{7} = 1.\overline{285714}$

Approximate answers: $\frac{9}{7} \approx 1.29$, $\frac{9}{7} \approx 1.285714$, $\frac{9}{7} \approx 1.285714286$

Exact Answers	**Should I do this?**
Improper Fraction $\frac{9}{7}$	Yes. An improper fraction is exact, and usually easier for continuing calculations.
Terminating decimal, with all places (Does not apply to this example.)	Maybe. If the decimal is short, yes. If the decimal is longer, probably not, since you may copy or type it wrong.
Mixed Number $1\frac{2}{7}$	Maybe. A mixed number is exact, but is often annoying for calculations.
Decimal with repeat bar $1.\overline{285714}$	Probably not. This is an exact answer, but it's not always easy to find or use.

Approximate Answers	**Should I do this?**
Rounded decimal: 1.29 or 1.285714 or rounded to any place value	Probably not. Read the instructions. Only round if the instructions say to round, and only round to the place instructed.
All decimal places in calculator screen for a non-terminating decimal: 1.285714286	NEVER. The calculator has rounded this answer so it will fit on the screen.

Wrong Answers	**Should I do this?**
Incorrectly rounded decimal: 1.28 (chopped)	Never.

The calculator shows all the places its "brain" can comprehend. But its "brain" only has 9-15 decimal places, which is not always enough.

Example 2: Calculate several answers for $\frac{9}{7}\cdot 7$ and identify if each is exact or approximate.

a. $\frac{9}{7}\cdot 7$ Answer: 9, exact

b. $\left(1\frac{2}{7}\right)\cdot 7$ Answer: 9, exact

c. $(1.29)\cdot 7$ Answer: ≈ 9.03, approximate

d. $(1.285714)\cdot 7$ Answer: ≈ 8.999998, approximate

e. $(1.285714286)\cdot 7$ Answer: ≈ 9.000000002, approximate
(retype the decimal, don't use ANS)

f. If your exam question asks you to find $\frac{9}{7}\cdot 7$, which answer(s) would be correct?
Answer: Only the exact answer 9 (obtained from a or b) is correct.

Example 3: Calculate different answers for $\frac{7}{9}\cdot 36$ and identify if each is exact or approximate.

a. $\frac{7}{9}\cdot 36 = 28$ exact

b. $(.777777778)\cdot 36 = 28.00000001$ is approximately equal to $\frac{7}{9}\cdot 36$

So far, so good. But do these next two by hand first, then use your GC.

c. $(.7777777778)\cdot 36$ = 28.0000000008 is approximately equal to $\frac{7}{9}\cdot 36$

d. $(.7777777777)\cdot 36$ = 27.9999999972 is approximately equal to $\frac{7}{9}\cdot 36$

For both of these, the GC gives 28 because it rounded when its "brain" was too small.

Practice: Perform the calculations and identify if your answers are exact or approximate.

1) Write $\frac{7}{9}$ as a decimal. _____ Exact or approximate?

   a. Round to the nearest ten-thousandth: _____ Exact or approximate?

   b. Every decimal place on the calculator: _____ Exact or approximate?

2) Write $\frac{1}{3}$ as a decimal. _____ Exact or approximate?

   a. Round to the nearest thousandth: _____ Exact or approximate?

   b. Every decimal place on the calculator: _____ Exact or approximate?

3) Give several different answers for $\frac{1}{3}\cdot 9$.

   a. $\frac{1}{3}\cdot 9$ = _____ Exact or approximate?

   b. $(0.333)\cdot 9$ = _____ Exactly or approximately equal to $\frac{1}{3}\cdot 9$?

   c. $(0.333333333)\cdot 9$ = _____ Exactly or approximately equal to $\frac{1}{3}\cdot 9$?

   d. If your exam question asks you to find $\frac{1}{3}\cdot 9$, which answer(s) would be correct?

4) Write $\frac{7}{8}$ as a decimal. _____ Exact or approximate?

   a. Round to the nearest hundredth: _____ Exact or approximate?

   b. Round to the nearest tenth: _____ Exact or approximate?

