Math 72 Graphing Calculator

Objectives

ON/OFF

2nd functions
negative numbers versus subtract
order of operations & extra parentheses
convert decimals to fractions
scientific notation
exact answers vs. approximate answers.
graphing
TABLES — AUTO
— ASK

adjusting the graphing WINDOW.
Time permitting: recall & edit previous calculation

Reference to Graphing Calculator Exercises

GC 1 on/off, power, negative numbers vs. subtract
GC 2 exponents + scientific notation
GC 3 order of op
GC 4 ▸ frac
GC 6 exact & approximate
GC 7 order of op & parentheses
GC 10 Tables
GC 15 Basic Graph
GC 17 Window

Math 72

Calculate by hand and by GC. Give exact answers.

① $-18-4\div 2+7$

$=-18-2+7$

$=-22+7$

$=\boxed{-15}$

order of op: ÷ before − or +

order of op: + & − from L→R

GC: [(-)] 18 [−] 4 [÷] 2 [+] 7 [ENTER]

Two different keys { [−] is subtract; [(-)] is negative

② $\dfrac{-18-4}{2+4}$ ← fraction bar is a grouping symbol!

Since GC knows order of operations, must use ( ).

$=\dfrac{-22}{6}$

$=\boxed{\dfrac{-11}{3}}=\boxed{-3\dfrac{2}{3}}$

GC: ([(-)] 18 − 4) / (2 + 4) [MATH] 1. ▸ frac [ENTER]

③ $\dfrac{-18-4^2}{2^3+4}$

order of op: exponents

$4^2=4\cdot 4=16$

$2^3=2\cdot 2\cdot 2=8$

$=\dfrac{-18-16}{8+4}$

$=\dfrac{-34}{12}$

$=\boxed{\dfrac{-17}{12}}=\boxed{-1\dfrac{5}{12}}$

GC: ([(-)] 18 − 4 [x^2]) / (2 [^] [3] + 4) [MATH] 1. ▸ frac [ENTER]

(4) $\dfrac{18-4^2}{2^3+400}$

a) Use GC to find exact result.

b) Use GC to find decimal result and round to the nearest ten-thousandth.

c) Convert rounded answer from b) to a fraction.

d) Is the result in c) the same (equal) to result from a)?

a) $(18 - 4\,[x^2]) \,/\, (2\,[\wedge]\,[3] + 400)$ [MATH] 1. ▸frac [ENTER]

$= \boxed{\dfrac{1}{204}}$

b) [MATH] 2. ▸Dec { (✓) and [ENTER] or [2]

.0049019608

$\approx$ .0049

↑ tenths ↑ hundredths ↑ thousandths ↑ ten-thousandths

c) .0049 [MATH] 1. ▸frac [ENTER]

GC might not know this fraction!!

$= \boxed{\dfrac{49}{10,000}}$

d) No.

$\dfrac{1}{204} \approx .0049019608\ldots$

$\dfrac{49}{10000} = .0049$

So $\dfrac{1}{204} > \dfrac{49}{10000}$

(5) Round to nearest ten-thousandth.

$$\frac{18-4^2}{2^3+4000}$$

(18 − 4 [x^2]) / (2 [^] [3] + 4000) [ENTER]

⇒ 4.99001996 E −4 GC display is NOT using standard math notation!

≈ $4.99001996 \times 10^{-4}$ scientific notation

= $4.99001996 \times .0001$

= .000499001996

≈ [.0005]

(6) Round to nearest ten-thousand.

$$\frac{18-4^{20}}{2^3+4}$$

(18 − 4 [^] 20) / (2 [^] 3 + 4) [ENTER]

⇒ −9.1625969 E 10

≈ $-9.1625969 \times 10^{10}$

= $-9.1625969 \times 10000000000$

= −91625969000

≈ [−91,625,970,000]

(7) In GC, graph $y = 2x + 3$

[Y=]

$Y_1 = 2$ [X,T,θ,n] $+ 3$

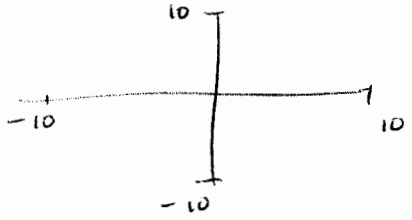
[2nd] QUIT [MODE]

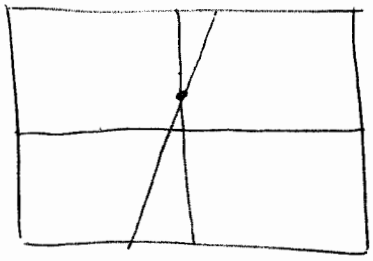
STEP 1
Tell the GC what to use for the equation.

[ZOOM]

6. ZStandard

STEP 2
Tell calculator to graph in 10x10 window





(8) Complete the table for $y = 2x + 3$

X	Y_1
-1	1
0	3
1	5
2	7
3	9
4	11
108	219
-47	-91

In (7) we told the GC to use $y = 2x+3$

Automatic Table →

[2nd] TBLSET [WINDOW]

TblStart 0
ΔTbl 1
Indpnt: [Auto] Ask
Depend: [Auto] Ask

[2nd] TABLE [GRAPH]

Use (Δ) or (∇)

Ask Table →

[2nd] TBLSET [WINDOW]

Indpnt: Auto [Ask]

Type 108 ENTER
(-) 47 ENTER

(9) Graph in GC $y = -x + 20$

Nothing shows!

Look at TABLE

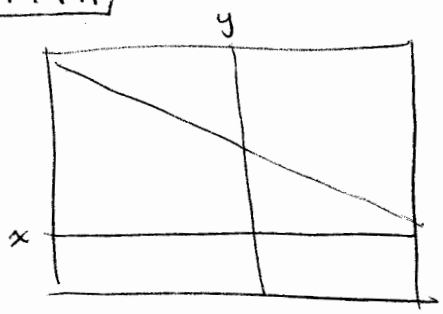
x	y
-1	21
0	20
1	19

} y-values are bigger than 10.

WINDOW

YMAX 30

GRAPH



(10) $4,000,000,000,000 \times .000000007$ in GC

↑ move 9 places

$= (4 \times 10^{15})(7 \times 10^{-9})$

4 [2nd] [,] 15 [X] 7 [2nd] [,] [(-)] 9

↑ neg #

EE is computer programming for $\times 10$

$= 28,000,000$ or 2.8×10^{7}

Scientific Notation Summary for Math 70

Objectives

1) Given a number in standard form, write it in scientific notat
   a) If small number (<1), negative exponent
   b) If large number (≥ 10), positive exponent
2) Given a number in scientific notation, write in standard form
   Method: Multiply.
3) Use scientific notation to make calculations easier.
4) Write results of calculations in scientific notation.

Scientific Notation: A number written as $a \times 10^N$, where

a) N is an integer $\{\ldots -3, -2, -1, 0, 1, 2, 3, \ldots\}$

b) $|a| > 0$ but $|a| < 10$.

(This means: a has one NONZERO digit to the left of the decimal pt.)

Examples: These numbers are in scientific notation.

① 2.035×10^4 means 20,350

② 1.98×10^0 means 1.98

③ $4. \times 10^{-2}$ means 0.04

Examples: These numbers aren't quite in scientific notation.

④ $\underline{0}.34 \times 10^5$ (digit to left of decimal point cannot be zero)

⑤ $\underline{13}.04 \times 10^{-3}$ ← (only one digit to left of decimal pt).

⑥ $\underline{20}.3 \times 10^4$ ↙

To write in scientific notation:

⑦ 270,300,000,000.

$2.703 \times 10^?$

270,300,000,000.
↑← ← ← ← ← ← ↵
11 places

$\boxed{2.703 \times 10^{11}}$

Starting from the LEFT, find one nonzero digit.
Write the "a" part of $a \times 10^N$.
Count the number of decimal places moved.
This is the exponent.

⑧ 0.0000000306 ← very small number; a negative power of 10 is needed.

$3.06 \times 10^{?}$

0.0000000306
↳ → → → → ↑
8 places

$\boxed{3.06 \times 10^{-8}}$

To write a number in standard form:

⑨ -3.5701×10^{8}
↑
move decimal pt 8 places

multiplying by a positive power of 10 makes a large number. (decimal pt moves right)
Move decimal point, using as many extra zeros as needed.

−357010000.
↓ - - → - - → - - ↑

$\boxed{-357{,}010{,}000.}$

---

⑩ 1.02×10^{-6}
↑
move decimal 6 places

multiplying by a negative power of 10 makes a small number (decimal pt moves left)

.000001,02
↑ ← - ← - ← ← ← ↵

$\boxed{.00000102}$

CAUTION Be sure your final answer has only one decimal point!

To use scientific notation for calculations (Mult & Divide only)

⑪ $(1.2 \times 10^{12})(3 \times 10^{-4})$

$= (1.2)(10^{12})(3)(10^{-4})$

$= (1.2)(3)(10^{12})(10^{-4})$

$= 3.6 \quad 10^{12-4}$

$= \boxed{3.6 \times 10^{8}}$

Note that this is simply four numbers, all multiplied.
Commutative property lets us change the order

(12) $\dfrac{4.8 \times 10^{-5}}{2 \times 10^{-26}}$

$= \left(\dfrac{4.8}{2}\right) \cdot \left(\dfrac{10^{-5}}{10^{-26}}\right)$

$= (2.4)(10^{-5-(-26)})$

$= \boxed{2.4 \times 10^{21}}$

Note that we can clarify by rewriting using the definition of fraction multiplication backward.

If $\dfrac{a}{b} \cdot \dfrac{c}{d} = \dfrac{ac}{bd}$,

then $\dfrac{a \times c}{b \times d} = \left(\dfrac{a}{b}\right) \cdot \left(\dfrac{c}{d}\right)$.

* CAUTION * The result may not be in proper scientific notation.

(13) $(4 \times 10^{-17})(9 \times 10^{-11})$

$= (4)(9)(10^{-17})(10^{-11})$

$= 36. \times 10^{-28}$ ← 2 digits to the left of the decimal.

$= 3.6 \times 10^{1} \times 10^{-28}$ ← Substitute for 36 what you get when you write 36 in scientific notation.

$36 = 3.6 \times 10^{1}$

$= \boxed{3.6 \times 10^{-27}}$

Then add exponents.

(14) $\dfrac{1.5 \times 10^{-3}}{3 \times 10^{15}}$

$= \left(\dfrac{1.5}{3}\right) \cdot \left(\dfrac{10^{-3}}{10^{15}}\right)$

$= \frac{1}{2} \cdot 10^{-3-15}$

$= 0.5 \times 10^{-18}$ ← Must have one nonzero digit to the left of the decimal pt.

$= 5.0 \times 10^{-1} \times 10^{-18}$ ← Substitute for 0.5 what you get when you write 0.5 in scientific notation:

$0.5 = 5 \times 10^{-1}$

$= \boxed{5.0 \times 10^{-19}}$

Then add exponents.

Intro to the Graphing Calculator, Review Order of Operations & Scientific Notation

Graphing calculator handouts

All-in-one problem -- this is the goal, and is remarkably similar to the question on the PQ!

GC 1
GC 2
GC 3
GC 4
GC 6

} GC packets include solutions to all practice problems

If you finish all of the above in class, then GC5

GC 5: Examples must be done IN ORDER, or the packet does not make sense.

You may choose from several approaches:

1) Challenge first: (Recommended only for students who have used a GC a lot.)

   Start with the All-in-one problem. If you don't have the correct answer, review handouts, especially
   GC 3 regarding the correct use of parentheses and
   GC 2 regarding scientific notation.
   Once you have the correct answer, do GC 5.
   GC 5: Examples must be done IN ORDER, or the packet does not make sense.

2) Systematic: (Recommended for students who are new to the GC or have forgotten.)

   Start with GC 1: do all
   GC 2: do examples 1-14 first, skip the Practice for now
   GC 3: do examples 1-12 first, skip the Practice for now
   GC 4: do examples 1-9 first, skip the Practice for now
   GC 6: do examples 1-3 first, skip the Practice for now
   All-in-one problem
   Test yourself – if you need more practices, go back to the Practice problems on GC 2-3-4-6
   GC 5: Examples must be done IN ORDER, or the packet does not make sense.

3) Review first: (For the impatient student. Not generally recommended.)

   Skim all examples, GC1-2-3-4-6
   Work on All-in-one problem.. If you don't have the correct answer, review handouts, especially
   GC 3 regarding the correct use of parentheses and
   GC 2 regarding scientific notation.
   Once you have the correct answer do GC 5.
   GC 5: Examples must be done IN ORDER, or the packet does not make sense.

Complete GC packets and all solutions are available on the class website under GC Exercises.
Keystrokes for the All-in-one problems are on the class website under Lecture Notes.

GC All-In-One problem

This question uses algebra to evaluate, GC to calculate (including extra parentheses, negative numbers, memory locations, locating obscure roots), scientific notation, standard notation, rounding, determining an exact versus an approximate answer, etc.

1) Evaluate $\dfrac{97y^9 - 4\sqrt[3]{x}}{908020\sqrt{x} - 993y}$ when $x = 0.92$ and $y = -1.06$, and round to the nearest ten-thousandth.

2) Check the box which describes your answer.
   - ☐ My answer is exact.
   - ☐ My answer is approximate.

GC All-In-One problem Solution

This question uses algebra to evaluate, GC to calculate (including extra parentheses, negative numbers, memory locations, locating obscure roots), scientific notation, standard notation, rounding, determining an exact versus an approximate answer, etc.

1) Evaluate $\dfrac{97y^9 - 4\sqrt[3]{x}}{908020\sqrt{x} - 993y}$ when $x = 0.92$ and $y = -1.06$, and round to the nearest ten-thousandth.

2) Check the box which describes your answer.

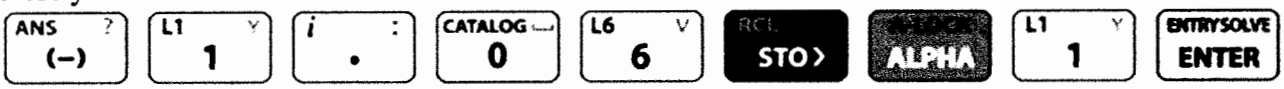
My answer is exact.

√ My answer is approximate.

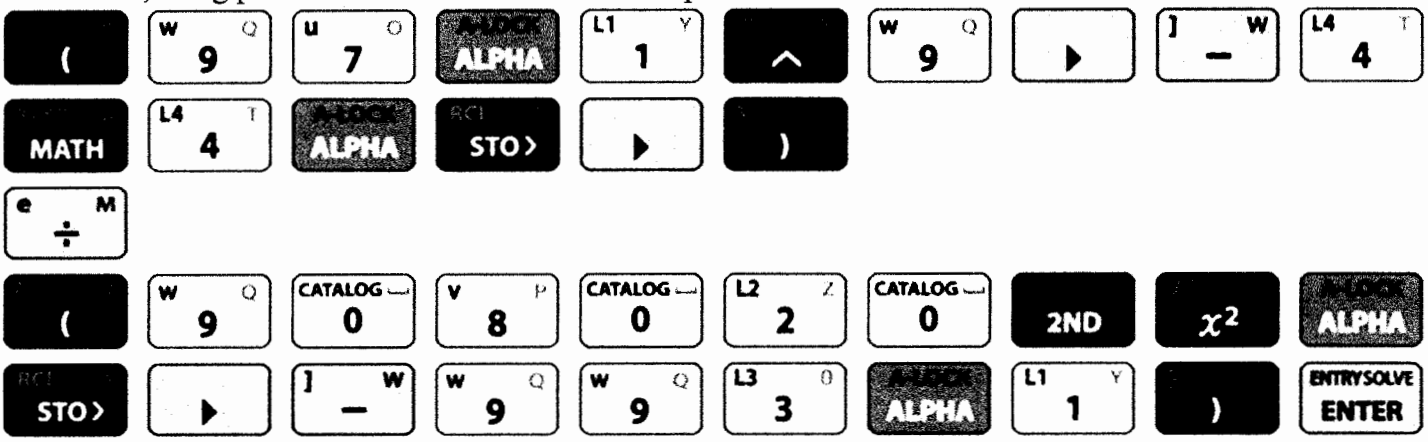
SOLUTION

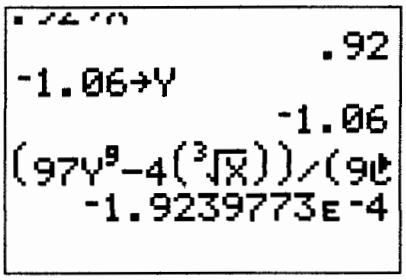
Store x

Store y



Calculation, using parentheses around numerator and parentheses around denominator





Result is in scientific notation! $-1.9239773E-4$ means -1.9239773×10^{-4} which means -0.00019239773

This is an approximate answer because

a) 0.92 is not a perfect square so $\sqrt{0.92}$ is irrational. Its decimal is nonrepeating and nonterminating.

b) 0.92 is not a perfect cube, so $\sqrt[3]{0.92}$ is irrational. Its decimal is nonrepeating and nonterminating.

c) There are almost certainly decimal places beyond the screen which could not be displayed.

