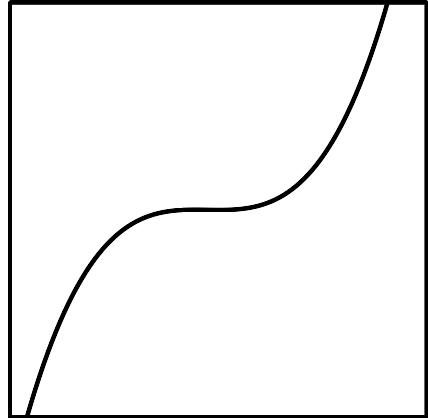
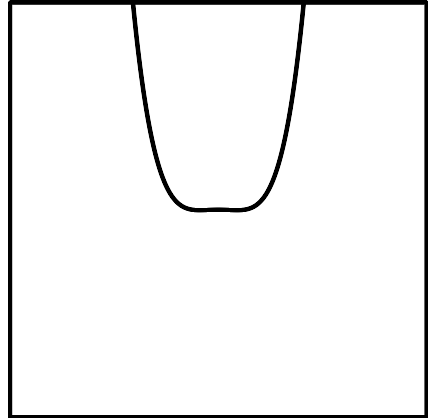
## Lesson 8: End Behavior (Part 1)

* Let’s investigate the shape of polynomials.

### 8.1: Notice and Wonder: A Different View

What do you notice? What do you wonder?





### 8.2: Polynomial End Behavior

1. For your assigned polynomial, complete the column for the different values of . Discuss with your group what you notice.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| * -1000 |  |  |  |  |
| * -100 |  |  |  |  |
| * -10 |  |  |  |  |
| * -1 |  |  |  |  |
| * 1 |  |  |  |  |
| * 10 |  |  |  |  |
| * 100 |  |  |  |  |
| * 1000 |  |  |  |  |

1. Sketch what you think the **end behavior** of your polynomial looks like, then check your work using graphing technology.

#### Are you ready for more?

Mai is studying the function . She makes a table of values for with and thinks that this function has large positive output values in both directions on the -axis. Do you agree with Mai? Explain your reasoning.

### 8.3: Two Polynomial Equations

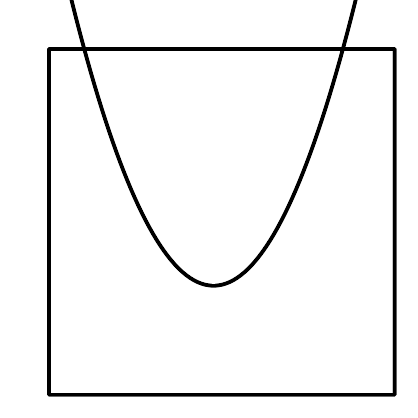
Consider the polynomial .

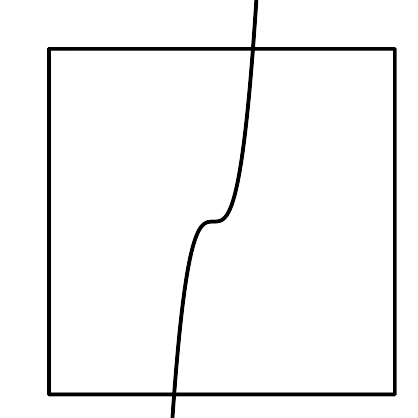
1. Identify the degree of the polynomial.
2. Which of the 6 terms, , , , , , or , is greatest when:
3. Describe the end behavior of the polynomial.

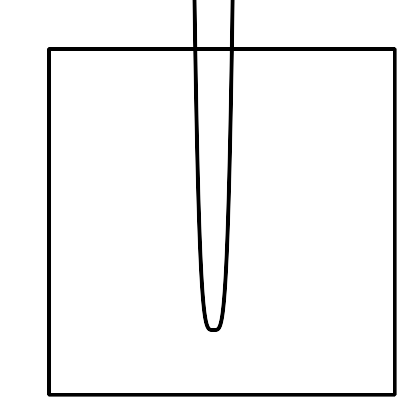
### Lesson 8 Summary

We know that if the expression for a polynomial function written in factored form has the factor , then is a zero of (that is,) and the point is on the graph of the function. But what about other values of ? In particular, as we consider values of that get larger and larger in either the negative or positive direction, what happens to the values of ?

The answer to this question depends on the degree of the polynomial, because any negative real number raised to an even power results in a positive number. For example, if we graph , and and zoom out, we see the following:







For both and , large positive values of or large negative values of each result in large positive values of . But for , large positive values of result in large positive values of , while large negative values of result in large negative values of .

Consider the polynomial . The leading term, , almost seems smaller than the other 3 terms. For certain values of , this is even true. But, for values of far away from zero, the leading term will always have the greatest value. Can you see why?

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
| -500 | 62,500,000,000 | 3,750,000,000 | -5,000,000 | 1,000 | 66,245,001,000 |
| -100 | 100,000,000 | 30,000,000 | -200,000 | 1,000 | 129,801,000 |
| -10 | 10,000 | 30,000 | -2,000 | 1,000 | 39,000 |
| 0 | 0 | 0 | 0 | 1,000 | 1000 |
| 10 | 10,000 | -30,000 | -2,000 | 1,000 | -21,000 |
| 100 | 100,000,000 | -30,000,000 | -200,000 | 1,000 | 69,801,000 |
| 500 | 62,500,000,000 | -3,750,000,000 | -5,000,000 | 1,000 | 58,745,001,000 |

The value of the leading term determines the **end behavior** of the function, that is, how the outputs of the function change as we look at input values farther and farther from 0. In the case of , as gets larger and larger in the positive and negative directions, the output of the function gets larger and larger in the positive direction.



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