5) Calculate different answers for $\frac{7}{8}\cdot 16$ and identify if exact or approximate.

   a. $\frac{7}{8}\cdot 16$ = _____ Exact or approximate?

   b. $(0.875)\cdot 16$ = _____ Exactly or approximately equal to $\frac{7}{8}\cdot 16$?

   c. $(0.88)\cdot 16$ = _____ Exactly or approximately equal to $\frac{7}{8}\cdot 16$?

   d. $(0.9)\cdot 16$ = _____ Exactly or approximately equal to $\frac{7}{8}\cdot 16$?

   e. If your exam question asks you to find $\frac{7}{8}\cdot 16$, which answer(s) would be correct?

1) $\frac{7}{9} = 0.\overline{7}$, a repeating decimal or fraction is exact.

   a. $\frac{7}{9} \approx 0.7778$ approximate

   b. $\frac{7}{9} \approx 0.7777777778$ approximate

2) $\frac{1}{3} = 0.\overline{3}$, repeating decimal, exact (must use repeat bar).

   a. $\frac{1}{3} \approx 0.333$ approximate

   b. $\frac{1}{3} \approx 0.3333333333$ approximate

3) a. $\frac{1}{3} \cdot 9 = 3$ exact

   b. $\frac{1}{3} \cdot 9 \approx 2.997$ approximate

   c. $\frac{1}{3} \cdot 9 \approx 2.999999997$ approximate

   d. Only the exact answer 3, obtained from a, would be correct.

4) $\frac{7}{8} = 0.875$ exact

   a. $\frac{7}{8} \approx 0.88$ approximate

   b. $\frac{7}{8} \approx 0.9$ approximate

5) a. $\frac{7}{8} \cdot 16 = 14$ exact

   b. $\frac{7}{8} \cdot 16 = 0.875 \cdot 16 = 14$ exact

   c. $\frac{7}{8} \cdot 16 \approx 14.08$ approximate

   d. $\frac{7}{8} \cdot 16 \approx 14.4$ approximate

   e. Only the exact answer 14, obtained from a. or b. would be correct.

Name _____

Date _____

TI-84+ GC 7 Avoiding Round-off Error in Multiple Calculations

Objectives: Recall the meaning of exact and approximate
Observe round-off error and learn to avoid it
Perform calculations using the order of operations and extra parentheses

Recall: An exact answer has no error. If we use an exact result to perform additional calculations, we'll continue to get exactly the right answer. If we perform the same calculation to different versions of an exact answer, we'll always get the same, exact final result.

An approximate answer is close to the exact answer, but is a "near miss". We usually find approximate answers by rounding or approximating. If we start with an approximate answer and perform additional calculations, we'll get approximate final results.

CAUTION: You should always give an EXACT answer unless the instructions tell you to round.

Round-off error is the absolute value of the difference between the exact answer and a rounded approximation of that answer, given by this formula: $RoundoffError = |exact - approximate|$.

Round-off error is the answer to the question "How wrong is the rounded answer?"

Example 1: $\frac{1}{8}$ = 0.125 exactly. Rounded to the nearest tenth, $\frac{1}{8} \approx .1$

The round-off error, using the formula, in the answer 0.1 is $|0.125 - 0.1| = 0.025$

In this example, the answer is wrong by 0.025.

Round-off errors can become much bigger if a calculation is done from rounded partial results.

Example 2: To illustrate the error of rounding partial results, calculate $\frac{2472.7908}{0.4678}$ exactly and with rounded partial results, and then find the resulting round-off error. How wrong will the answer be?

a) Calculate $\frac{2472.7908}{0.4678}$ exactly. Answer: 5286

b) Round 2472.7908 to the nearest tenth. Answer: 2472.8

c) Round 0.4678 to the nearest tenth. Answer: 0.5

d) Divide your rounded answer for 2472.7908 by your rounded answer for 0.4678

$\frac{2472.8}{.5} = 4945.6$ Answer: 4945.6

e) Find the round-off error for this calculation.