Round to the nearest ten-thousandth means four decimal places.

Approximate answer: -0.0002

Name _____

Date _____

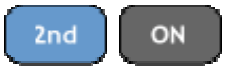
TI-84+ GC 1: On/Off, 2nd functions, Screen, Batteries, Error Messages, Order of Operations

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 

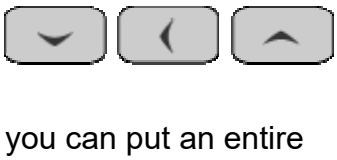
, notice that a number flashes in the upper-right corner of the screen. This number tells how high the brightness is. If it's too high, the screen will turn black.

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 

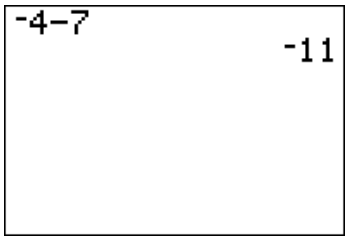
.

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!

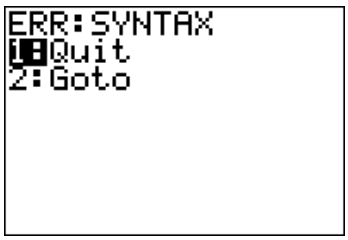
Example 1: $-4-7=-11$ [(–)] [4] [—] [7] [ENTER] Answer: -11



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

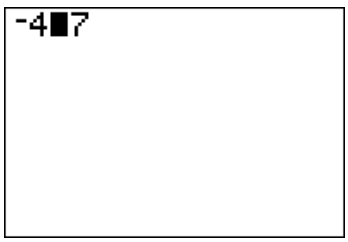
Try this calculation with a wrong key: [(–)] [4] [(–)] [7] [ENTER]

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: _____

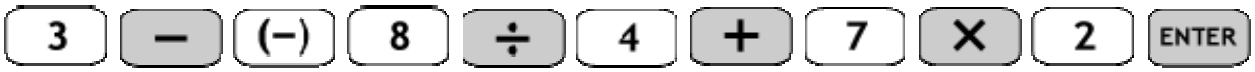
2) $-27\div 3^2$ = {Remember: exponents before divide.}

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

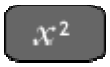
1) 22.5
2) -3
3) 19
4) 25
5) 3

Name _____

Date _____

TI-84+ GC 2: Exponents and Scientific Notation

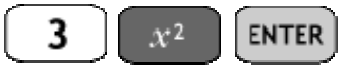
Objectives: Use the caret and square keys to calculate exponents
Review scientific notation
Input a calculation in scientific notation
Recognize an answer in scientific notation
Use scientific notation mode to display all results in scientific notation

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

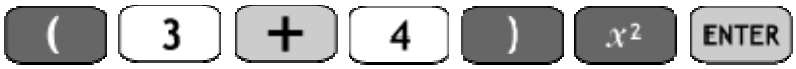
Example 2: 3^2



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

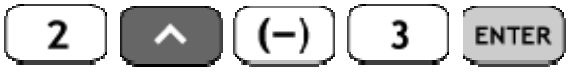
Remember also that any non-zero base raised to the zero power is 1.

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 $\{...-3,-2,-1,0,1,2,3,...\}$.

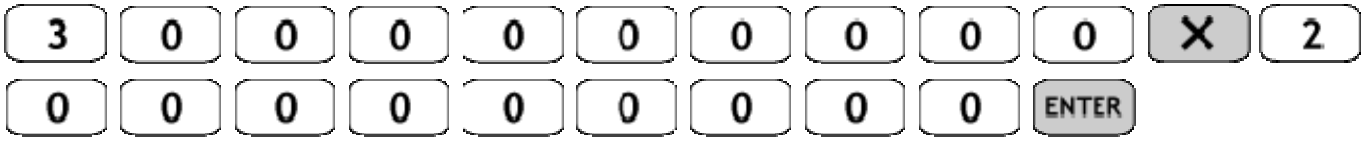
Example 8: $30{,}200$ is written in scientific notation as 3.02×10^4.

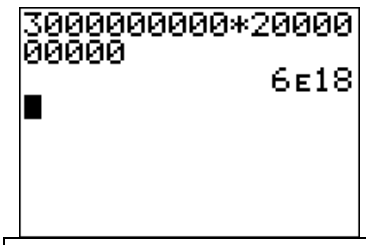
Example 9: 0.0004087 is written in scientific notation as 4.087×10^{-4}

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





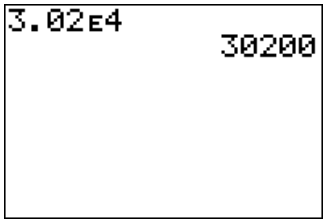
The GC uses its own abbreviation for scientific notation. **6E18** means 6×10^{18}

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

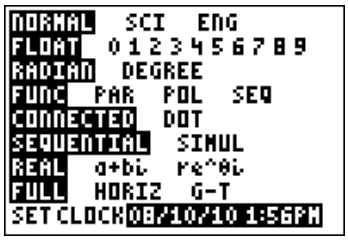
[3] [.] [0] [2] [2nd] [,] [4] [ENTER]



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.

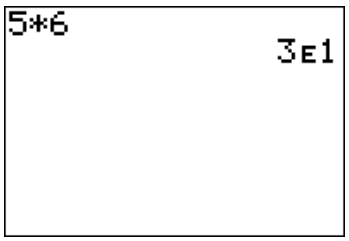
When we select SCI, every result will be shown in scientific notation.
This is sometimes very useful and sometimes not useful at all.

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.

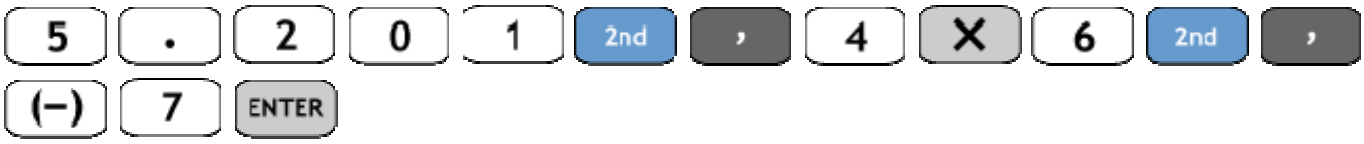
Then press [2nd] [MODE] (or [CLEAR]) to QUIT the MODE menu.

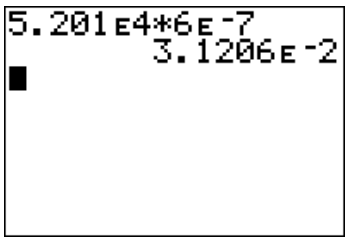
Example 13: Write 5×6 in scientific notation using GC in scientific notation mode.



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}

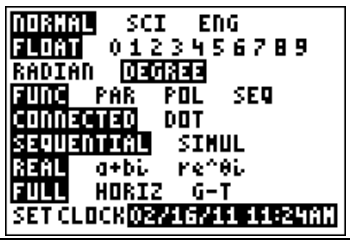
To leave scientific notation mode and return to normal mode, press:

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.

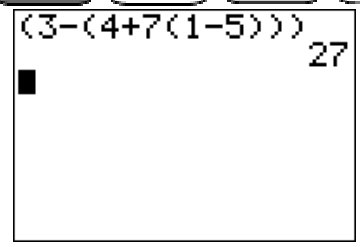
Note: You must have the same number of open 

as you have closed 

parentheses.

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

(3 − (4 + 7 (1 − 5))



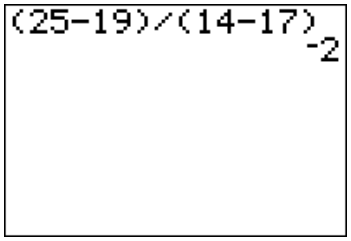
)) ENTER

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 −



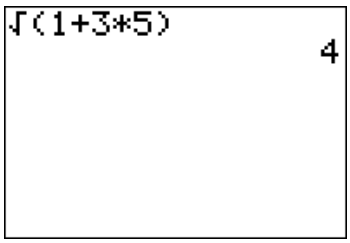
1 7) ENTER

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.

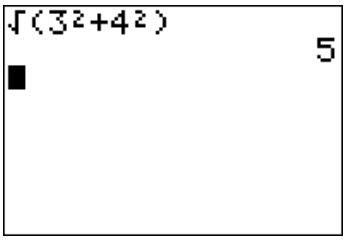
Example 4: $\sqrt{1+3\cdot 5}$ becomes $\sqrt{(1+3\cdot 5)}$

2nd x^2 1 + 3 × 5) ENTER



Answer: 4

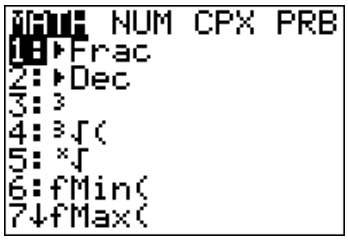
Example 5: $\sqrt{3^2+4^2}$ becomes $\sqrt{\left(3^2+4^2\right)}$



Answer: 5

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

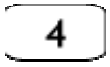
button, which opens a screen with four menus across the top: MATH, NUM, CPX, and PRB. You are automatically in the MATH menu, which is highlighted. We will use the NUM menu later.



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

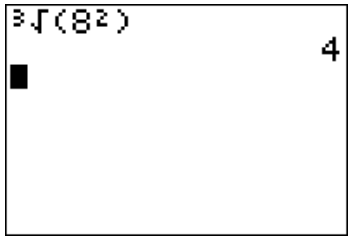
One way is to use the down arrow  to move to 4:, then press 

.

A quicker way is to press 

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

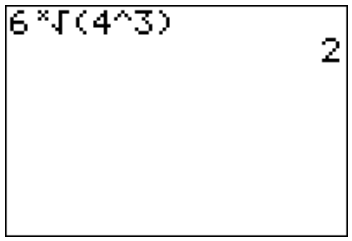
Example 6: $\sqrt[3]{8^2}$



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:

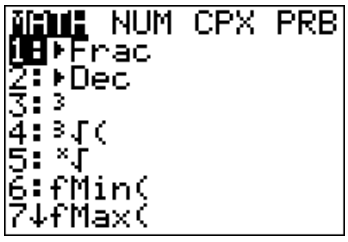
1. Absolute value returns a non-negative answer.

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

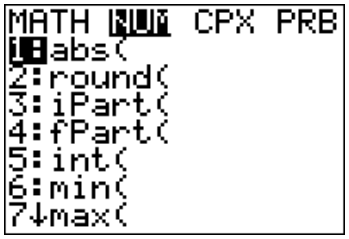
3. $|x|$ and x are not the same. A variable x can represent a positive, negative, or zero, but $|x|$ can't be negative. We cannot ignore or "remove" the absolute value.

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

Press MATH



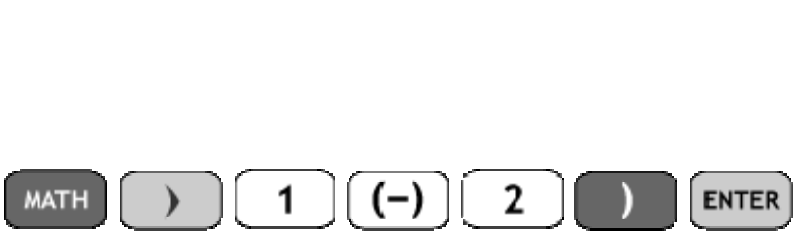
Press ▶ for the NUM menu:

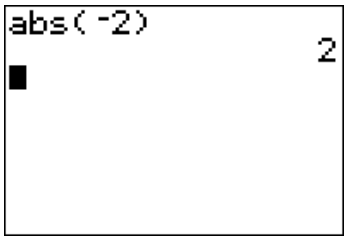


Press 1 or ENTER to select absolute value, abbreviated abs(

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

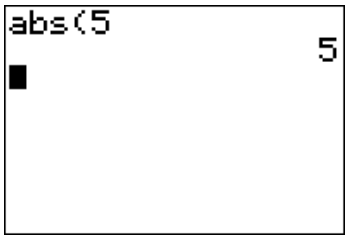
Example 8: $|-2|$





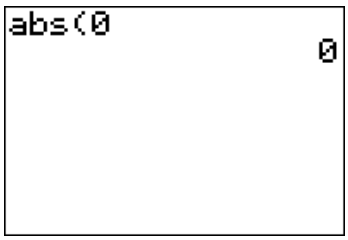
Answer: 2

Example 9: $|5|$



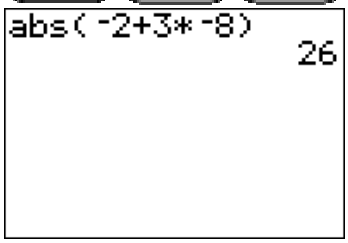
Answer: 5

Example 10: $|0|$



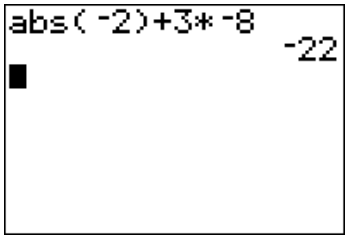
Answer: 0

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: _____

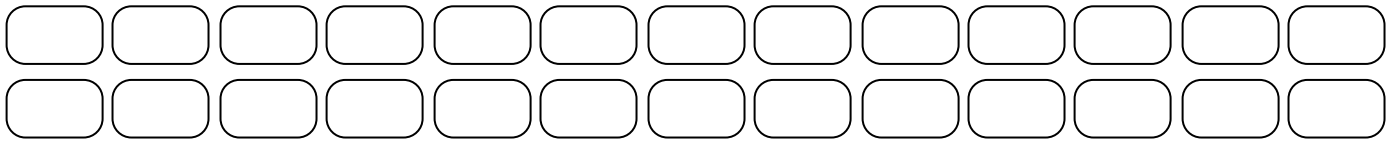
15) $\left\{3-\left[4+7(1-5)^2\right]\right\}$ Answer: _____

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

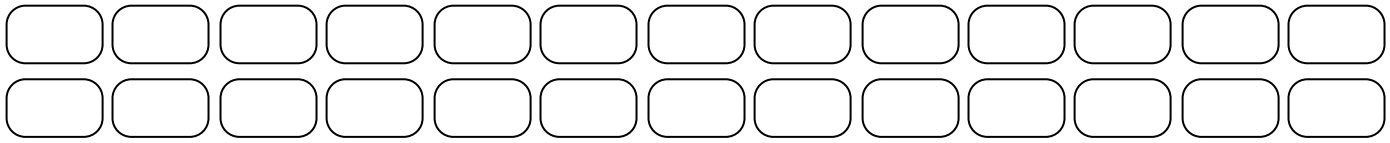
17) $\dfrac{3^2-2^2}{3\cdot2+2^2}$ Answer: _____

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

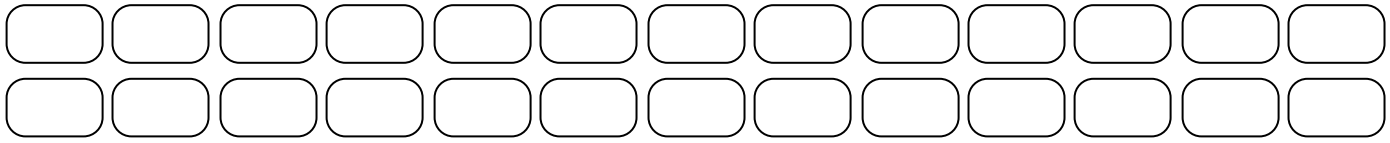
19) $\frac{-2^2+1}{-2-3}$ Answer: _____



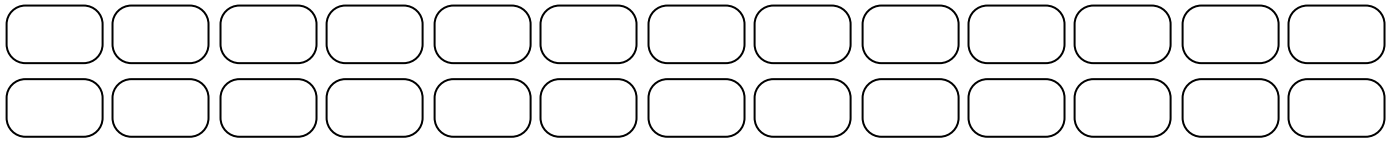
20) $(-2)^2+\frac{1}{-2}-3$ Answer: _____



