IM 9–12 MATH v.1

Unit 2

Polynomials and Rational Functions

ALGEBRA 2

Lesson 10

Multiplicity

Illustrative Mathematics®

Kendall Hunt

Learning Goal

Let's sketch some polynomial functions.

Algebra 2

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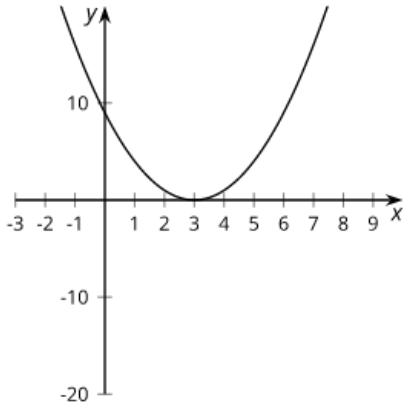
Duplicate Factors

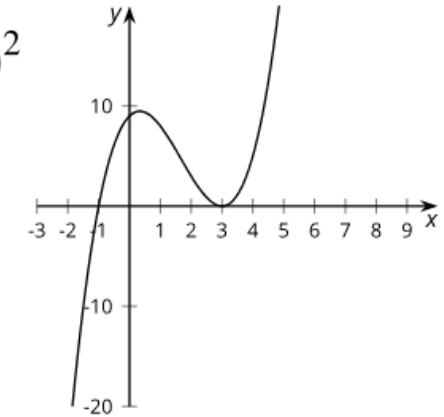
Warm-up: Notice and Wonder

What do you notice? What do you wonder?

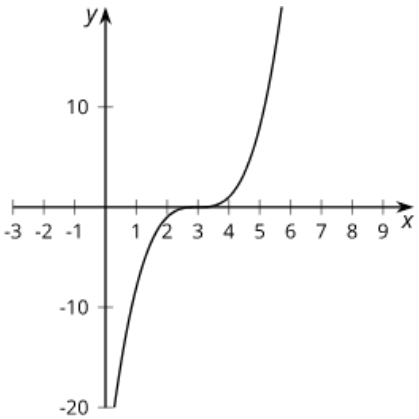
$y = (x - 3)^2$



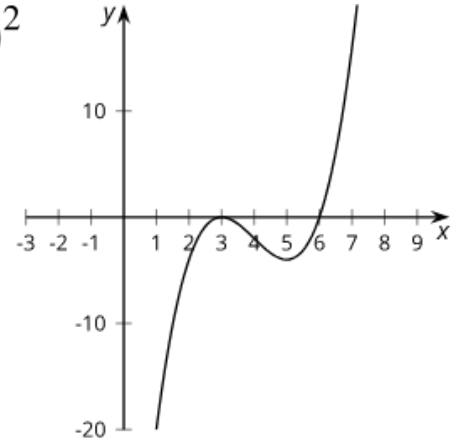
$y = (x + 1)(x - 3)^2$



$y = (x - 3)^3$

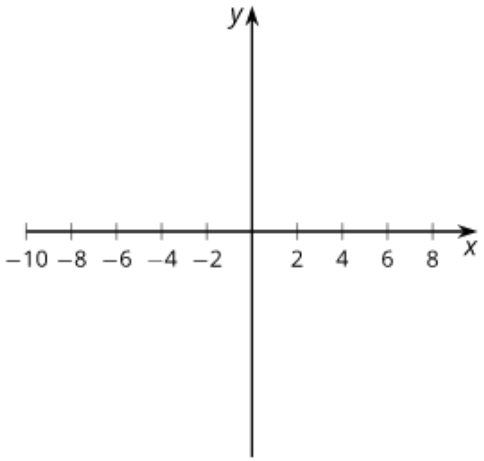


$y = (x - 6)(x - 3)^2$



Sketching Polynomials

$$f(x) = (x+9)(x+3)(x-4)^2$$



1. For polynomials *A–F*:
   a. Write the degree, all zeros, and complete the sentence about the end behavior.
   b. Sketch a possible graph.
   c. Check your sketch using graphing technology.

   Pause here for your teacher to check your work.

1. Create your own polynomial for your partner to figure out.
   a. Create a polynomial with degree greater than 2 and less than 8 and write the equation in the space given.
   b. Trade papers with a partner, then fill out the information about their polynomial and complete a sketch.
   c. Trade papers back. Check your partner's sketch using graphing technology.