$|5286 - 4945.6| = 340.4$ Answer: 340.4

How wrong is the answer? It's off by 340.4! That's a lot.

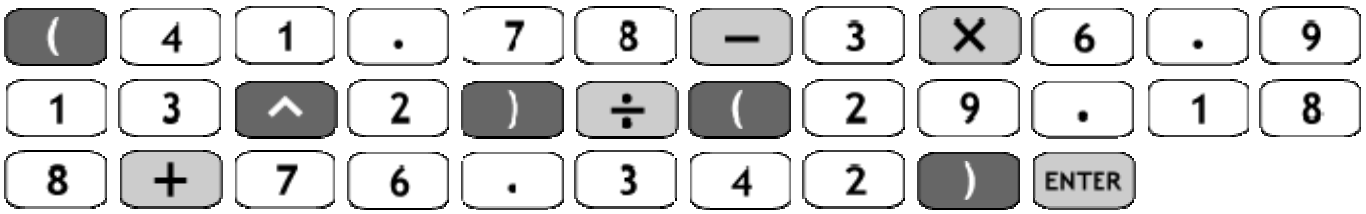
IMPORTANT: Do not round parts of a calculation! Instead, do the calculation all at once (using extra parentheses for the correct order of operations) or use memory storage locations.
If the instructions say to round, round only the final answer.

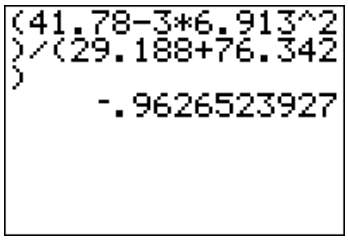
Example 3:

Calculate $\frac{41.78-3(6.913)^2}{29.188+76.342}$. Round to the nearest thousandth.

Remember that the long fraction bar means that the entire numerator and entire denominator must be calculated before the results are divided. But the GC follows the order of operations and will not add or subtract before dividing unless we use extra parentheses, like this:

$$\frac{\left(41.78-3(6.913)^2\right)}{\left(29.188+76.342\right)}$$





Then round the final answer to the nearest thousandth. Answer: -.963

Example 4: Calculate $\frac{(-12)^{3-6}}{9.7-18.034}$. Round to the nearest ten-thousandth.

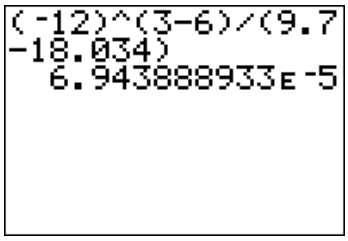
Notice that there is a subtraction in the exponent. The GC will not subtract before an exponent unless extra parentheses are added, like this:

$$\frac{(-12)^{(3-6)}}{9.7-18.034}$$

Also notice the long fraction bar, as before. Again, extra parentheses are needed so the GC will subtract the denominator before dividing, like this:

$$\frac{(-12)^{(3-6)}}{(9.7-18.034)}$$

Example 4, continued:



Convert scientific notation to standard notation:

Multiply 6.943888933 by 10^{-5}, by moving the decimal point five places left to get 0.00006943888933

Then round to the nearest ten thousandth (four decimal places):