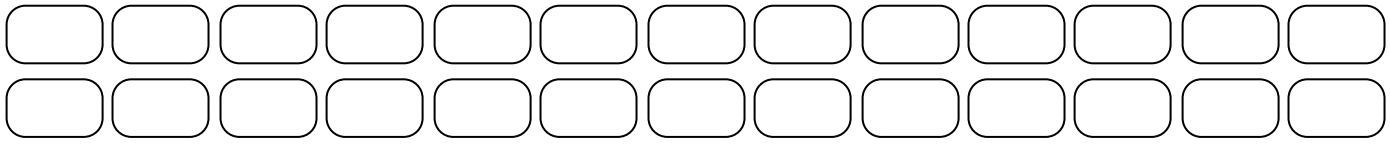
21) $-2^2+\frac{1}{-2}-3$ Answer: _____



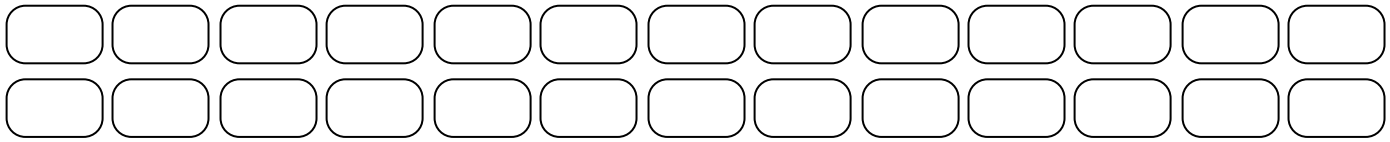
22) $(-2)^2+\frac{1}{-2-3}$ Answer: _____



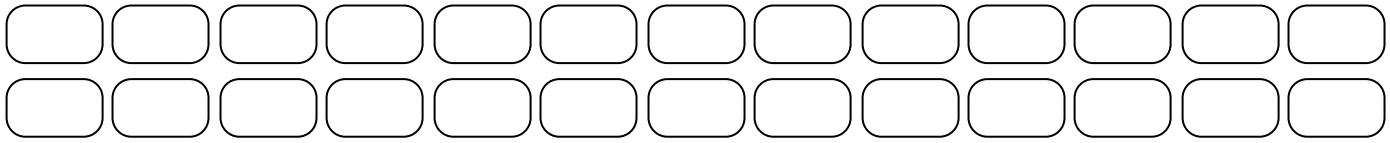
23) $-2^2+\frac{1}{-2-3}$ Answer: _____



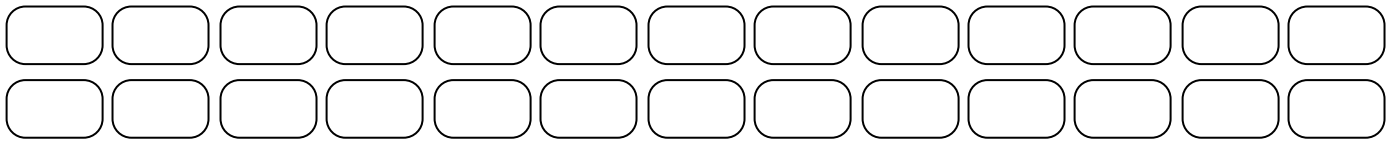
24) $\frac{(-2)^2+1}{-2}-3$ Answer: _____



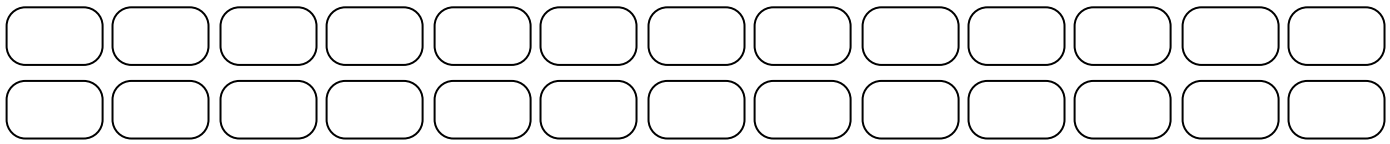
25) $\frac{-2^2+1}{-2}-3$ Answer: _____



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



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

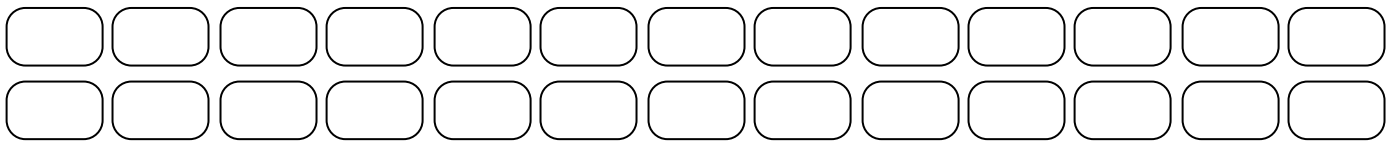


28) $\sqrt{6^2+8^2}$ Answer: _____

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

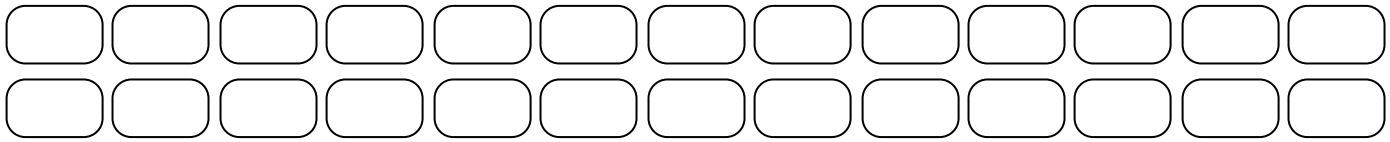
30) $\sqrt[5]{32}$ Answer: _____

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

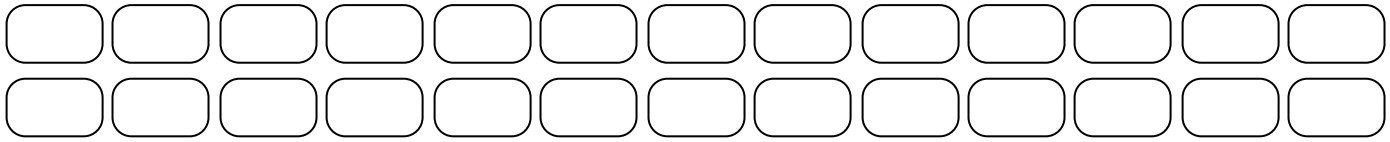


32) $|7+-3(5)|$ Answer: _____

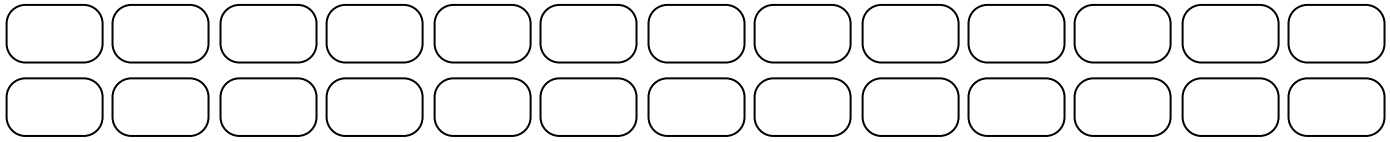
33) $|-1(12)|-3|-2|$ Answer: _____



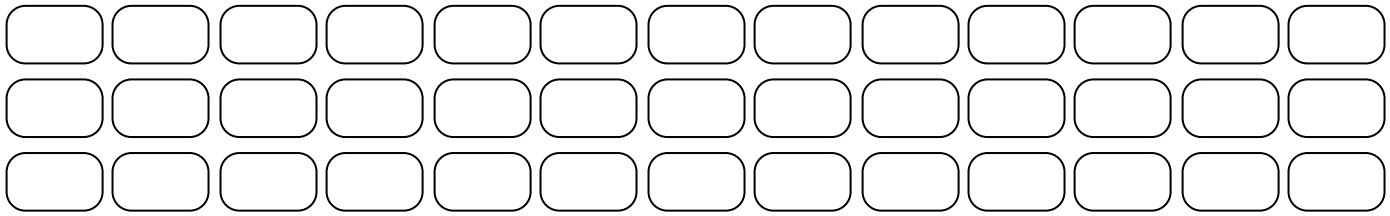
34) $\dfrac{-3+6}{|2-7|-|-2|}$ Answer: _____



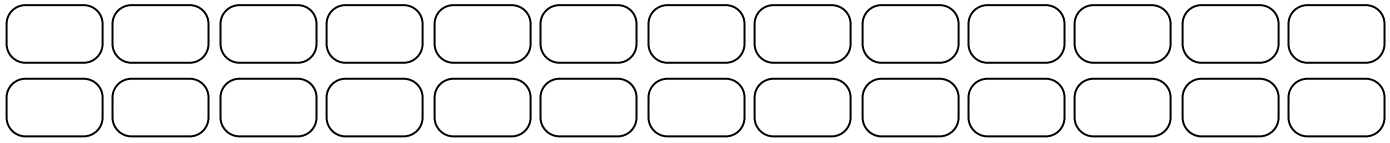
35) $\dfrac{2+3|5-(-1)|}{11+2(-3)}$ Answer: _____



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



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

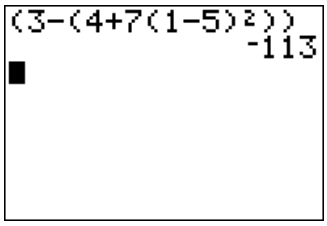


TI-84+ GC 3: Order of Operations, Additional Parentheses, Roots and Absolute Value

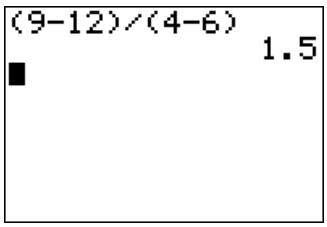
Solutions:

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

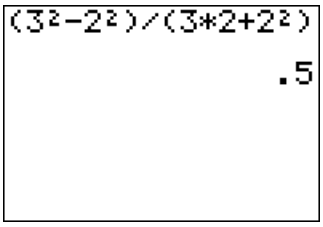
15) -113



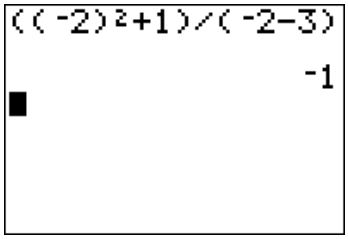
16) 1.5



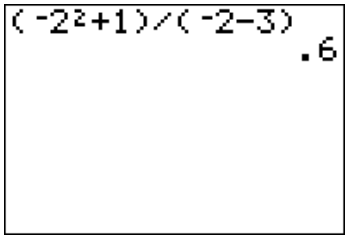
17) .5



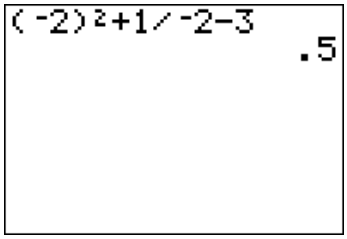
18) -1



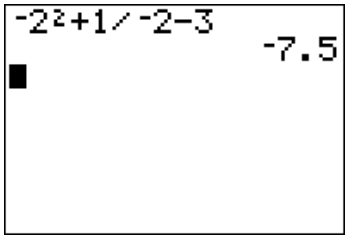
19) 0.6



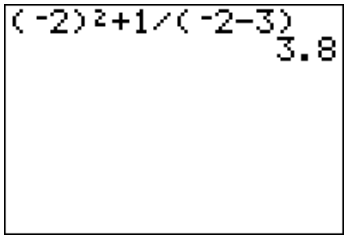
20) 0.5



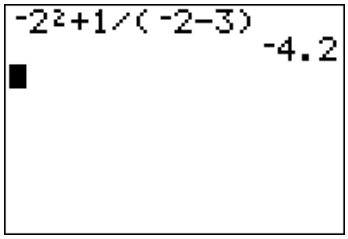
21) -7.5



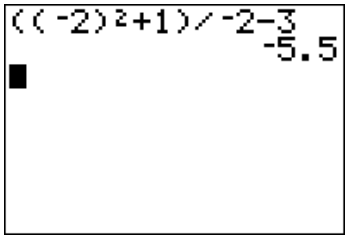
22) 3.8



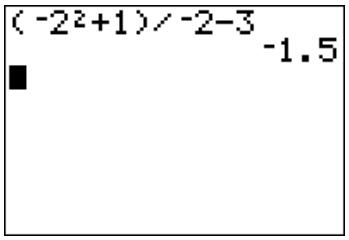
23) -4.2



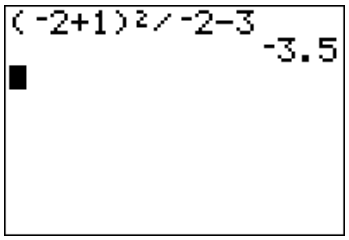
24) -5.5



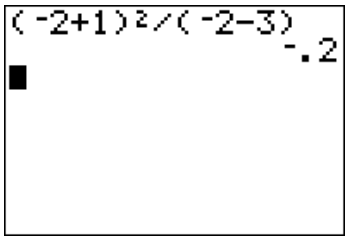
25) -1.5



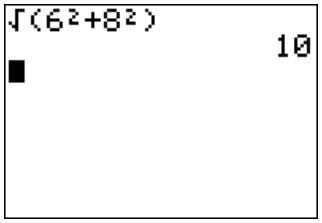
26) -3.5



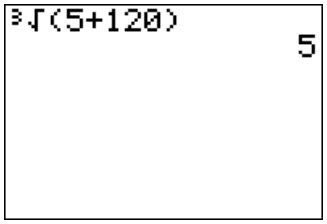
27) -0.2



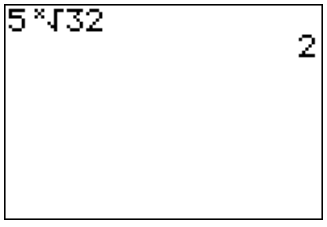
28) 10



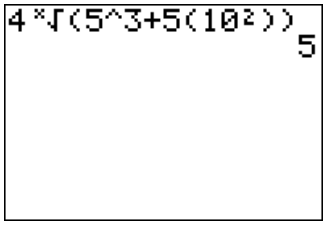
29) 5



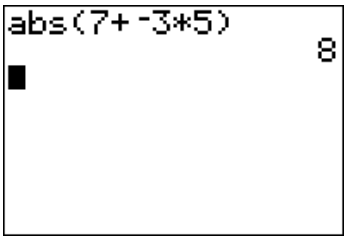
30) 2



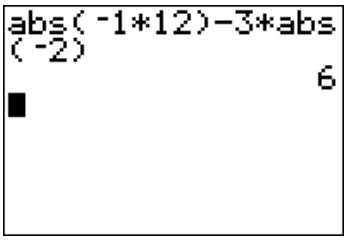
31) 5



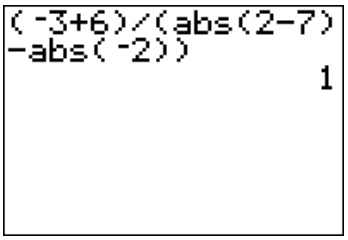
32) 8



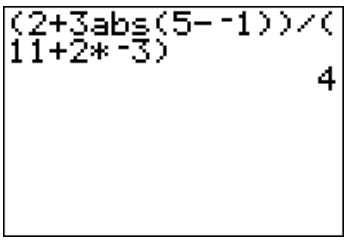
33) 6



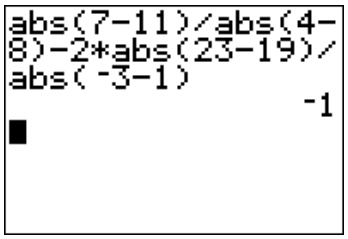
34) 1



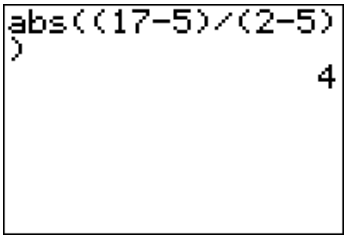
35) 4



36) -1



37) 4



Rev 12-2-11

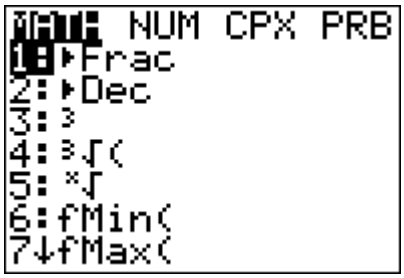
Name _____

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.

