Order of Operations on the Graphing Calculator
Lesson Plan

Objective

The students will be able to enter an expression into the CFX-9850G+ to find its value. The student will then check their work by graphing the resulting ordered pairs. The result should be a picture of the symbol pi (B).

Engage

Discuss with students the importance of entering expressions into the calculator correctly using the proper symbols, especially when entering fractions. Demonstrate why the students cannot use the brackets "[ ]" on the calculator in arithmetic operations. Discuss the Order of Operations and what each of the letters of the pneumonic PEMDAS stand for in relation to the arithmetic operations.

Explore

1. Using the calculator, model how enter expressions into the calculator including fractions, negative numbers, and exponents.
2. Demonstrate how to draw a line between two coordinates using the Sketch Function.

Elaborate

Students will become proficient at entering expressions into the calculator and finding their value. They will then draw segments using the coordinates as the endpoints in the given order. The resulting picture will be the Pi symbol "B".

Evaluate

The student will be able to evaluate any given expression in preparation for evaluating formulas.

Extensions

1. Ask the students to create expressions using four 4's, four 5's, or other combination to equal the values of 1 through 10.
2. Have students work in pairs to have one create an expression and the other find its value.
3. Have students create a number puzzle using expressions where the answers are the values of the expressions.

Student Activity: Order of Operations

Objective:

Given an expression, the student will be able to find its value. The student will then be able to check their work by using the values as coordinates to create a specified picture.

Introduction:

Numerical expressions are solve using the Order of Operations. This process is an agreed upon process that assures that each numerical expression has only one solution. This is important since it is used when applying formulas to problem solving. It would not be good to have two different solvers get two different answers for the same numerical expression. The Order of Operations uses the pneumonic **PEMDAS** which stands for **P**arentheses, **E**xponents, **M**ultiplication, **D**ivision, **A**ddition, and **S**ubtraction. Parentheses includes both parentheses and brackets. All multiplication and division is done in the order in which appears from left to right in the expression. All addition and subtraction is also done in the order in which it appears from left to right. You will learn how to enter an expression into a calculator correctly and find the correct value of the expression. At the same time, you will gain the skill of sketching using a graphing calculator.

Materials:

a. Expressions used to find coordinates.
b. CFX-9850G+ Graphing Calculator

Evaluate the Given Expressions:

Point 1: $x = 5\left[24 + 9(2) + {}^{-}6\right] \div 60$

$y = \left[7(15-2) - 2(18+2)\right] \div \dfrac{-30-4}{2}$

Point 2: $x = 9(13 - 7) + 5(6 - 16)$

$y = 15 - [3(12 + 5) - 2(17 + 3)]$

Point 3: $x = 25 - 18 + 7 - 16$
$y = 4(18) - 3(20) - 2(4)$

Point 4: $x = 4^3 - 5^2 + (-3)^3 - 4^2$
$y = 6^2 - 2^5 - 4^{.5}$

Point 5: $x = 5^3 - (16 - 5)^2 + (3 - 5)^3 + 2$

$y = \dfrac{4^3 - 7^2}{5}$

Point 6: $x = \dfrac{(-3)^5 + 6^3}{9}$

$y = 9^2 + (-3)^3 - 6^2 - 21$

Point 7: $x = 3(13 - 15)^3 + 5^2 - 2$

$$y = \frac{-2\left[3(9-5)^2 - 3(5-9)^3\right]}{10(4^2)}$$

Point 8: $x = 5[18 - 3(5 + 9)]^0 - 1$

$$y = \left(\frac{1}{2}\right)^{-5} + \left(-\frac{1}{4}\right)^{-3} + \left(-\frac{1}{6}\right)^{-2} - \left(\frac{1}{2}\right)^{-1}$$

Point 9: $$x = \left(\frac{1}{4}\right)^{-3} - \left(\frac{1}{3}\right)^{-3} + \left(-\frac{1}{2}\right)^{-5} - \left(\frac{1}{3}\right)^{-1}$$