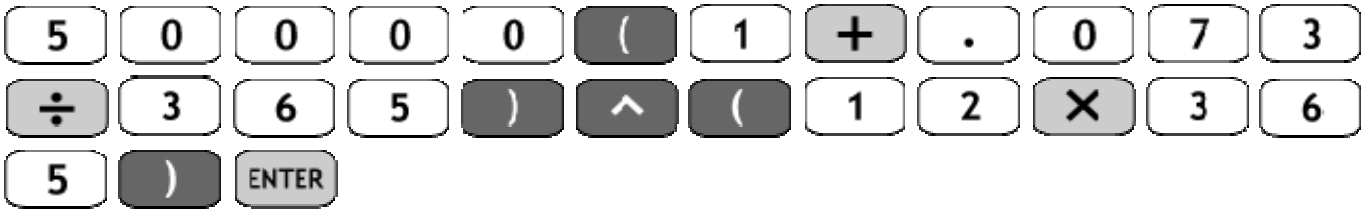
0.0001

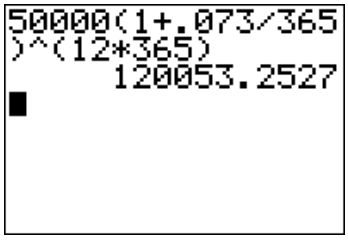
Answer: 0.0001

Example 5: Calculate $50000\left(1+\frac{0.073}{365}\right)^{12(365)}$. Round to the nearest hundredth.

Notice that there is a multiplication in the exponent. The GC will not multiply before an exponent unless extra parentheses are used:

$$50000\left(1+\frac{0.073}{365}\right)^{(12(365))}$$





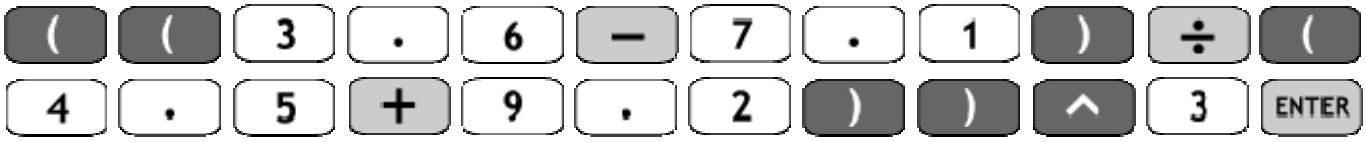
Round to nearest hundredth (2 decimal places): 120,053.25

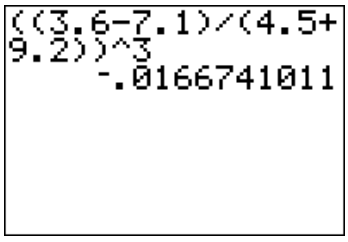
Answer: 120,053.25

Example 6: Calculate $\left(\frac{3.6-7.1}{4.5+9.2}\right)^3$. Round to the nearest thousandth.

Notice that the parentheses supplied surround both the numerator and the denominator. These do not ensure that the numerator will be subtracted first! To get the correct answer, use additional parenthesis *inside* the given parentheses, like this:

$\left(\frac{(3.6-7.1)}{(4.5+9.2)}\right)^3$



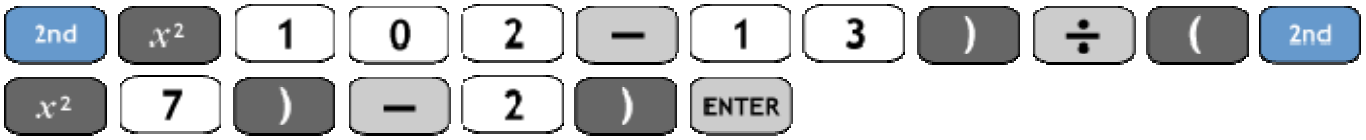


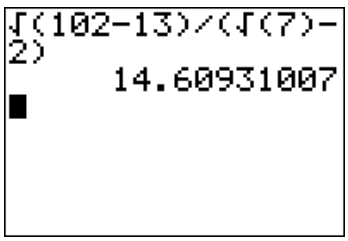
Answer: -0.017

Example 7: Calculate $\frac{\sqrt{102-13}}{\sqrt{7}-2}$. Round to the nearest hundredth.

Notice the square roots are different. First, the square root in the numerator is the square root of a difference – use parentheses around the difference. Second, the denominator is a difference of a square root and 2, so close the parentheses for the square root, and use another set around the entire denominator, like this:

$\frac{\sqrt{(102-13)}}{(\sqrt{(7)}-2)}$





Answer: 14.61

Practice:

1) Find the round-off error if $\frac{5}{16}$ is rounded to the nearest tenth. Answer: _____

2) Find the round-off error if 1289 is rounded to the nearest hundred. Answer: _____

3) Calculate $\frac{7.2(43.9)^3 - 97.42}{63.08 - 9.71 + (-23.64)}$. Round to the nearest tenth.