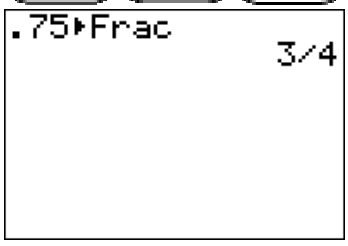
Pressing MATH ENTER will select option 1, > FRAC. Press ENTER again to find the fraction.

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.

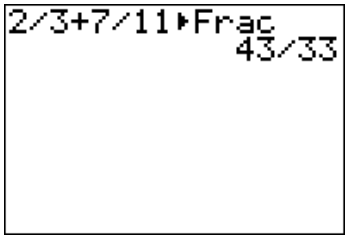
. 7 5 MATH ENTER ENTER



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.

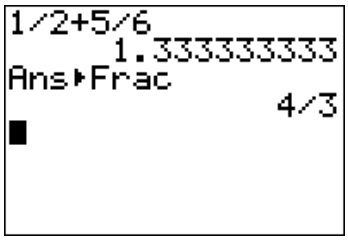
Example 3: (calculation, but forget to convert to fraction) $\frac{1}{2}+\frac{5}{6}$

[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]

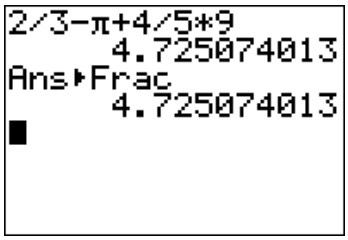
Attempt to convert to fraction: [MATH] [ENTER] [ENTER]

```
√(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.

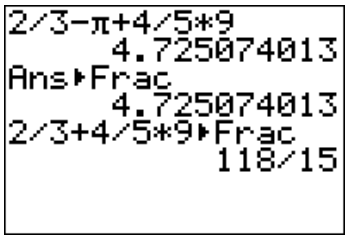
Wrong method: The entire calculation, with the π and without thinking:



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: _____

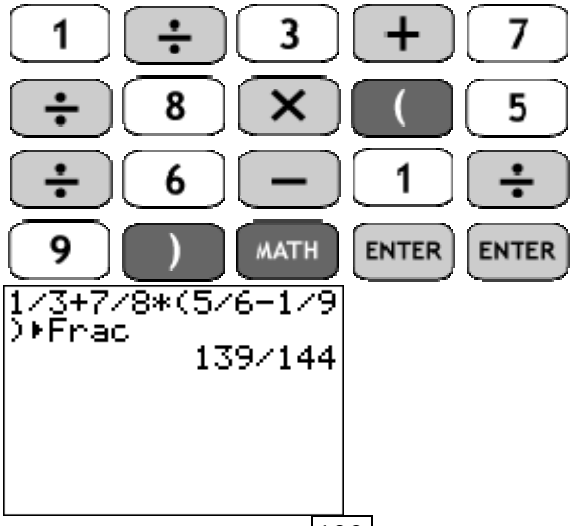
17) $\dfrac{-3\sqrt{60+4}+(-3)^2}{2^3+|4(-7)|}$ Answer: _____

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: _____

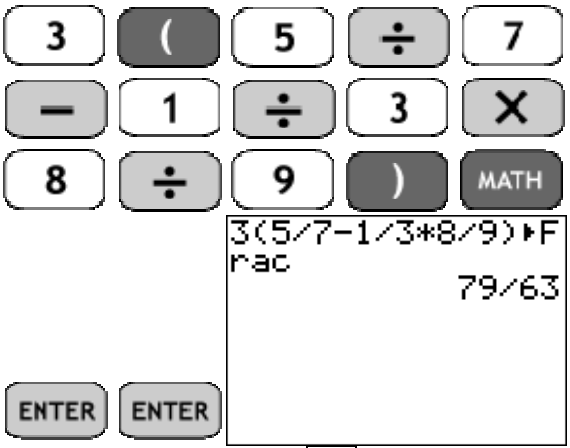
Solutions:

1)



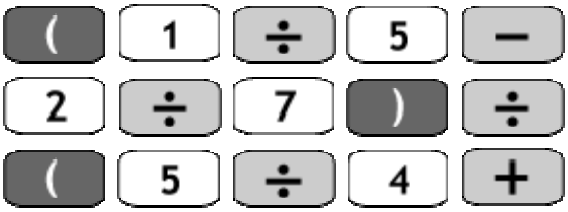
Rational, Answer: $\frac{139}{144}$

2)

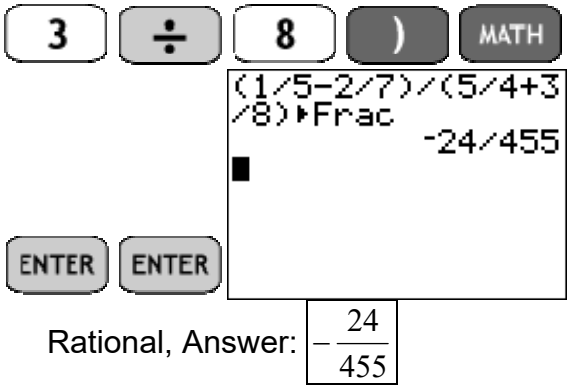


Rational, Answer: $\frac{79}{63}$

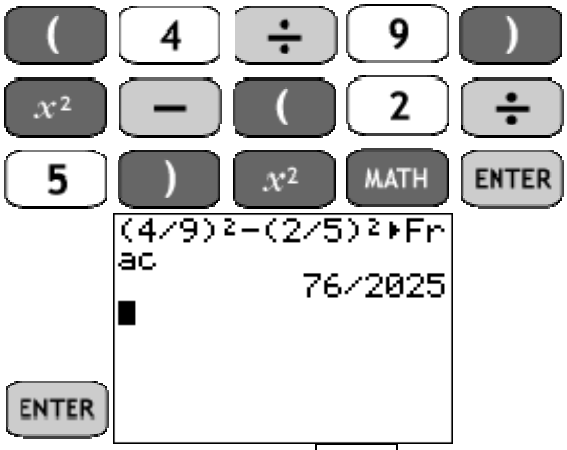
3)



4)

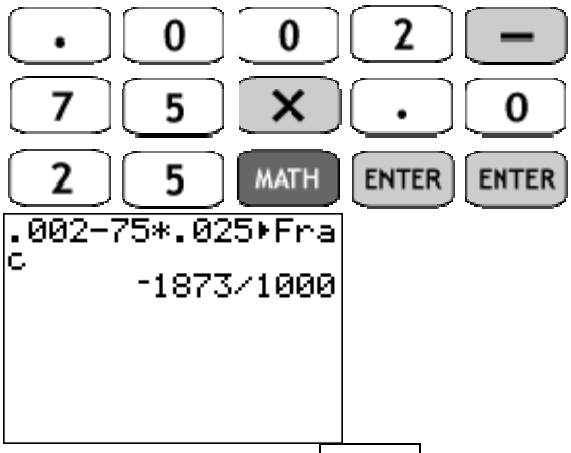


Rational, Answer: $-\frac{24}{455}$



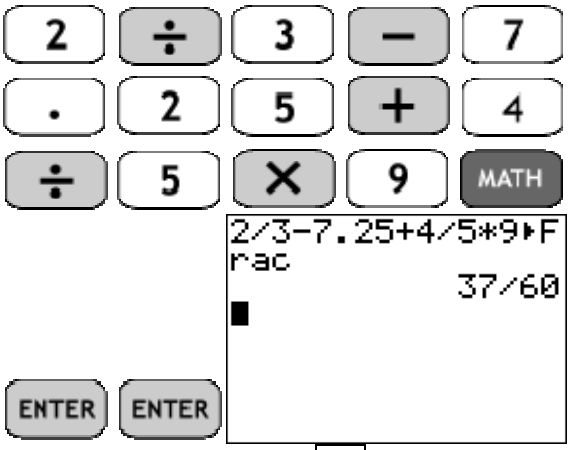
Rational, Answer: $\frac{76}{2025}$

5)

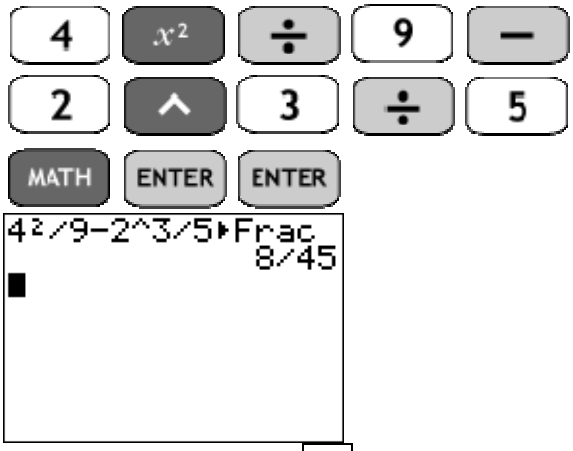


Rational, Answer: $-\frac{1873}{1000}$

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

6) 

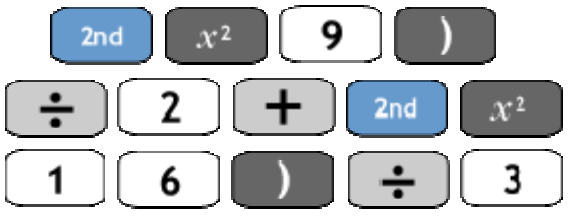
Rational, Answer: $\boxed{\frac{37}{60}}$

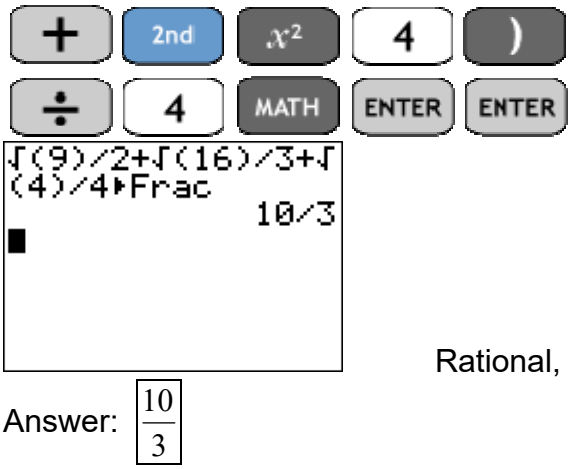
7) 

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: $\boxed{\frac{2080}{2081}}$

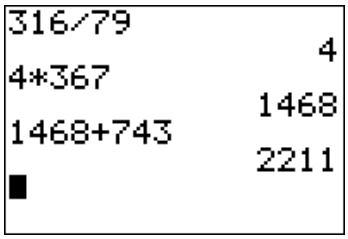
10) 



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:



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

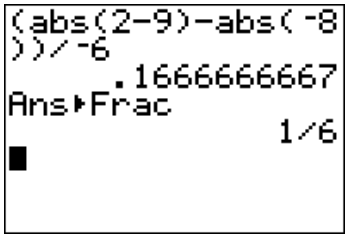
12) Rational, $\frac{2}{2014}-\frac{1}{4028}=\frac{4}{4028}-\frac{1}{4028}=$ Answer: $\boxed{\frac{3}{4028}}$

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

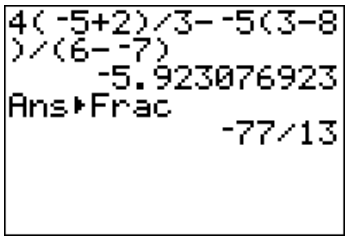
14) Irrational, $\frac{\pi}{4}+3\left(\frac{\pi}{8}\right)=\frac{2\pi}{8}+\frac{3\pi}{8}=$ Answer: $\boxed{\frac{5\pi}{8}}$

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

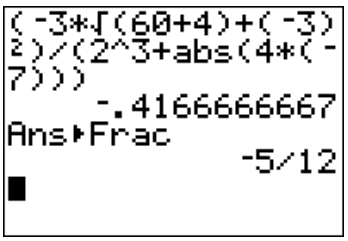
15) $\frac{1}{6}$



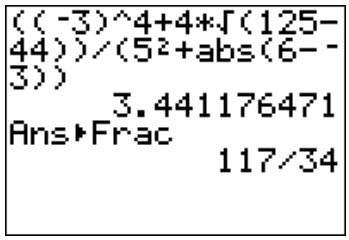
16) $-\frac{77}{13}$



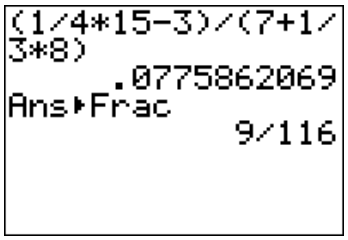
17) $-\frac{5}{12}$



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



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



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.

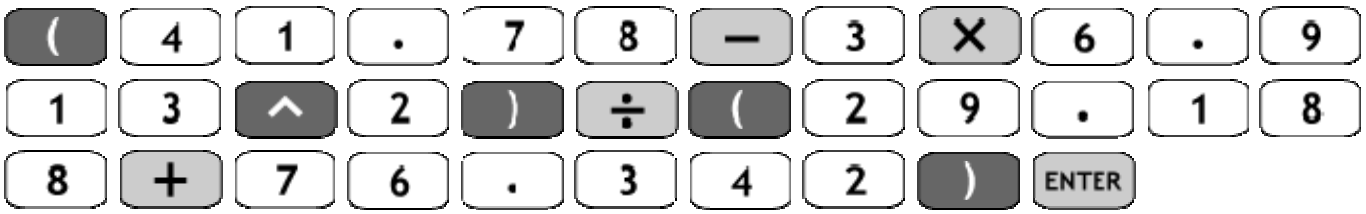
IMPORTANT: Do not round parts of a calculation! Instead, do the calculation all at once (using extra parentheses for the correct order of operations) or use memory storage locations.
If the instructions say to round, round only the final answer.

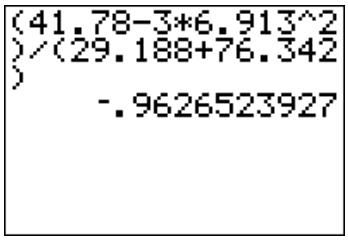
Example 3:

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.

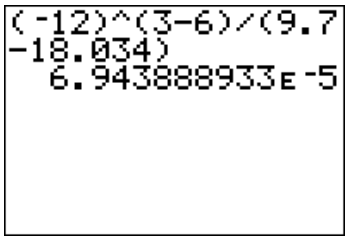
Notice that there is a subtraction in the exponent. The GC will not subtract before an exponent unless extra parentheses are added, like this:

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

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):

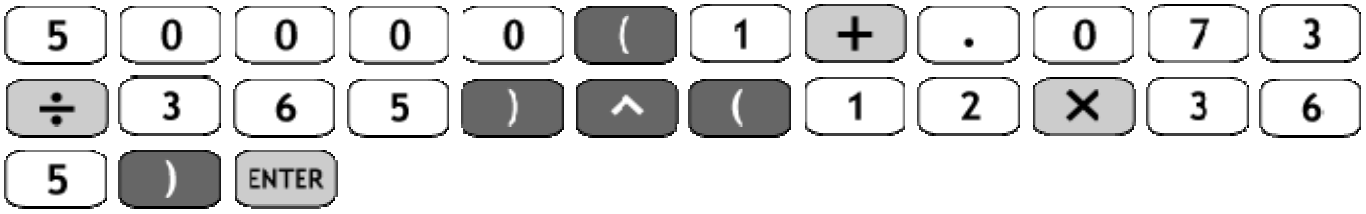
0.0001

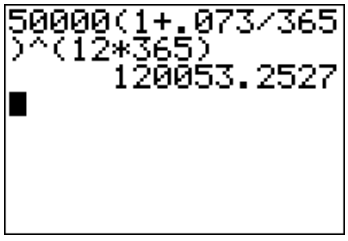
Answer: 0.0001

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:

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





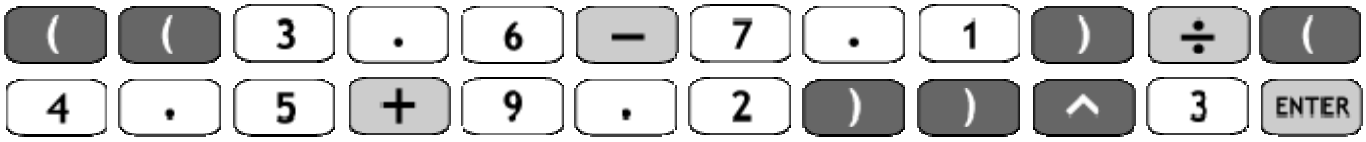
Round to nearest hundredth (2 decimal places): 120,053.25

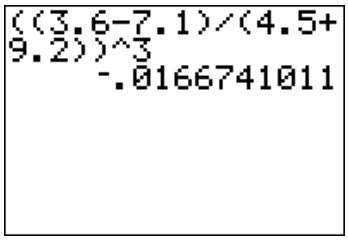
Answer: 120,053.25

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:

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



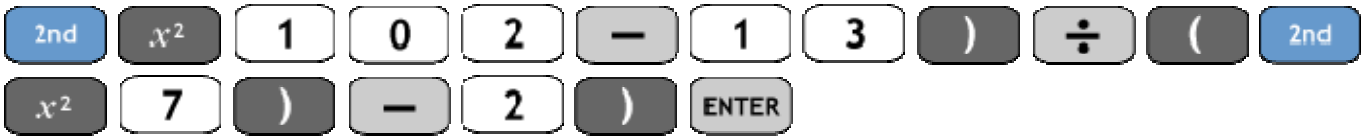


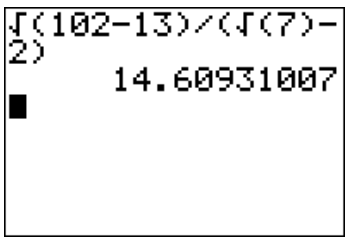
Answer: -0.017

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.

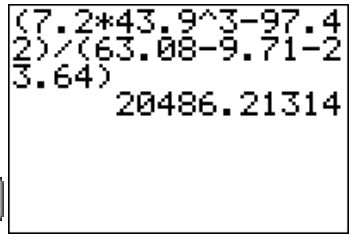
Answer: _____

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

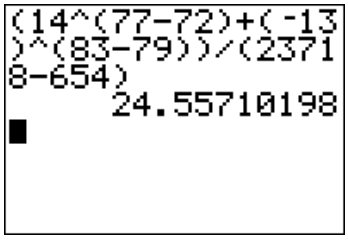
2) 1289 rounded to the nearest hundred is 1300. Round-off error $|1289 - 1300| = |-11| = 11$ Answer: 11

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



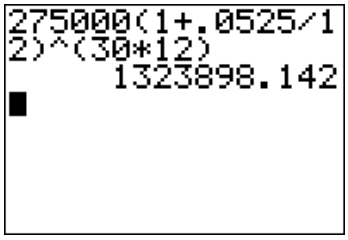
Answer: 20486.2

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



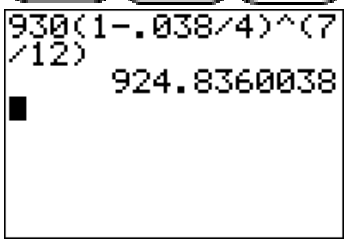
Answer: 24.56

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



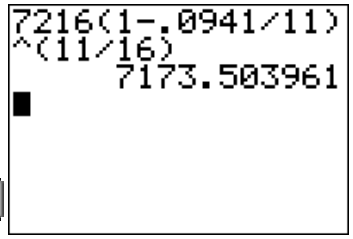
Answer: 1,323,898.14

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



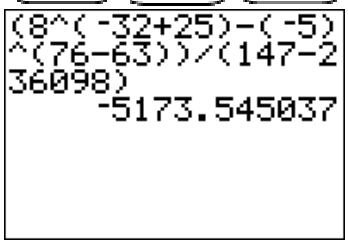
Answer: 925

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



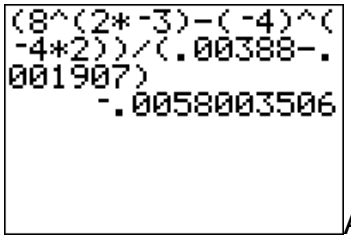
Answer: 7270.

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



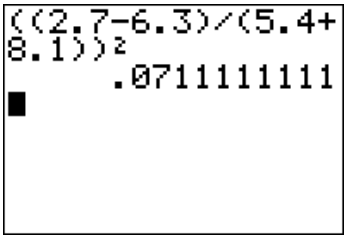
Answer: -5173.55

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



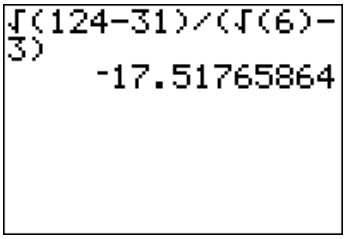
Answer: -0.006

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



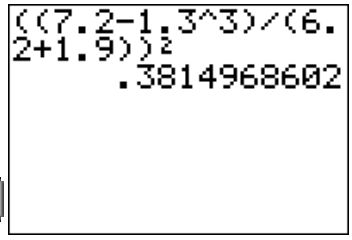
Answer: 0.071

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



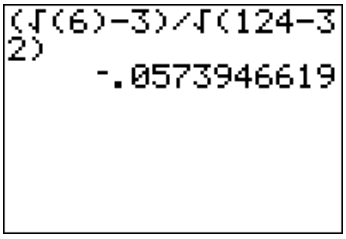
Answer: -17.52

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



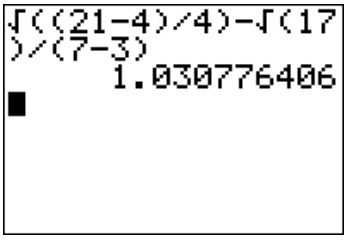
Answer: 0.38

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

Rev 1-14-16

Name _____

Date _____

TI-84+ GC 10+ Using the Y= menu, Automatic and Ask Tables

Objectives: Input functions into the Y= menu
Use TBLSET and TABLE to set up and view tables

In addition to the calculating screen and the menus for mathematical operations, the graphing calculator has other screens to store equations, create tables or graph. The starting point for tables or graphs is the Y= menu.
CAUTION: When using the Y= menu, the equation must be solved for y.

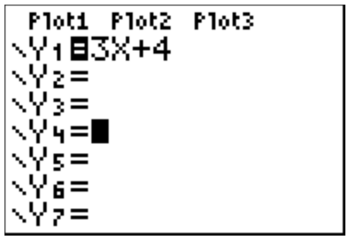
To input equations, press [Y=]. Use the variable key [X,T,Θ,n] for x and the regular number and operation keys (including the MATH menu and its options) for everything else.

CAUTION: Do not use the memory storage location [ALPHA] [STO▸] for x. This can cause strange errors without any error screens.

Example 1: Put $y = 3x + 4$ in the Y= menu.

[Y=] [CLEAR] [3] [X,T,Θ,n] [+] [4] [ENTER]

Answer:



Notice that the Y= menu allows more than one equation. For now, make sure that all the equations after y_1 are cleared by using the [▾] or [ENTER] keys and [CLEAR].

Once an equation has been put into the Y= menu, we can use the GC to make a table of values.

Step 1: Input the equation into the Y= menu. Begin by pressing [Y=].

Step 2: Set up the table using TBLSET. Begin by pressing [2nd] [WINDOW]
In the TBLSET menu there are four settings:
1. TblStart ("Table Start") refers to the first x-value to be used in the table.
2. △Tbl ("Delta Table") is the amount that will be added to each x-value to get the next x-value.
3. Indpt: ("Independent variable") is whether you will input each x-value or let the GC calculate it.
4. Depend ("Dependent variable") is whether you should input each y-value or the let the GC do it.

