

## Lesson 7: Using Factors and Zeros

- Let's write some polynomials.

### 7.1: More Than Factors

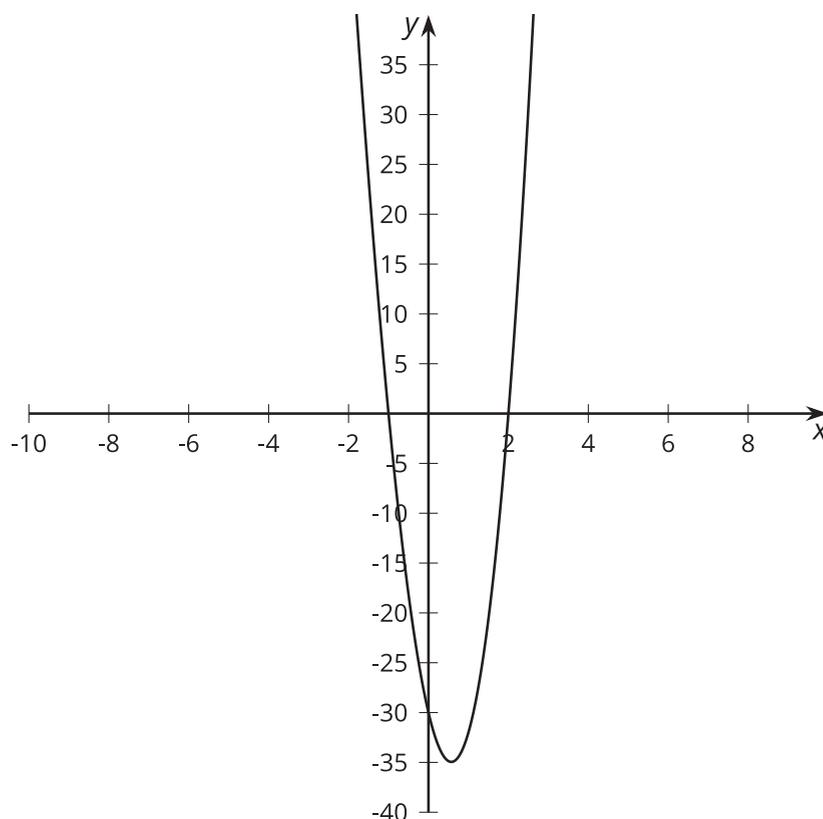
$M$  and  $K$  are both polynomial functions of  $x$  where

$$M(x) = (x + 3)(2x - 5) \text{ and } K(x) = 3(x + 3)(2x - 5).$$

1. How are the two functions alike? How are they different?
2. If a graphing window of  $-5 \leq x \leq 5$  and  $-20 \leq y \leq 20$  shows all intercepts of a graph of  $y = M(x)$ , what graphing window would show all intercepts of  $y = K(x)$ ?

### 7.2: Choosing Windows

Mai graphs the function  $p$  given by  $p(x) = (x + 1)(x - 2)(x + 15)$  and sees this graph.



She says, "This graph looks like a parabola, so it must be a quadratic."

1. Is Mai correct? Use graphing technology to check.
2. Explain how you could select a viewing window before graphing an expression like  $p(x)$  that would show the main features of a graph.
  
3. Using your explanation, what viewing window would you choose for graphing  $f(x) = (x + 1)(x - 1)(x - 2)(x - 28)$ ?

### Are you ready for more?

Select some different windows for graphing the function  $q(x) = 23(x - 53)(x - 18)(x + 111)$ . What is challenging about graphing this function?

## 7.3: What's the Equation?

Write a possible equation for a polynomial whose graph has the following horizontal intercepts. Check your equation using graphing technology.

1.  $(4, 0)$
  
2.  $(0, 0)$  and  $(4, 0)$
  
3.  $(-2, 0)$ ,  $(0, 0)$  and  $(4, 0)$
  
4.  $(-4, 0)$ ,  $(0, 0)$ , and  $(2, 0)$
  
5.  $(-5, 0)$ ,  $(\frac{1}{2}, 0)$ , and  $(3, 0)$

## Lesson 7 Summary

We can use the zeros of a polynomial function to figure out what an expression for the polynomial might be.

Let's say we want a polynomial function  $Z$  that satisfies  $Z(x) = 0$  when  $x$  is  $-1$ ,  $2$ , or  $4$ . We know that one way to write a polynomial expression is as a product of linear factors. We could write a possible expression for  $Z(x)$  by multiplying together a factor that is zero when  $x = -1$ , a factor that is zero when  $x = 2$ , and a factor that is zero when  $x = 4$ . Can you think of what these three factors could be?

It turns out that there are many possible expressions for  $Z(x)$ . Using linear factors, one possibility is  $Z(x) = (x + 1)(x - 2)(x - 4)$ . Another possibility is  $Z(x) = 2(x + 1)(x - 2)(x - 4)$ , since the  $2$  (or any other rational number) does not change what values of  $x$  make the function equal to zero.

To check that these expressions match what we know about  $Z$ , we can test the three values  $-1$ ,  $2$ , and  $4$  to make sure that  $Z(x)$  is  $0$  for those values. Alternatively, we can graph both possible versions of  $Z$  and see that the graphs intercept the horizontal axis at  $-1$ ,  $2$ , and  $4$ , as shown here.