Answer: _____

4) Calculate $\frac{14^{77-72} + (-13)^{83-79}}{23718 - 654}$. Round to the nearest hundredth.

Answer: _____

5) Calculate $275000\left(1 + \frac{0.0525}{12}\right)^{30(12)}$. Round to the nearest hundredth.

Answer: _____

6) Calculate $930\left(1 - \frac{0.038}{4}\right)^{7/12}$. Round to the nearest whole.

Answer: _____

7) Calculate $7216\left(1 - \frac{0.0941}{11}\right)^{11/16}$. Round to the nearest ten.

Answer: _____

8) Calculate $\frac{8^{-32+25} - (-5)^{76-63}}{147 - 236098}$. Round to the nearest hundredth.

Answer: _____

9) Calculate $\frac{8^{2\cdot(-3)} - (-4)^{-4(2)}}{0.00388 - 0.001907}$. Round to the nearest thousandth.

Answer: _____

10) Calculate $\left(\frac{2.7 - 6.3}{5.4 + 8.1}\right)^2$. Round to the nearest thousandth.

Answer: _____

11) Calculate $\frac{\sqrt{124 - 31}}{\sqrt{6} - 3}$. Round to the nearest hundredth.

Answer: _____

12) Calculate $\left(\frac{7.2 - 1.3^3}{6.2 + 1.9}\right)^2$. Round to the nearest hundredth.

Answer: _____

13) Calculate $\frac{\sqrt{6} - 3}{\sqrt{124 - 31}}$. Round to the nearest hundredth.

Answer: _____

14) Calculate $\sqrt{\frac{21 - 4}{4}} - \frac{\sqrt{17}}{7 - 3}$. Round to the nearest hundredth.

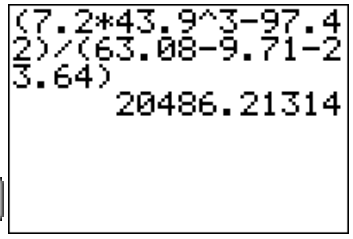
Answer: _____

TI-84+ GC 7 Avoiding Round-off Error in Multiple Calculations, solutions, page 6

1) $\frac{5}{16} = 0.3125$ rounds to 0.3. Round-off error = $|0.3125 - 0.3| = 0.0125$ Answer: 0.0125

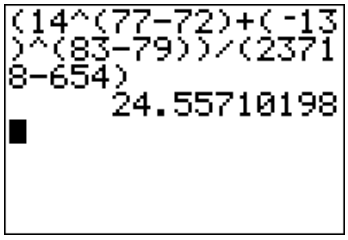
2) 1289 rounded to the nearest hundred is 1300. Round-off error $|1289 - 1300| = |-11| = 11$ Answer: 11