Step 3: View the table using TABLE. Press [2nd] [GRAPH]. Use [▾] and [▴] to move down or up the table. If you go "off the edge", the table will move and re-fill (if automatic).

Example 2: Find the x-values calculated by these choices in TBLSET.

TblStart is -73, so the first x-value will be -73.
△Tbl is .5, so the GC will add .5=½ to -73 to get the next x-value, and continue adding ½ to get each subsequent value in the table.
Both Indpnt and Depend are automatic, so the GC will fill the table automatically with y-values from the Y= menu. (Without seeing the Y= menu, we can't know what values of y it will calculate.)

Answer:

x	y
-73	
-72.5	
-72	
-71.5	

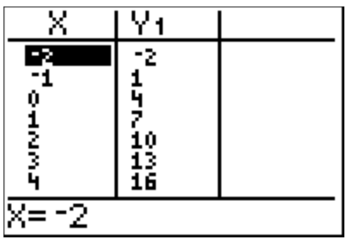
Example 3: Create an automatic table for $y = 3x + 4$ and use it to fill in the given table.

x	-2	-1	0	1	2
y					

Step 1: Input $y = 3x + 4$ into the Y= menu. (See Example 1.)
Step 2: Notice that the table begins with x=-2 and advances by 1 each row. Set up the table using TBLSET so that TblStart is -2, △Tbl is 1, and Indpt and Depend are both Auto.

Step 3: View the table by pressing 

and use the display to complete the blank table.



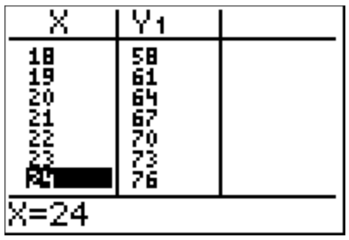
Answer:

x	-2	-1	0	1	2
y	-2	1	4	7	10

Example 4: Scroll down in the automatic table for $y = 3x + 4$ and fill in the given table.

x	20	21	22	23	24
y					

Step 3: View the table. Press 2nd GRAPH, then ⌄ 26 times. Complete the blank table.



x	20	21	22	23	24
y	64	67	70	73	76

When the desired x-values are not in order or are not equally spaced, we could scroll up and down in an automatic table, but an Ask table will probably be quicker.
To set up an Ask table, in TBLSET, set Indpt to Ask, but leave Depend Auto.

Example 5: Create an Ask table for $y = 3x + 4$ and use it to fill in this table.

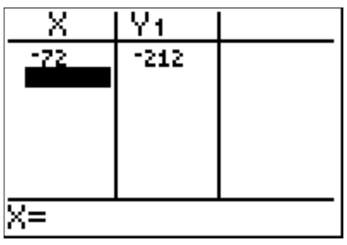
x	-72	-15	46	-3	103
y					

Step 2: TblStart and △Tbl can be any values. Change Indpt to Ask and leave Depend as Auto.

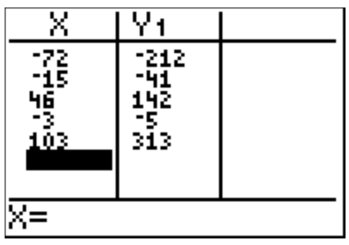
2nd WINDOW ⌄ ⌄ › ENTER

Step 3: View the table by pressing 2nd GRAPH, input the desired values of x, and use the display to complete the blank table.

(−) 7 2 ENTER (−) 1 5 ENTER 4 6 ENTER (−) 3 ENTER 1 0 3 ENTER



becomes



Example 5, continued.

Answer:

x	-72	-15	46	-3	103
y	-212	-41	142	-5	313

NOTE: Sometimes, an Ask table will already have values in it. Just press the desired x-value and the GC will display it where the cursor is.

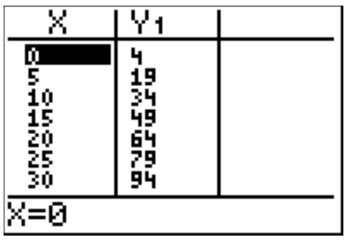
CAUTION: Setting Indpt to Auto and Depend as Ask (the reverse of what we just did) is useful only for checking y-values you already know. If your table doesn't behave as you expect, this might be your mistake. Setting both to Ask is similarly unhelpful.

Tables can help us guess which values of x are closest to a target value of y.

CAUTION: Sometimes it's difficult to make the table show exactly the desired value of y. Then you have to use your brain.

Example 6: Use an automatic table with △Tbl=5 to determine the two multiples of 5 for which $y = 3x + 4$ is closest to 57.

TblStart can be any value.



x=15 gives y=49, and x=20 gives y=64. Since 57 is between 49 and 64, the x-value which results in a y-value of 57 is between 15 and 20.

Answer: between x=15 and x=20

When the same values of x are being used for two (or more) different equations, we can calculate them at the same time by putting all the desired equations into the Y= menu. The table still displays ordered-pair information, but the x-values are not printed twice.

Example 7: What ordered pairs are represented by this table?

x	$y_1 = 3x + 4$	$y_2 = -3x + 4$
1	7	1
-3	-5	13

Example 7, continued.

Answer:

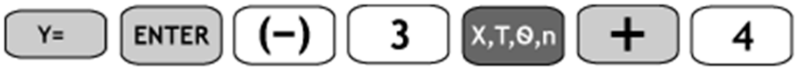
(1,7) and (-3,-5) are ordered pairs on the graph of $y_1 = 3x + 4$. (The first column)

(1,1) and (-3,13) are ordered pairs on the graph of $y_2 = -3x + 4$. (The second column)

Example 8: Fill in an Ask table for $y_1 = 3x + 4$ and $y_2 = -3x + 4$ simultaneously and list the ordered pairs for each function.

x	$y_1 = 3x + 4$	$y_2 = -3x + 4$
-34		
46		
-12		
0		
1003		

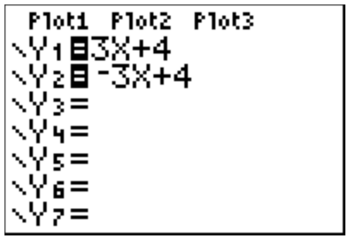
Step 1: Input both equations into the Y= menu. $y_1 = 3x + 4$ is already there.

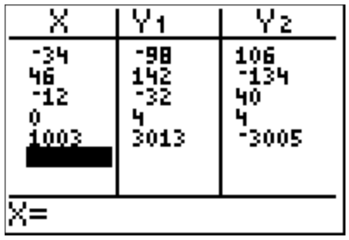


Step 2: TblStart and △Tbl can be any values. Set Indpt to Ask and Depend as Auto.

Step 3: View the table by pressing 

, input the desired values of x, and use the display to complete the blank table. Notice that $y_2 = -3x + 4$ is in the second column.





Answer:

x	$y_1 = 3x + 4$	$y_2 = -3x + 4$
-34	-98	106
46	142	-134
-12	-32	40
0	4	4
1003	3013	-3005

(-34, -98), (46,142), (-12,-32), (0,4) and (1003,3013) are ordered pairs on the graph of $y_1 = 3x + 4$.

(-34,106), (46,-134), (-12,40), (0,4) and (1003,-3005) are ordered pairs on the graph of $y_2 = -3x + 4$.

Note: If you scroll right on the table, you'll see extra decimal places at the bottom of the screen.

Practice

1) Complete the following table for $y = 2x - 5$

x	-2	-1	0	1	2
y					

2) Complete the following table for $y = 2x - 5$

x	20	21	22	23	24
y					

3) Complete the following table for $y = 2x - 5$

x	-72	-15	46	-3	103
y					

4) Complete the following table for $y = x^2 - 1$

x	0	5	10	15	20
y					

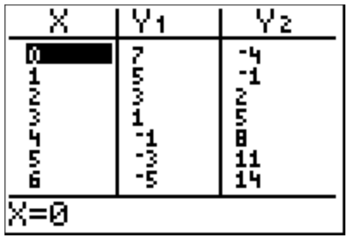
5) Complete the following table for $y = \sqrt{100 - x^2}$. Round to the nearest hundredth if necessary.

x	0	2	4	6	8
y					

6) Complete the following table for $y = 3x^2 - x + 9$

x	-12	-36	52	-1	98
y					

7) Use an automatic table with △Tbl=5 to determine the two multiples of 5 for which $y = 2x - 5$ is closest to 57.
8) Use an automatic table with △Tbl=1 to determine the two integers for which $y = 2x - 5$ is closest to 108.
9) List the ordered pairs represented by this table.

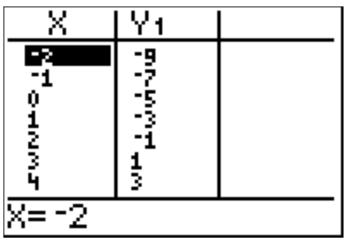


10) Fill in an Ask table for $y_1 = -2x + 7$ and $y_2 = 3x - 4$ simultaneously and list the ordered pairs for each function.

x	$y_1 = -2x + 7$	$y_2 = 3x - 4$
-34		
46		
-12		
0		
1003		

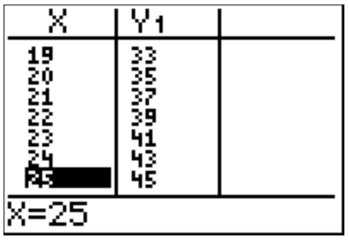
TI-84+ GC 10+ Using the Y= menu, Automatic and Ask Tables page 7 Solutions

1)



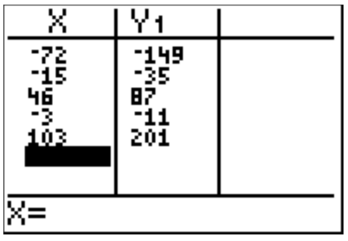
x	-2	-1	0	1	2
y	-9	-7	-5	-3	-1

2)



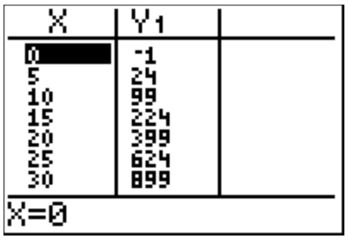
x	20	21	22	23	24
y	35	37	39	41	43

3)



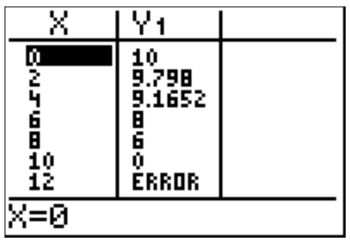
x	-72	-15	46	-3	103
y	-149	-35	87	-11	201

4)



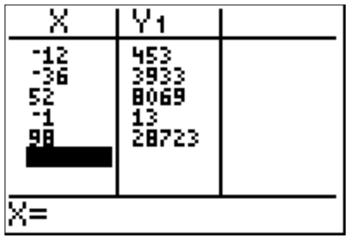
x	0	5	10	15	20
y	-1	24	99	224	399

5)



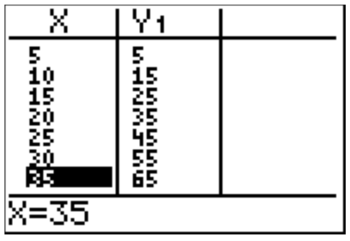
x	0	2	4	6	8
y	10	9.80	9.17	8	6

6)



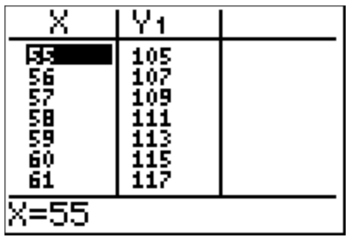
x	-12	-36	52	-1	98
y	453	3933	8069	13	28723

7)



y is 55 when x is 30, and 65 when x with 35. The value of x for which y is 57 is between 30 and 35.

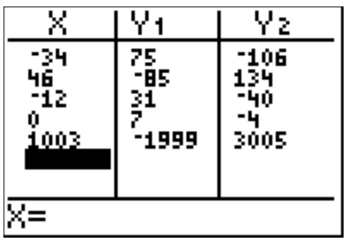
8)



y is 107 when x is 56 and 109 when x is 57. The value of x for which y is 108 is between 56 and 57.

9) The ordered pairs for y_1 in this table are (0,7), (1,5),(2,3),(3,1),(4,-1),(5,-3), and (6,-5). The ordered pairs for y_2 in this table are (0,-4), (1,-1),(2,2),(3,5),(4,8),(5,11), and (6,14).

10)



x	$y_1 = -2x + 7$	$y_2 = 3x - 4$
-34	75	-106
46	-85	134
-12	31	-40
0	7	-4
1003	-1999	3005

The ordered pairs for y_1 in this table are (-34,75), (46,-85),(-12,31),(0,7),and (1003,-1999). The ordered pairs for y_2 in this table are (-34,-106), (46,134),(-12,-40),(0,-4),and (1003,3005).

Rev 12-16-13

Name _____

Date _____