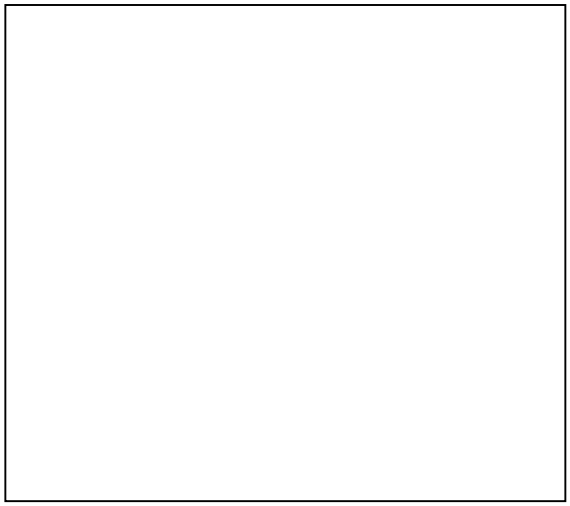
$$y = 2^6 - \left(\frac{1}{4}\right)^{-2} + (-2)(23)$$

Point 10: $$x = \frac{5(18) - 4(12)}{6(7)}$$

$$y = \frac{-8(9) + 5(6)}{3 - 17}$$

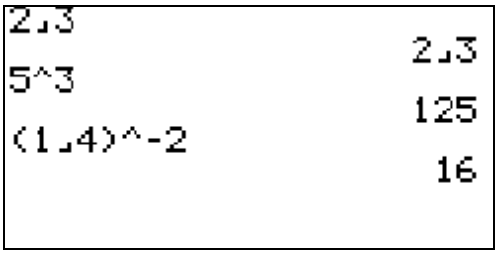
Sketch the Results:

1. Draw a segment connecting Point 1 to Point 2 on the calculator.
2. Continue drawing segments by connecting the ending point of one segment to the beginning point of the next segment.
3. Draw a sketch of your results.

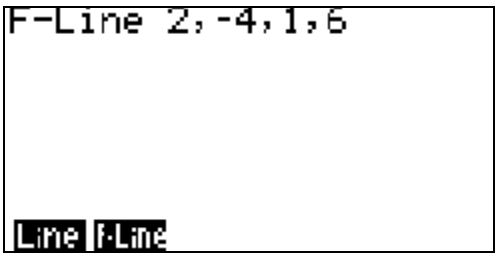


Calculator Notes

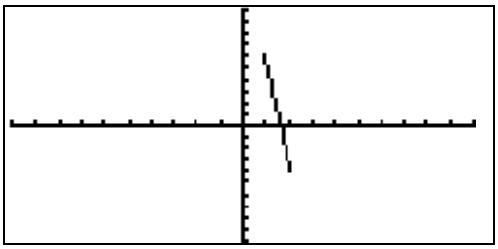
1. Turn on the calculator, go to the RUN Menu and press **EXE**. The screen should look blank. In order to enter fractions, you will use the key above 7 which has a $^{b}/_{c}$. To enter a fraction, first enter the numerator, press the a $^{b}/_{c}$ key and then enter the denominator. To enter an exponent, use the **^** key next to the $\mathbf{x^2}$ key. Enter the term then press **^** and enter the exponent. Fractions should be put in parentheses before using exponents. The fraction β and the expressions 5^3 and $(^1/_4)^{-2}$ have been entered and the screen will look like the one at the right.



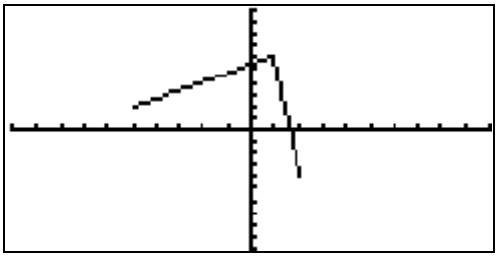
2. To draw a segment connecting two points, press **Shift F4 F6 F2** and **F2** again. Enter the values of the first pair of coordinates separating them with commas. Then enter the second pair of coordinates the same way. The screen at the right shows how to enter the endpoints of a segment connecting (2, -4) and (1, 6).



3. Press **EXE** to have the calculator draw the segment. It will look like the one on the right.



4. To draw a segment that joins (1, 6) to (-5, 2), press the **AC/^{on}** key and **F2**. Enter the coordinates just as they were done above. The screen at the right shows the results.



5. This process can be continued to form a quadrilateral by drawing a line segment from (-5, 2) to (-4, -3) and the connecting (-4, -3) to (2, -4). When completed, the screen will look like the one at the right.