Sketching Polynomials

$A(x) = (x + 2)(x - 2)(x - 8)$

$B(x) = -(x + 2)(x - 2)^2$

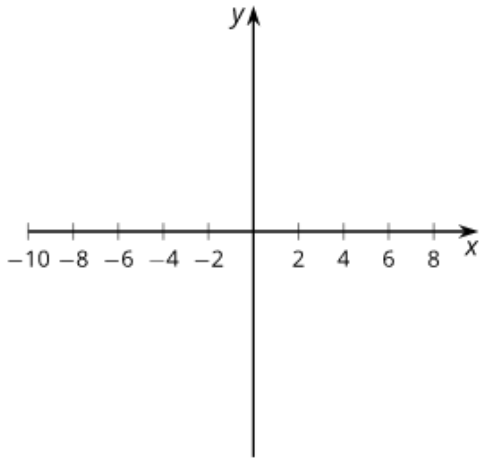
$C(x) = (x + 6)(x + 2)^2$

$D(x) = -(x + 6)^2(x + 2)$

$E(x) = (x + 4)(x - 2)^3$

$F(x) = x^3(x + 4)(x - 3)^2$

Your Polynomial

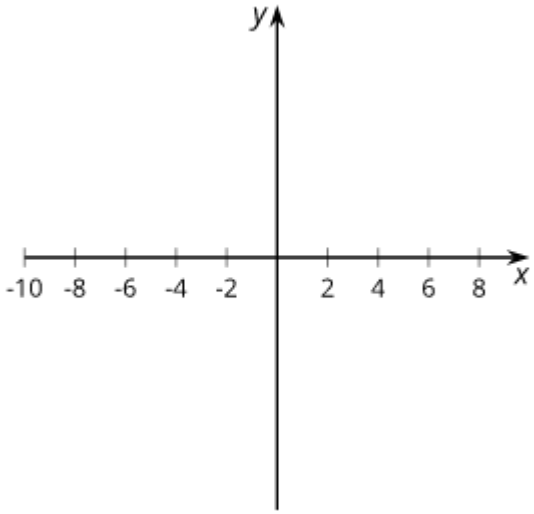


Degrees: Zeros:

End behavior: As x gets larger and larger in the negative direction.

Using Knowledge of Zeros

1. Sketch a graph for a polynomial function $y = f(x)$ that has 3 different zeros and $f(x) \geq 0$ for all values of x.
2. What is the smallest degree the polynomial could have?
3. What is a possible equation for the polynomial? Use graphing technology to see if your equation matches your sketch.



Multiplicity

Lesson Synthesis

- If you have a 4th degree polynomial with only 3 unique factors, what must be true about the multiplicity of the factors?
- If you changed which of your factors had a multiplicity of 2, how would the end behavior of your graph change?
- What is one number you could change in your equation that would result in a graph with different end behavior?

I can use zeros and multiplicities to sketch a graph of a polynomial.

Learning Targets

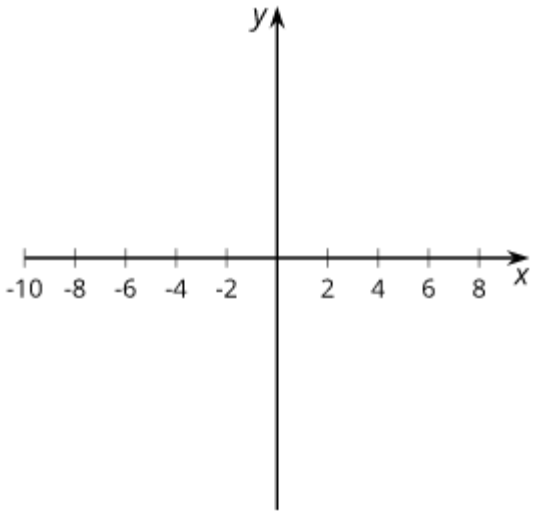
Algebra 2

One Last Sketch

Cool-down

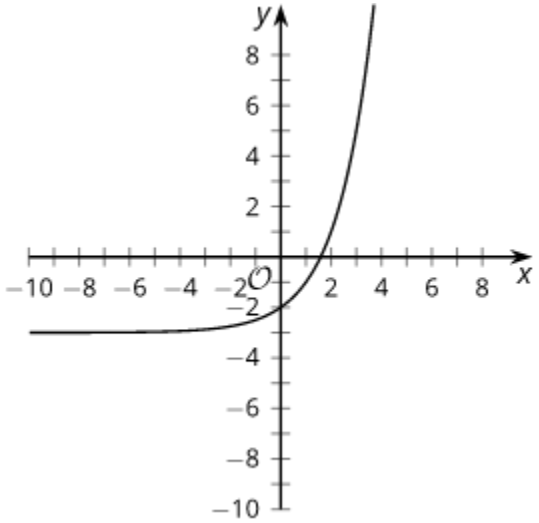
Use the information provided to sketch a possible graph for the polynomial function described on the provided axis.

- Degree: 4
- Zeros: -3, 4, 6
- End behavior: As x gets larger and larger in either the positive or the negative direction, y gets larger and larger in the negative direction.



end behavior

How the outputs of a function change as we look at input values further and further from 0.



This function shows different end behavior in the positive and negative directions. In the positive direction the values get larger and larger. In the negative direction the values get closer and closer to -3.

multiplicity

The power to which a factor occurs in the factored form of a polynomial. For example, in the polynomial $(x - 1)^2(x + 3)$, the factor $x - 1$ has multiplicity 2 and the factor $x + 3$ has multiplicity 1.