TI-84+ GC 15 Settings and Basic Graph

Objectives: Before graphing, set the options in MODE and clear the Y= menu
Recognize the error message for turning off plots
Input a function using Y=
Review the slope-intercept form for the equation of a line
Learn the size of the standard window and zoom to it
Graph quadratic, cubic, square root and absolute value functions

If someone else has used your calculator before you, the settings may not be what you need. So before we graph anything, let's check.

Press MODE to open a window with nine menus, one menu on each row (across).
On each row, the word or symbol with white letters on a black background is currently selected.

Use the ▲ or ▼ buttons to move up and down among the menus, and the ▶ or ◀ buttons to move across a menu. Your cursor is a flashing dark area.

When you have moved the cursor to the option you want, press ENTER to select it. Check each of the nine rows to make your screen match this image:

Here's a summary of what each menu does and what you should select for now.

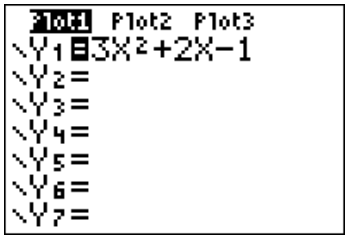
NORMAL SCI ENG	numerical notation for calculations
FLOAT 0 1 2 3 4 5 6 7 8 9	number of decimal places (or significant figures) displayed
RADIAN **DEGREE**	units used for trigonometric functions
FUNC PAR POL SEQ	type of equation: function, parametric, polar, or sequence
CONNECTED DOT	whether to use solid or dotted lines for graphs
SEQUENTIAL SIMUL	whether to plot multiple graphs one at a time or simultaneously
REAL a+bi *re^θi*	real or complex numbers and which complex format
FULL HORIZ G-T	to split the screen into two screens and which two
SET CLOCK	set the date and time and the format it is displayed

"Float" means that the decimal point is permitted to display in any location.
If you select "Set Clock", you will enter a different menu of options that sets the clock's time, date, and appearance.

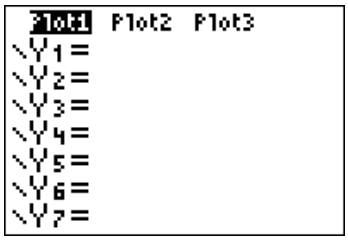
Press CLEAR to exit the MODE menu when you are done.

The first time you use your GC to graph, check two more things.

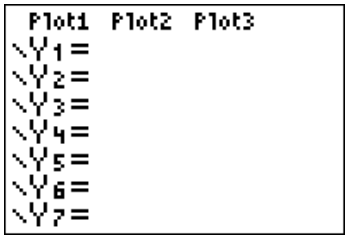
Open the menu of functions to be graphed, press Y=. (This button is at the top, in the separate row of buttons just below the screen.) Here's what my screen looked like:



First, clear any functions that may be there by pressing CLEAR ENTER for each existing function.

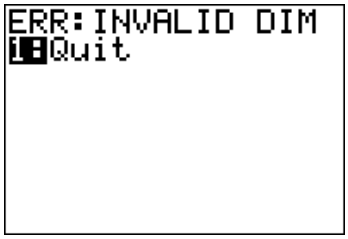


Second, check that Plot1, Plot2, and Plot3 are NOT selected. Press ▲ (and ▶ If needed) to move your cursor to that plot, and then press ENTER to turn it off. Make sure all three plots are turned off. When you are done, your screen should look like this:



You are now ready to graph.

It's easy to overshoot and turn on a plot accidentally. If you do, you'll see this error screen when you try to graph:



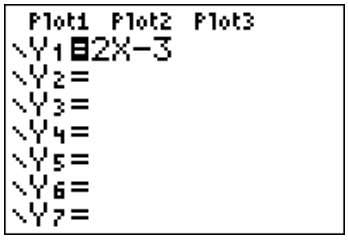
This error screen means "Turn off Plots in Y=."

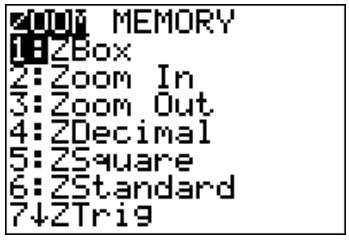
Example 1: Graph $y = 2x - 3$ in the GC graphing window.

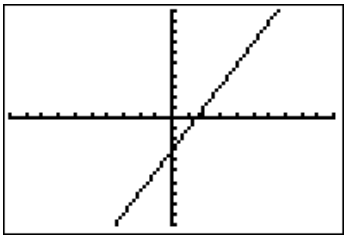
Open the Y= page: [Y=].

Type the function to be graphed: [2] [X,T,Θ,n] [−] [3] [ENTER]

Graph in a standard window: [ZOOM] [6]







1. CAUTION: Always use the graphing variable x [X,T,Θ,n] when typing functions into the Y= menu. Some versions of the GC will give a wrong graph (but no error message!) if you use the storage location [ALPHA] [STO▶] (which is also the letter x) instead of [X,T,Θ,n].

2. The GC does not put numbers on the axes. You have to know that each tick mark in the standard window represents one unit, so the standard window shows the x-axis from -10 to +10 and shows the y-axis from -10 to +10.

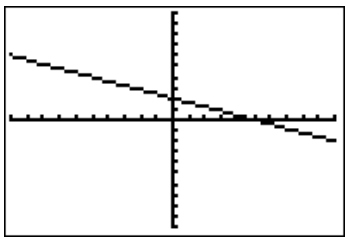
3. The GC will continue to use the same "window" (set of axes) until you change it. So you can press [GRAPH] instead of [ZOOM] [6] when your previous window is acceptable.

4. To exit the graphing window and return to the calculating window, press [CLEAR], or press QUIT, which is [2nd] [MODE].

5. You can use the editing keys DEL, INS and type-over when putting functions in the Y= menu.

Example 2: Graph $y = -\frac{2}{5}x + 2$ on the GC.

[Y=] [CLEAR] [(−)] [2] [÷] [5] [X,T,Θ,n] [+] [2] [GRAPH]



The GC can plot graphs using the Y= menu or the DRAW menu. The DRAW menu makes pretty pictures, but we can't do many of the useful graphing calculations with these pictures, so it's not very useful.

As you've probably noticed, the Y= menu requires that the equation be solved for y!

Recall: An equation of a line (or linear equation in two variables) can be appear in several forms:

$y = mx + b$ Slope-intercept form, where *m* is the slope and $(0, b)$ is the y-intercept.

$Ax + By = C$ Standard form

$y - y_1 = m(x - x_1)$ Point-slope form, where *m* is the slope and (x_1, y_1) is a point on the line.

Example 3: Write the equation $4x + 3y = 12$ in slope-intercept form by solving for y.

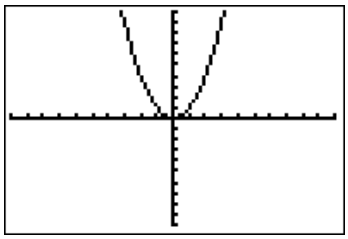
Subtract 4x from both sides: $3y = -4x + 12$

Divide all terms by 3: $\frac{3y}{3} = \frac{-4x}{3} + \frac{12}{3}$

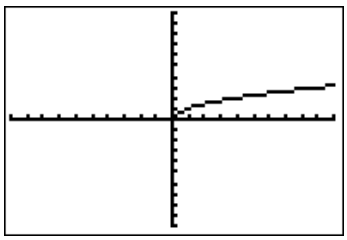
Simplify: Answer: $\boxed{y = -\frac{4}{3}x + 4}$

All the operators and expressions can be used in the Y= menu, too.

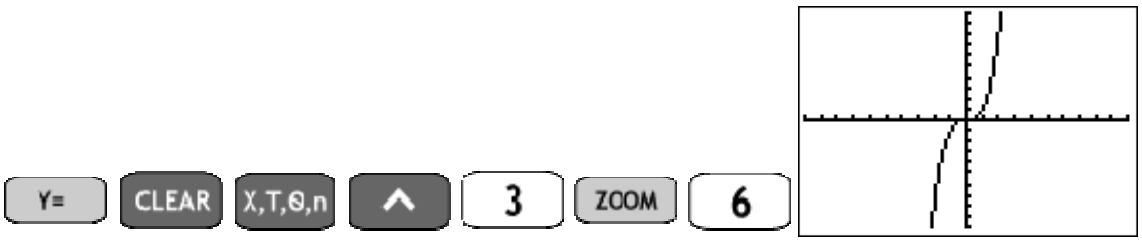
Example 4: Graph $y = x^2$ on the GC.



Example 5: Graph $y = \sqrt{x}$ on the GC.

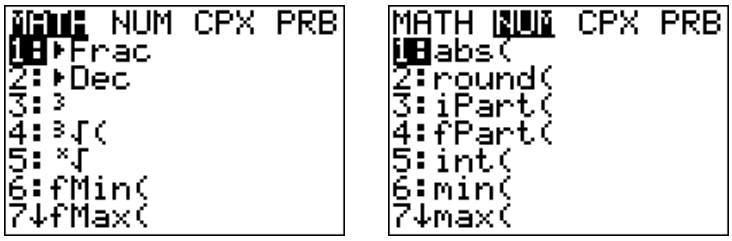


Example 6: Graph $y = x^3$ on the GC.



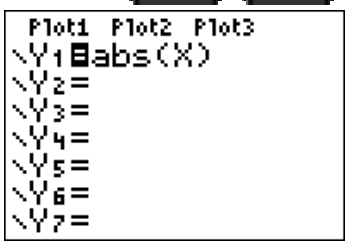
Absolute value is found under the MATH menu, in the NUM sub-menu:

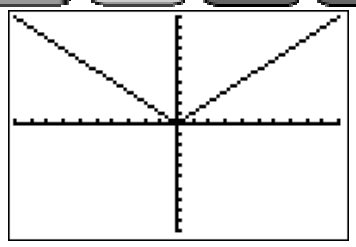
Press MATH, then) to see the NUM sub menu



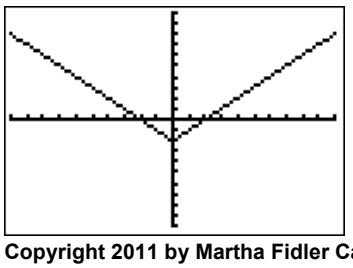
Press ENTER to select absolute value. Be sure to close the parentheses.

Example 7: Graph $y = |x|$ on the GC.





Example 8: Graph $y = |x| - 2$ on the GC.



TI-84+ GC 15 Settings and Basic Graph, page 6

Practice:

1) Write the equation $3x-2y=6$ in slope-intercept form by solving for (or isolating) y.

Graph each of the following functions on the GC using a standard window.

2) $y=-2x-7$

3) $y=\frac{2}{3}x-5$

4) $y=-7$

5) $3x-2y=6$

6) $4x+\frac{2}{3}y=\frac{8}{3}$

7) $4x+3y=12$

8) $y=2x^2$

9) $y=\frac{1}{2}x^2$

10) $y=x^2+1$

11) $y=(x-1)^2$

12) $y=\sqrt{x}-2$

13) $y=\sqrt{x-2}$

14) $y=-x^3$

15) $y=\frac{1}{2}x^3$

16) $y=|x|+3$

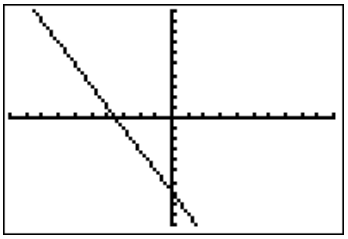
17) $y=|x+3|$

TI-84+ GC 15 Settings and Basic Graph, solutions page 7

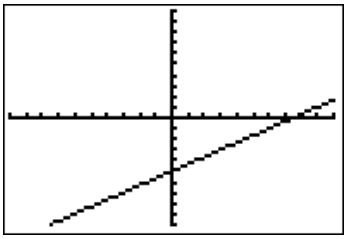
1) $3x-2y=6 \qquad -2y=-3x+6$

$$\frac{-2y}{-2}=\frac{-3x}{-2}+\frac{6}{-2} \qquad y=\frac{3}{2}x-3$$

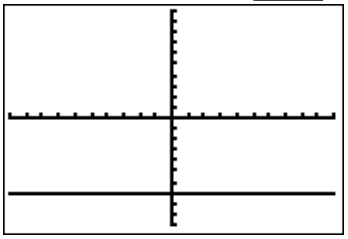
2) Y= CLEAR (−) 2 X,T,Θ,n — 7 ENTER ZOOM 6



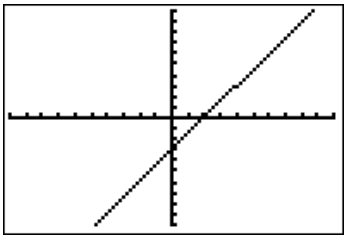
3) Y= CLEAR 2 ÷ 3 X,T,Θ,n — 5 GRAPH



4) Y= CLEAR (−) 7 GRAPH



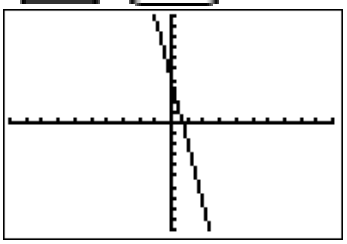
5) Y= CLEAR 3 ÷ 2 X,T,Θ,n — 3 GRAPH



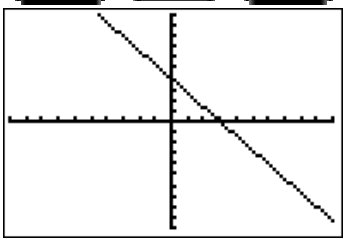
6) $4x+\frac{2}{3}y=\frac{8}{3} \qquad \frac{2}{3}y=-4x+\frac{8}{3}$

$$\frac{3}{2}\cdot\frac{2}{3}y=-4\cdot\frac{3}{2}x+\frac{3}{2}\cdot\frac{8}{3} \qquad y=-6x+4$$

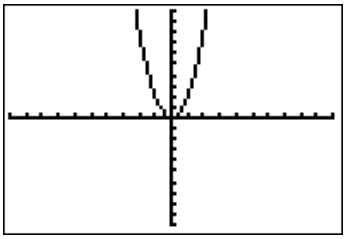
Y= CLEAR (−) 6 X,T,Θ,n + 4 GRAPH



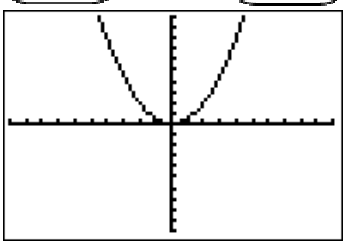
7) Y= CLEAR (−) 4 ÷ 3 X,T,Θ,n + 4 ZOOM 6



8) Y= CLEAR 2 X,T,Θ,n x^2 ZOOM 6

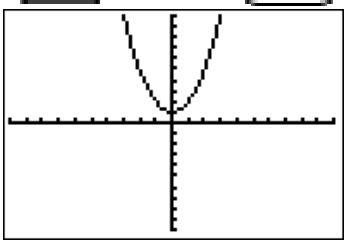


9) Y= CLEAR X,T,Θ,n x^2 ÷ 2 ZOOM 6