3) (7 . 2 × 4 3 . 9 ^ 3 − 9 7 . 4 2) ÷ (6 3 . 0 8 − 9 . 7 1 − 2 3 . 6 4) ENTER



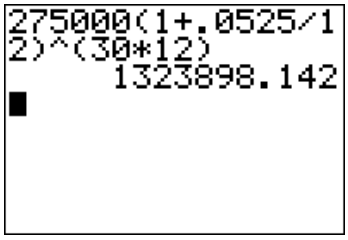
Answer: 20486.2

4) (1 4 ^ (7 7 − 7 2) + ((−) 1 3) ^ (8 3 − 7 9)) ÷ (2 3 7 1 8 − 6 5 4) ENTER



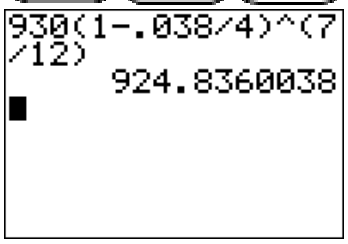
Answer: 24.56

5) 2 7 5 0 0 0 (1 + . 0 5 ÷ 2 5) ^ (3 0 × 1 2) ENTER



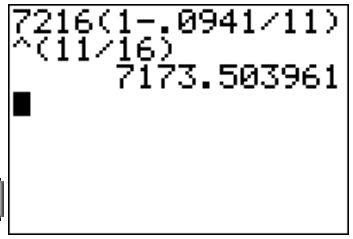
Answer: 1,323,898.14

6) 9 3 0 (1 − . 0 3 8 ÷ 4) ^ (7 ÷ 1 2) ENTER



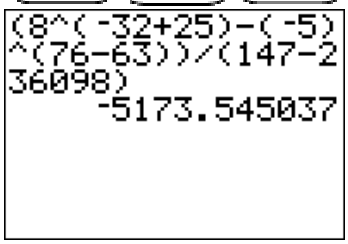
Answer: 925

7) 7 2 1 6 (1 − . 0 9 4 1 ÷ 1 1) ^ (1 1 ÷ 1 6) ENTER



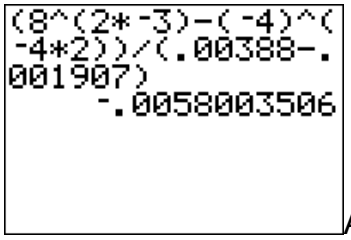
Answer: 7270.

8) (8 ^ ((−) 3 2 + 2 5) − ((−) 5) ^ (7 6 − 6 3)) ÷ (1 4 7 − 2 3 6 0 9) 8) ENTER



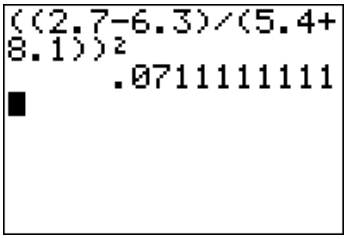
Answer: -5173.55

9) (8 ^ (2 × (−) 3) − ((−) 4) ^ ((−) 4 × 2)) ÷ (. 0 0 3 8 8 − . 0 0 1 9 0 7) 0 7) ENTER



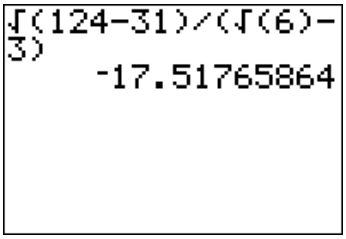
Answer: -0.006

10) ((2 . 7 − 6 . 3) ÷ (5 . 4 + 8 . 1)) x^2 ENTER



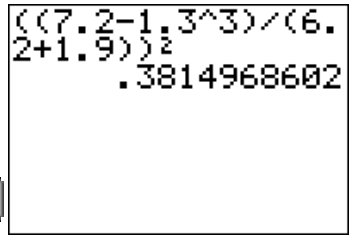
Answer: 0.071

11) 2nd x^2 1 2 4 − 3 1) ÷ (2nd √ (124 − 31) ÷ (√ (6) − 3) x^2 6) − 3) ENTER



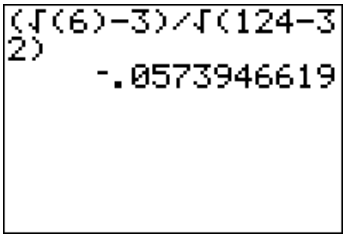
Answer: -17.52

12) ((7 . 2 − 1 . 3 ^ 3) ÷ (6 . 2 + 1 . 9)) x^2 ENTER



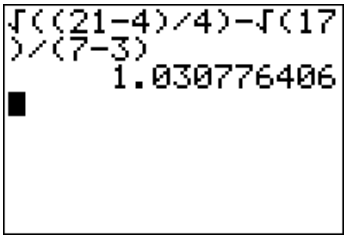
Answer: 0.38

13) (2nd x^2 6) − 3) ÷ 2nd x^2 1 (√ (6) − 3) ÷ √ (124 − 32) ENTER



Answer: -0.06

14) 2nd x^2 (2 1 − 4) ÷ 4) − 2nd x^2 1 7) ÷ (7 − 3)) ENTER



Answer: 1.03