## 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 $M\left(x\right)=\left(x+3\right)\left(2x−5\right)$ and $K\left(x\right)=3\left(x+3\right)\left(2x−5\right)$.

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 $y=M\left(x\right)$, what graphing window would show all intercepts of $y=K\left(x\right)$?

### 7.2: Choosing Windows

Mai graphs the function $p$ given by $p\left(x\right)=\left(x+1\right)\left(x−2\right)\left(x+15\right)$ 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 $p\left(x\right)$ that would show the main features of a graph.
3. Using your explanation, what viewing window would you choose for graphing $f\left(x\right)=\left(x+1\right)\left(x−1\right)\left(x−2\right)\left(x−28\right)$?

#### Are you ready for more?

Select some different windows for graphing the function $q\left(x\right)=23\left(x−53\right)\left(x−18\right)\left(x+111\right)$. 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. $\left(4,0\right)$
2. $\left(0,0\right)$ and $\left(4,0\right)$
3. $\left(-2,0\right)$, $\left(0,0\right)$ and $\left(4,0\right)$
4. $\left(-4,0\right),\left(0,0\right)$, and $\left(2,0\right)$
5. $\left(-5,0\right)$, $\left(\frac{1}{2},0\right)$, and $\left(3,0\right)$

### 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 $Z\left(x\right)=0$ 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 $Z\left(x\right)$ 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 $Z\left(x\right)$. Using linear factors, one possibility is $Z\left(x\right)=\left(x+1\right)\left(x−2\right)\left(x−4\right)$. Another possibility is $Z\left(x\right)=2\left(x+1\right)\left(x−2\right)\left(x−4\right)$, 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 $Z\left(x\right)$ 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.





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