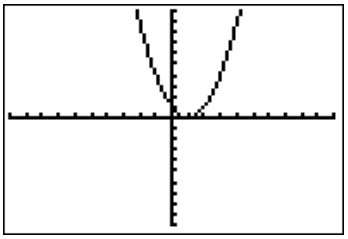


TI-84+ GC 15 Settings and Basic Graph, solutions page 8

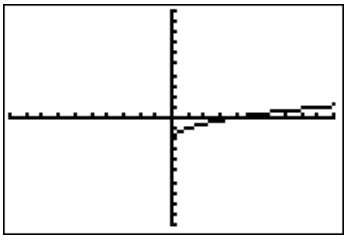
10) Y= CLEAR X,T,Θ,n x^2 + 1 ZOOM 6



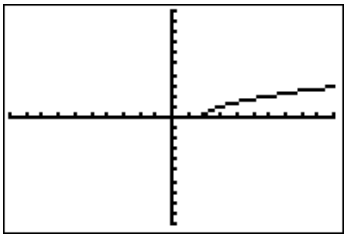
11) Y= CLEAR (X,T,Θ,n − 1) x^2 ZOOM 6



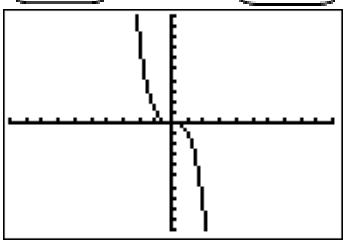
12) Y= CLEAR 2nd x^2 X,T,Θ,n) − 2 ZOOM 6



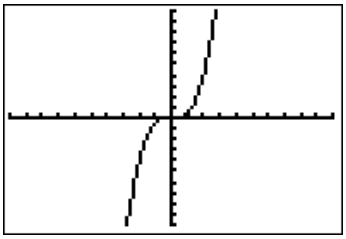
13) Y= CLEAR 2nd x^2 X,T,Θ,n − 2) ZOOM 6



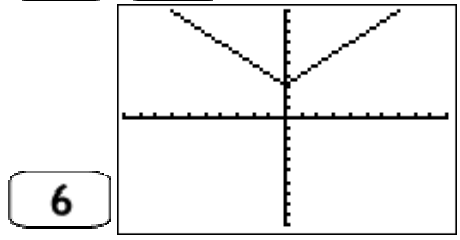
14) Y= CLEAR (−) X,T,Θ,n ^ 3 ZOOM 6



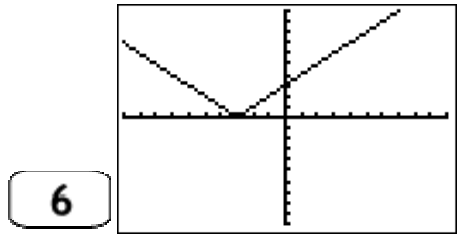
15) Y= CLEAR X,T,Θ,n ^ 3 ÷ 2 ZOOM 6



16) Y= CLEAR MATH) ENTER X,T,Θ,n) + 3 ZOOM 6



17) Y= CLEAR MATH) ENTER X,T,Θ,n + 3) ZOOM 6



Name _____

Date _____

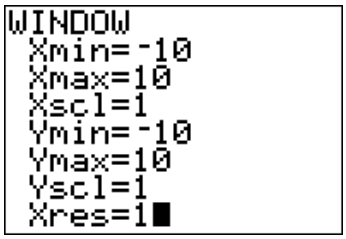
TI-84+ GC 17 Changing the Window

Objectives: Adjust Xmax, Xmin, Ymax, and/or Ymin in Window menu
Understand and adjust Xscl and/or Yscl in Window menu

The GC's standard graphing window shows the x-axis from -10 to 10 and the y-axis from -10 to 10.

If the entire graph or an important point on the graph is not visible, we need to change the window.

To do this, use the WINDOW menu to change the smallest and/or largest x and/or y values on the axes of the graphing window. Here's the menu:



Xmin = smallest x-value on the x-axis (the left side of the graphing screen)
Xmax = largest x-value on the x-axis (the right side of graphing screen)
Ymin = smallest y-value on the y-axis (the bottom of the graphing screen)
Ymax = largest y-value on the y-axis (the top of the graphing screen)
Xscl = scale on the x-axis, the distance between two adjacent tick marks on the x-axis
Yscl = scale on the y-axis, the distance between two adjacent tick marks on the y-axis

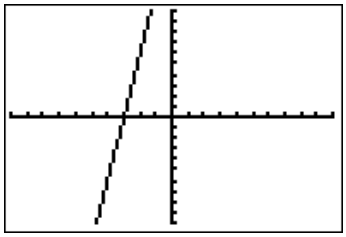
To change any of these, use ▼ to move to the desired line, press CLEAR to remove the existing value, and type the new value you want.

Don't forget to use (−) for negative numbers (not −).

When all the changes are done, press GRAPH to see the new graphing window.

Example 1: Graph $y = 6x + 18$ on your GC using a standard window. Is the x-intercept visible in the standard window? Is the y-intercept visible in the standard window?

Y= CLEAR 6 X,T,Θ,n + 1 8 ENTER ZOOM 6

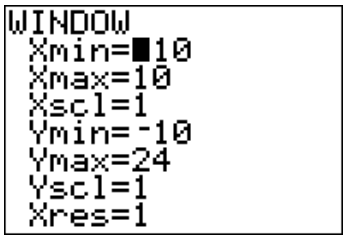
Answer: 

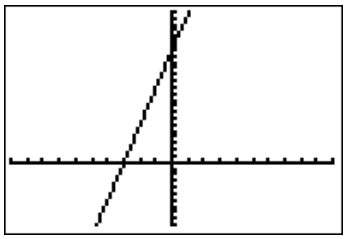
The x-intercept (-3,0) is visible. The y-intercept (0,18) is not visible because the y-coordinate of the y-intercept is larger than +10. The y-intercept is off the top of the graphing window.

Example 2: Change the graphing window so that the y-intercept of $y = 6x + 18$ is visible in the GC window.

There are many acceptable values, but all of them involve increasing the Ymax value so that it is larger than the y-coordinate of (0,18). For this example, Ymax will be 24.

Answer:





Notice that the tick marks on the y-axis are now closer together, so that all the values from -10 to +24 are shown. The x-axis is unchanged.

It's possible for one, two, three, or all four window dimensions to be wrong for your graph.

When an important point is not visible on the graph, ask:

1. Is the x-coordinate of the important point larger than Xmax?
   (Or, is the important point off the right side of the screen?) If yes, increase Xmax.

2. Is the x-coordinate of the important point smaller than Xmin?
   (Or, is the important point off the left side of the screen?) If yes, increase Xmin.

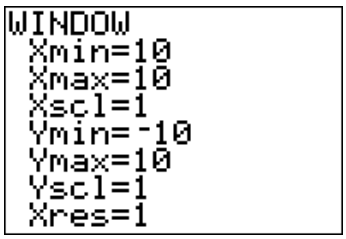
3. Is the y-coordinate of the important point larger than Ymax?
   (Or, is the important point off the top of the screen?) If yes, increase Ymax.

4. Is the y-coordinate of the important point smaller than Ymin?
   (Or: is the important point off the bottom of the screen?) If yes, increase Ymin.

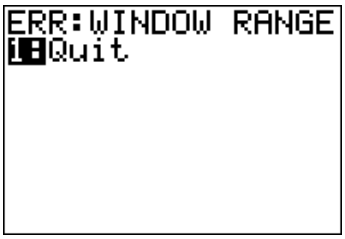
When you have the correct dimensions, all the x-coordinates of the desired points should be between Xmin and Xmax. Similarly, all the y-coordinates of the desired points should be between Ymin and Ymax.

Example 3: CAUTION: Do not set Xmax (or Ymax) to something less than or equal to Xmin (or Ymin).

For example:



gives this error:



NOTE: You can use DEL, INS, and type-over to edit the window dimensions. If the window comes out crazy-looking or gives an error, check for missing negatives or digits leftover from the previous entry.

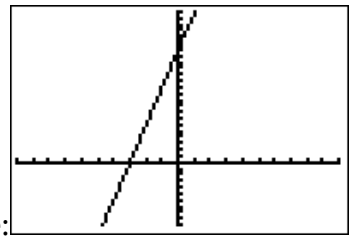
We can increase the space between tick marks by changing the scales, Xscl and/or Yscl.

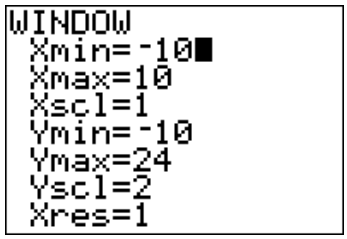
Example 4: Change Yscl in the graph of $y = 6x + 18$ so tick marks are every 2 units instead of every 1 unit.

Since the tick marks are so close together in our graph, it would be difficult to look at the graph and count ticks to find the coordinates of the y-intercept.

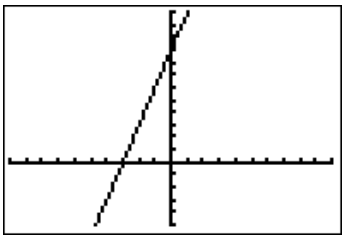
Press WINDOW, move to Yscl, and change it to 2.

Before:





After:



The y-intercept is still (0,18), but it's 9 tick marks up instead of 18 tick marks.
We could also have used Yscl=3, or even Yscl=6; because these divide evenly into 18.

When choosing a window, we want:
- Use what we know about the function to check the graph
- Make all important values of the function visible.
- Hide most invalid values of the function.
- Set tick marks to be easy to count and calculate.

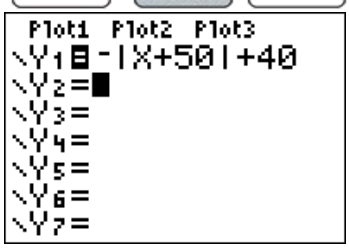
Example 5: If Xscl = 0.71, list the values of the first five ticks. Is this a usable choice for Xscl?

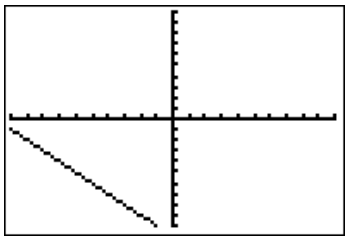
Answer: Each tick is a multiple of 0.71, so the first five ticks are 0.71, 1.42, 2.13, 2.84, and 3.55.
These are not easy to see or to calculate, so this is not a good choice for Xscl.

Example 6: If Xscl = 5, list the values of the first five ticks. Is this a usable choice for Xscl?

Answer: Each tick is a multiple of 5, so the first five ticks are 5, 10, 15, 20, 25.
These are easy to calculate, and if appropriate for the function, could be a good choice for Xscl.

Example 7: Graph $y = -|x+50|+40$ in the standard window. Use information about absolute value functions to determine if the important values of the function are visible. Is this a good window choice? If not, determine useful window values and graph $y = -|x+50|+40$.





An absolute value of a linear expression should give a V shape, but we are only seeing a line. This is not a good window choice.

Step 1: Notice the 50, 40, and negative. If you know shifts, recognize that $x+50$ has moved the graph *left* 50 units, making the point of the V in QII or QIII. Imagine or sketch this before continuing.

The negative makes every *y*-coordinate its opposite, turning the V upside down to make a tent ∧. Imagine or sketch this before continuing.

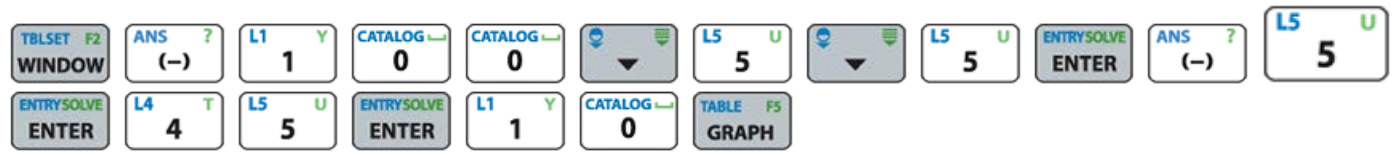
The +40 moves the *y*-coordinates up 40 units, so the point of the tent is in QII, with coordinates $(-,+)$. Imagine or sketch this before continuing. You may want to check a table of values in your GC.

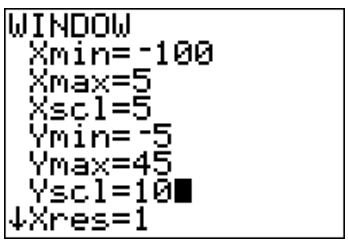
Step 2: Find Xmin, Xmax, and Xscl. If the point of the tent is $(-50,40)$, the graph continues *left*, and Xmin must be smaller than -50. Because the point is moved up 40 units, the x-intercept is even further left, or -90. We'll use Xmin = -100. Imagine or sketch this before continuing. We don't need positive values of x, so use Xmax = 5, so including the origin as a point of reference.

