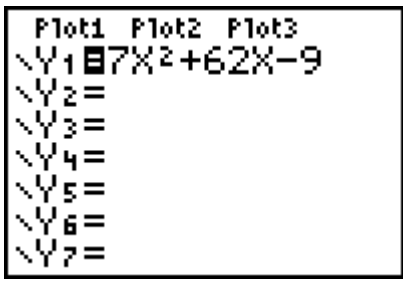
Watch Your P's and Q's

Name: _____

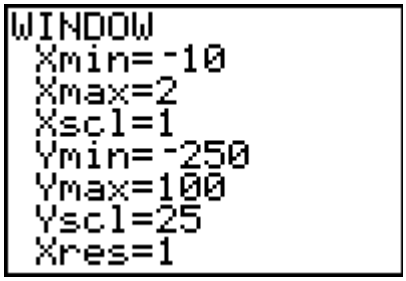
Class: _____

Problem 1 – Zeros of a Parabola

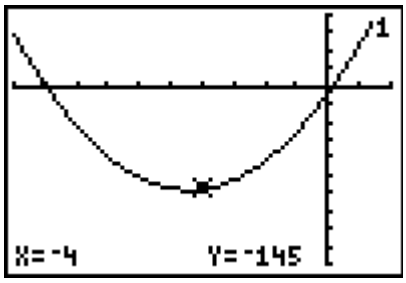
To find the zeros of the function $f(x) = 7x^2 + 62x - 9$ by graphing, first enter the function as **Y1**.



Adjust the graphing window to the settings shown. And press [GRAPH] to view the graph.



Press [TRACE] [FORMAT] Use the left and right arrows to move the cursor along the graph and locate the zeros.



Zeros of a polynomial are the ***x-values***. The location $(x, 0)$ is referred to as the *x-intercept*.

- How many zeros does this graph have?

- What are the zeros, approximately?

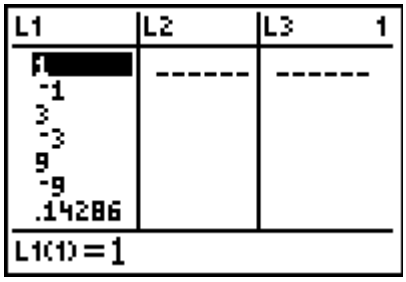
Notice that these zeros are not exact. This is a limitation of finding results graphically. To find the exact value of this zero (if it is rational), the Rational Zero Theorem must be applied.

The ***Rational Zero Theorem*** states that all ***potential*** rational zeros of a polynomial are of the form $\frac{P}{Q}$, where P represents all positive and negative factors of the *last* term of the polynomial and Q represents all positive and negative factors of the *first* term of the polynomial.

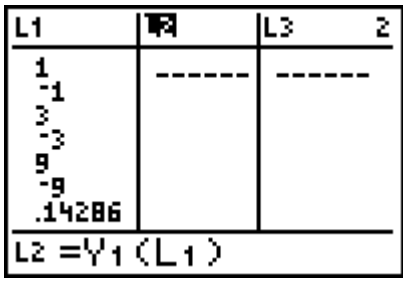
For this polynomial, $7x^2 + 62x - 9$, the possible rational zeros are:

$$\frac{P}{Q} = \frac{\pm 1, \pm 3, \pm 9}{\pm 1, \pm 7} = \pm 1, \pm 3, \pm 9, \pm \frac{1}{7}, \pm \frac{3}{7}, \pm \frac{9}{7}$$

We can find the exact zeros of the function by making a list. Press [STAT] then [ENTER] and enter all of the potential zeros into **L1**. You should have 12 entries.



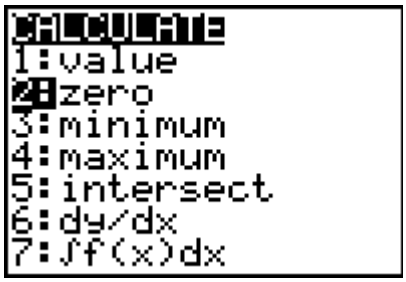
Highlight **L2**. Enter **Y1(L1)** and then press [ENTER] to calculate the value of the function at each of these potential zeros.