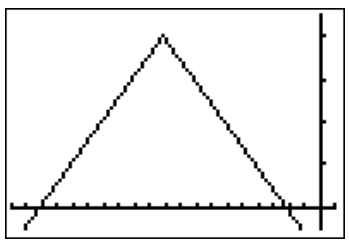
To determine Xscl, subtract Xmax – Xmin = $5-(-100)=105$, which is divisible by 5. $105/5 = 21$ ticks, the same number as in a standard graphing window. Xscl = 5.

Step 3: Find Ymin, Ymax, and Yscl. In QII, we need *y*-values which are positive, including the value y=40. Let's choose Ymax = 45 and Ymin =-5 (to include the origin as a point of reference). Subtract Ymax – Ymin = $45-(-5)=50$, which is divisible by 5. $50/5 = 10$. Yscl = 10, fewer ticks than the standard window.

Step 4: Graph.







Practice:

1) What is the y-coordinate of any x-intercept on any graph? Answer: _____

2) What is the x-coordinate of any y-intercept on any graph? Answer: _____

The next five questions use $11x - y = 22$ and its graph.

3) Use algebra to find the x-intercept of $11x - y = 22$ and the y-intercept of $11x - y = 22$.

Answer: _____

4) Use algebra to isolate y so that you can graph $11x - y = 22$ in your GC.

Answer: _____

5) Graph $11x - y = 22$ using a standard window on your GC. Which intercept is not visible?

Answer: _____

6) Change the graphing window so that the y-intercept of $11x - y = 22$ is visible in the GC window. What Ymin value did you use?

Answer: _____

7) Choose a new Yscl so that there are fewer tick marks. What Yscl value did you use?

Answer: _____

The next five questions use $x + 4y = 20$ and its graph.

8) Use algebra to find the x-intercept of $x + 4y = 20$ and the y-intercept of $x + 4y = 20$.

Answer: _____

9) Use algebra to isolate y so that you can graph $x + 4y = 20$ in your GC.

Answer: _____

10) Graph $x + 4y = 20$ using a standard window on your GC. Which intercept is not visible?

Answer: _____

11) Adjust the window so that both the x-intercept and y-intercept of $x + 4y = 20$ are visible in your GC window. Which dimension(s) must be changed?

Answer: _____

12) Adjust Xscl and/or Yscl so that fewer tick marks are used. What values did you use?

Answer: _____

The next five questions use $2x - 5y = -30$ and its graph.

13) Use algebra to find the x-intercept of $2x - 5y = -30$ and the y-intercept of $2x - 5y = -30$.

Answer: _____

14) Use algebra to isolate y so that you can graph $2x - 5y = -30$ in your GC.

Answer: _____

15) Graph $2x - 5y = -30$ using a standard window on your GC. Which intercept is not visible?

Answer: _____

16) Adjust the window so that both the x-intercept and y-intercept are visible in your GC window. Which dimensions must be changed?

Answer: _____

17) Adjust Xscl and/or Yscl so that fewer tick marks are used. What values did you use?

Answer: _____

The next five questions use $3x + 4y = -48$ and its graph.

18) Use algebra to find the x-intercept of $3x + 4y = -48$ and the y-intercept of $3x + 4y = -48$.

Answer: _____

19) Use algebra to isolate y so that you can graph $3x + 4y = -48$ in your GC.

Answer: _____

20) Graph $3x + 4y = -48$ using a standard window on your GC. Which intercept(s) is(are) not visible?

Answer: _____

21) Adjust your GC window so that both intercepts are visible. Which dimension(s) must be changed?

Answer: _____

22) Adjust Xscl and Yscl so that there are fewer tick marks. What values did you choose?

Answer: _____

For the next problems, use the graph to decide how to adjust the window dimensions and scale so that all intercepts are visible. For your answers, write the values you chose for the window.

23) $4x - 3y = 48$

Xmin = **Xmax** = **Xscl** = **Ymin** = **Ymax** = **Yscl** =

24) $x + y = 15$

Xmin = **Xmax** = **Xscl** = **Ymin** = **Ymax** = **Yscl** =

25) $x - 2y = -30$

Xmin = **Xmax** = **Xscl** = **Ymin** = **Ymax** = **Yscl** =

26) $y = x^2 - 15$

Xmin = **Xmax** = **Xscl** = **Ymin** = **Ymax** = **Yscl** =

27) $y = \sqrt{x - 11}$

Xmin = **Xmax** = **Xscl** = **Ymin** = **Ymax** = **Yscl** =

28) $y = |x - 14|$

Xmin = **Xmax** = **Xscl** = **Ymin** = **Ymax** = **Yscl** =

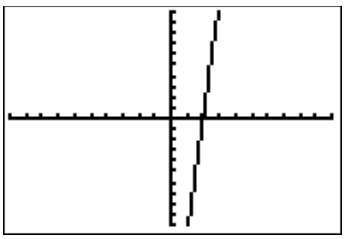
TI-84+ GC 17 Changing the Window, solutions p.8

1) The y-coordinate of any x-intercept is 0. (Any point on the x-axis has coordinates (_ ,0), where the blank is any real number.

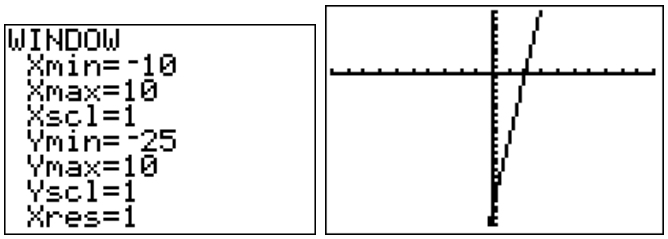
2) The x-coordinate of any y-intercept is 0. (Any point on the y-axis has coordinates (0, _), where the blank is any real number.)

3) The x-intercept is $(2,0)$, or $x=2$. The y-intercept is $(0,-22)$ or $y=-22$.

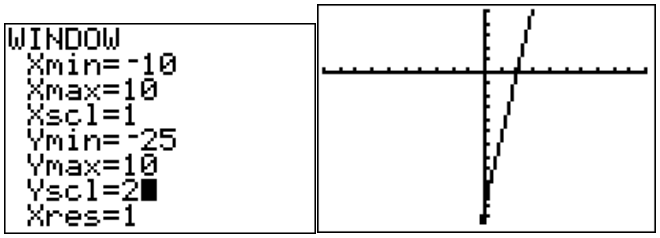
4) $y=11x-22$

5)  The y-intercept is not visible.

6) There are several acceptable choices. In this solution, Ymin is -25.



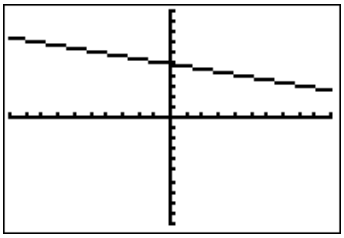
7) Again, there are several acceptable choices. In this solution, Yscl is 2.



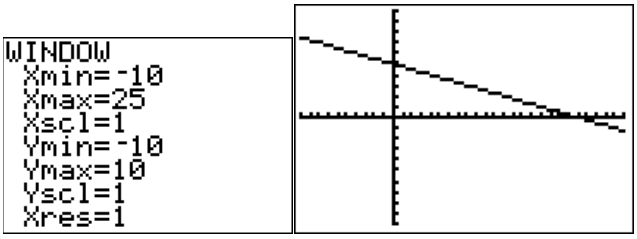
8) The x-intercept is $(20,0)$, or $x=20$. The y-intercept is $(0,5)$ or $y=5$.

9) $y=-\frac{1}{4}x+5$

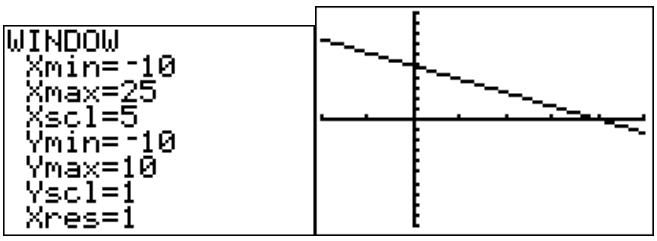
10) 

 The x-intercept is not visible.

11) To see the x-intercept of $x+4y=20$, we need to increase the Xmax value so that it is larger than the x-coordinate (20,0). Here Xmax 25.

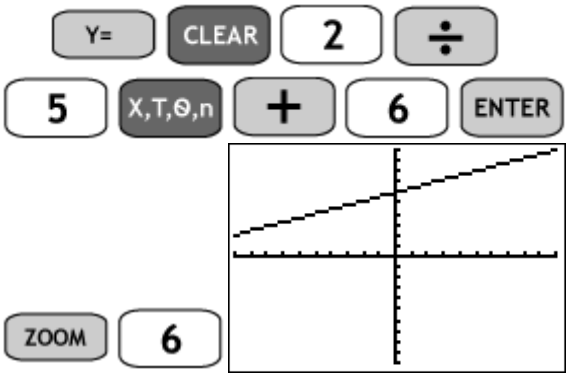


12) Again, there are many acceptable answers. Here, Xscl is 5.



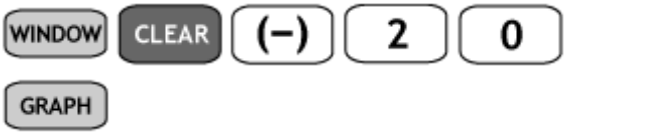
13) The x-intercept is $(-15,0)$, or $x=-15$. The y-intercept is $(0,6)$ or $y=6$.

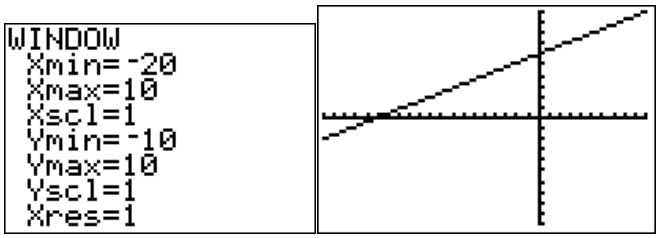
14) $y = \frac{2}{5}x + 6$

15) 

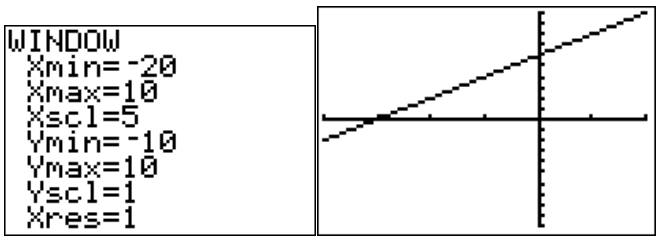
The x-intercept is not visible.

16) To see the x-intercept of $2x - 5y = -30$, decrease the Xmin value so that it is smaller than the x-coordinate (0,-15). Here Xmin - 20.



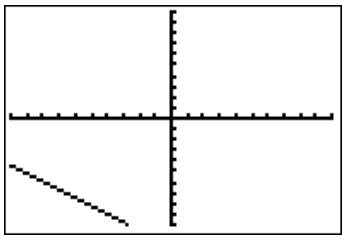


17) Again, there are many acceptable answers. Here, Xscl is 5.

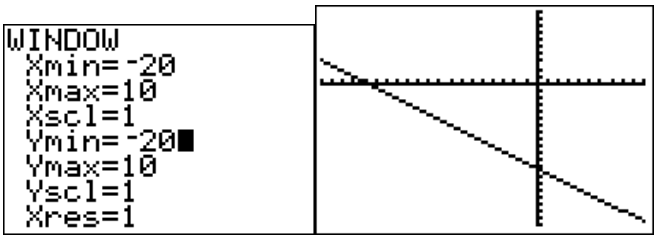


18) The x-intercept is (-16,0) or $x = -16$. The y-intercept is (0,-12) or $y = -12$.

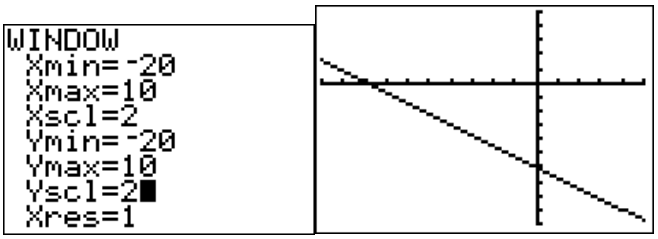
19) $y = -\frac{3}{4}x - 12$

20)  Neither the x-intercept nor the y-intercept is visible.

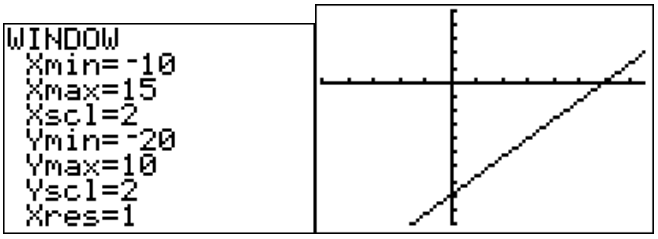
21) Must decrease both Xmin and Ymin.



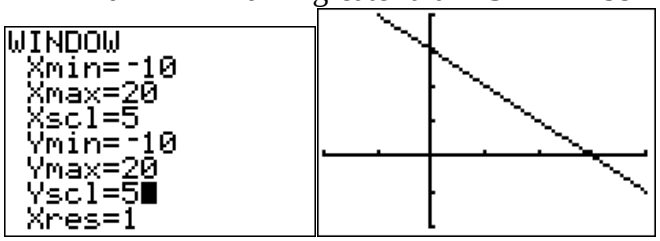
22) Again, there are several acceptable options. Here, Xscl is 2 and Yscl is also 2.



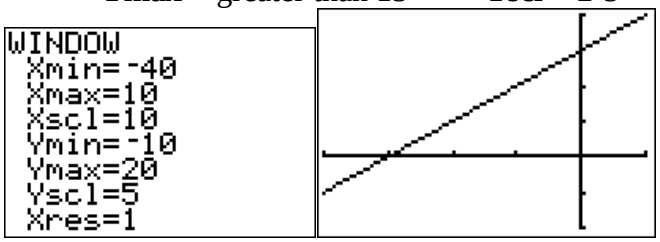
23) $4x - 3y = 48$ becomes $y = \frac{4}{3}x - 16$. **Xmin** = -10 **Xmax** = greater than 12 **Xscl** = 2-5 **Ymin** = less than -16 **Ymax** = 10 **Yscl** = 2-5



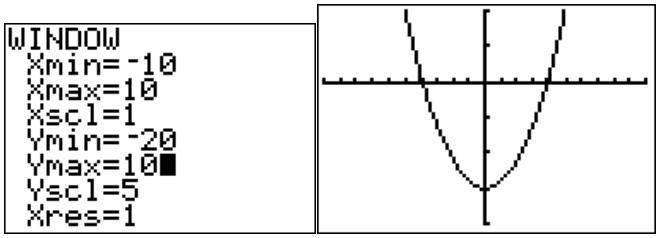
24) $x + y = 15$ becomes $y = -x + 15$ **Xmin** = -10 **Xmax** = greater than 15 **Xscl** = 2-5 **Ymin** = -10 **Ymax** = greater than 15 **Yscl** = 2-5



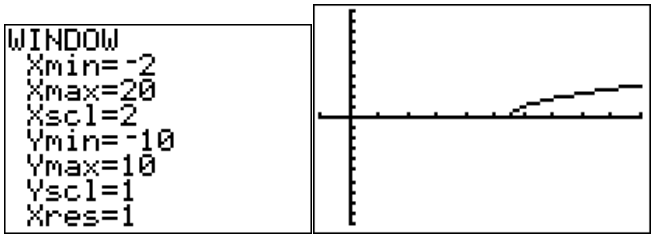
25) $x - 2y = -30$ becomes $y = \frac{1}{2}x + 15$ **Xmin** = less than -30 **Xmax** = 10 **Xscl** = 2-10 **Ymin** = -10 **Ymax** = greater than 15 **Yscl** = 2-5



26) $y = x^2 - 15$ is a parabola with vertex at (0, -15). **Xmin** = -10 **Xmax** = 10 **Xscl** = 1 **Ymin** = less than -15 **Ymax** = 10 **Yscl** = 2-5



27) $y = \sqrt{x - 11}$ is half of a sideways parabola with vertex at (11,0). **Xmin** = -10 (or larger) **Xmax** = greater than 11 **Xscl** = 2-5 **Ymin** = -10 **Ymax** = 10 **Yscl** = 1



28) $y = |x - 14|$ is a V-shape x-int at (14,0). **Xmin** = close to but less than 0 **Xmax** = greater than 15 **Xscl** = 2 or 7 **Ymin** = -10 or more **Ymax** = 10 or less **Yscl** = 1