Scroll up and down the list. Where is the value of the function zero?

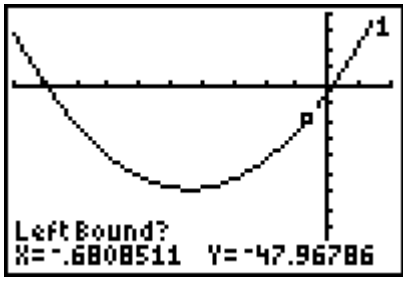
- What are the exact zeros of this function?

You can also calculate the zeros of a graph using the **Zero** command. Press [2nd] [TRACE] to open the **Calculate** menu and chose **2:zero**.



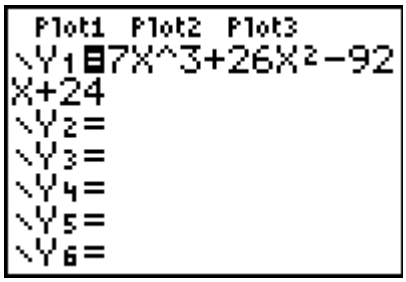
Move the cursor to the left of the zero and press [ENTER]. The move the cursor to the right of the zero and press [ENTER] again. Then make a guess and press [ENTER] again. The calculator displays the coordinates of the *x*-intercept.

- Use the **zero** command to check your answers.

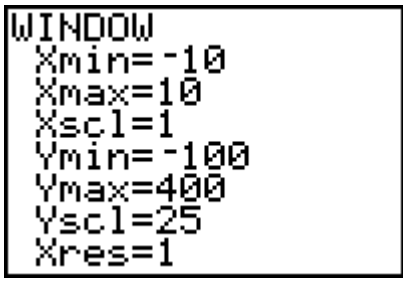


Problem 2 – Zeros of a cubic function

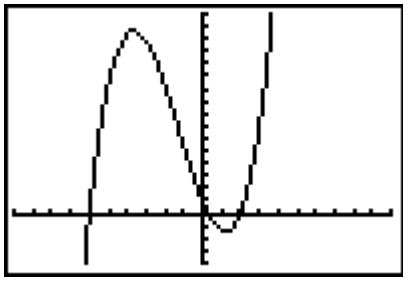
In this problem, you will find the zeros of a cubic function. Enter the function $f(x) = 7x^3 + 26x^2 - 92x + 24$ in **Y1**.



Adjust the graphing window to the settings shown.



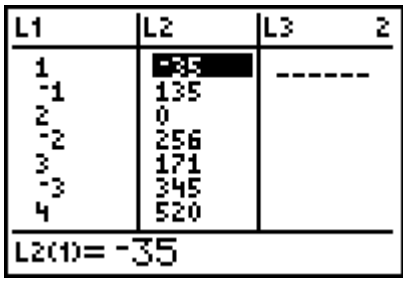
Trace the graph and locate the zeros.



- How many zeros does this graph have?

- What are the zeros, approximately?

- Identify all the possible rational zeros using the Rational Zero Theorem



Enter these results in **L1**. (There should be 32 entries.)

- What are the zeros of this function?

- Use the **zero** command to check your answers.

Exercises

1. Use the method described in the activity to find the rational zeros for $-10x^3 + 15x^2 + 16x - 12$.

2. How could synthetic division be used to help find the other zeros for the polynomial in Exercise 1? Use this to find the other zeros.

3. Is it possible for a polynomial to not have any rational zeros? or any zeros at all? Explain.

4. An object that is launched vertically from a point s_0 above the ground at an initial speed of v_0 feet per second. Its vertical distance above the ground is given by the equation $s = -16t^2 + v_0 t + s_0$. Determine how long an object with velocity of 300 ft/sec will stay in the air if thrown upwards from a height of 5 feet.