Warm Up

Determine the possible values for x in each equation.

1. $2x - 5 = 0$

2. $(x + 4)(x - 4) = 0$

3. $x(x + 3) = 0$

4. $(x - 5)(x + 1)(x - 2) = 0$

A Difference in Degree

You know that another name for a linear function that is not a constant function is a polynomial of degree 1, because the greatest exponent in a linear function equation is 1. A quadratic function is a polynomial of degree 2, and a cubic function is a polynomial of degree 3.

1. Determine the degree of each function.

a. $f(x) = x$

b. $g(x) = x - 1$

c. $h(x) = x(x - 1)$

d. $j(x) = (x - 1)(x - 1)$

e. $k(x) = x(x - 1)(x - 1)$

f. $m(x) = (x)(x)(x - 1)$

Multiplicity is how many times a particular number is a zero for a given function. The zero in each of the functions *f* and *g*, for example, has a multiplicity of 1.

2. **For the functions given in parts (c) through (f), identify the number of zeros and the multiplicity of each zero.**

3. **What do you notice about the zeros of a function, counted with multiplicity, and the degree of the function?**

ACTIVITY

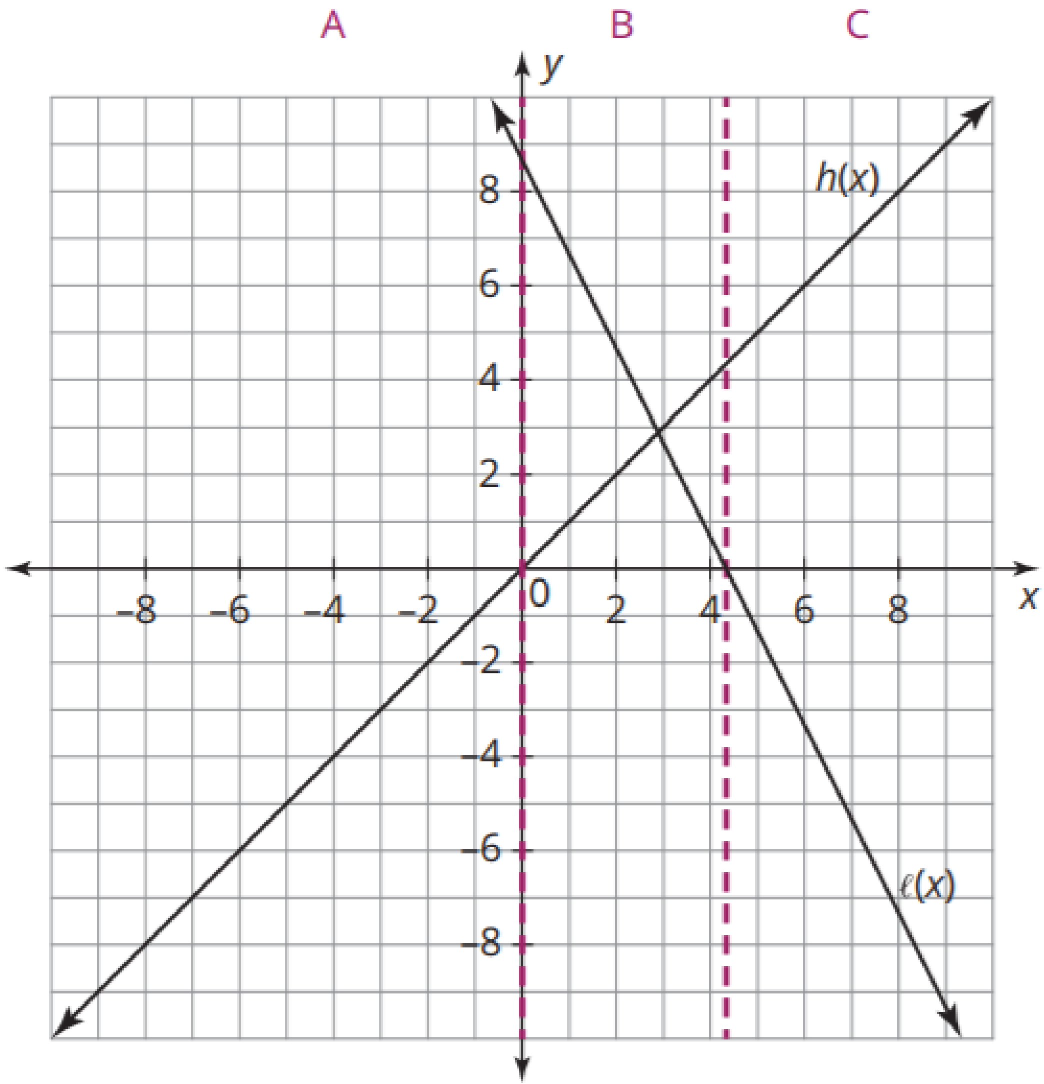
6.1

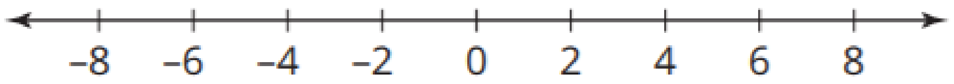
Decomposing a Quadratic Function

Consider the quadratic function you created to represent the cross-sectional area of the rain gutter in a previous lesson. This function was written as a product of two linear functions: one representing the height, $h(x) = x$, and one representing the length, $\ell(x) = -2x + 8.5$. Let's consider how to sketch the graph of the quadratic function without technology using the two linear functions.

The graph shows the two linear functions. Dashed lines are drawn through each x-intercept to divide the graph into three regions.

- Region A: From negative infinity to the leftmost zero.
- Region B: The region between the two zeros.
- Region C: From the rightmost zero to positive infinity.





1. **Label the zeros of each function with open points on the coordinate plane and on the number line below the coordinate plane.**
2. **Consider the three regions. For each region:**

   a. **Determine whether the output values of the product of the functions, $h(x) \cdot \ell(x)$ is positive or negative. Label the number line accordingly.**

   b. **Choose an x-value in the region. Evaluate the functions $h(x)$, $\ell(x)$, and $h(x) \cdot \ell(x)$ for that x-value. Plot each point on the coordinate plane.**

Ask yourself:

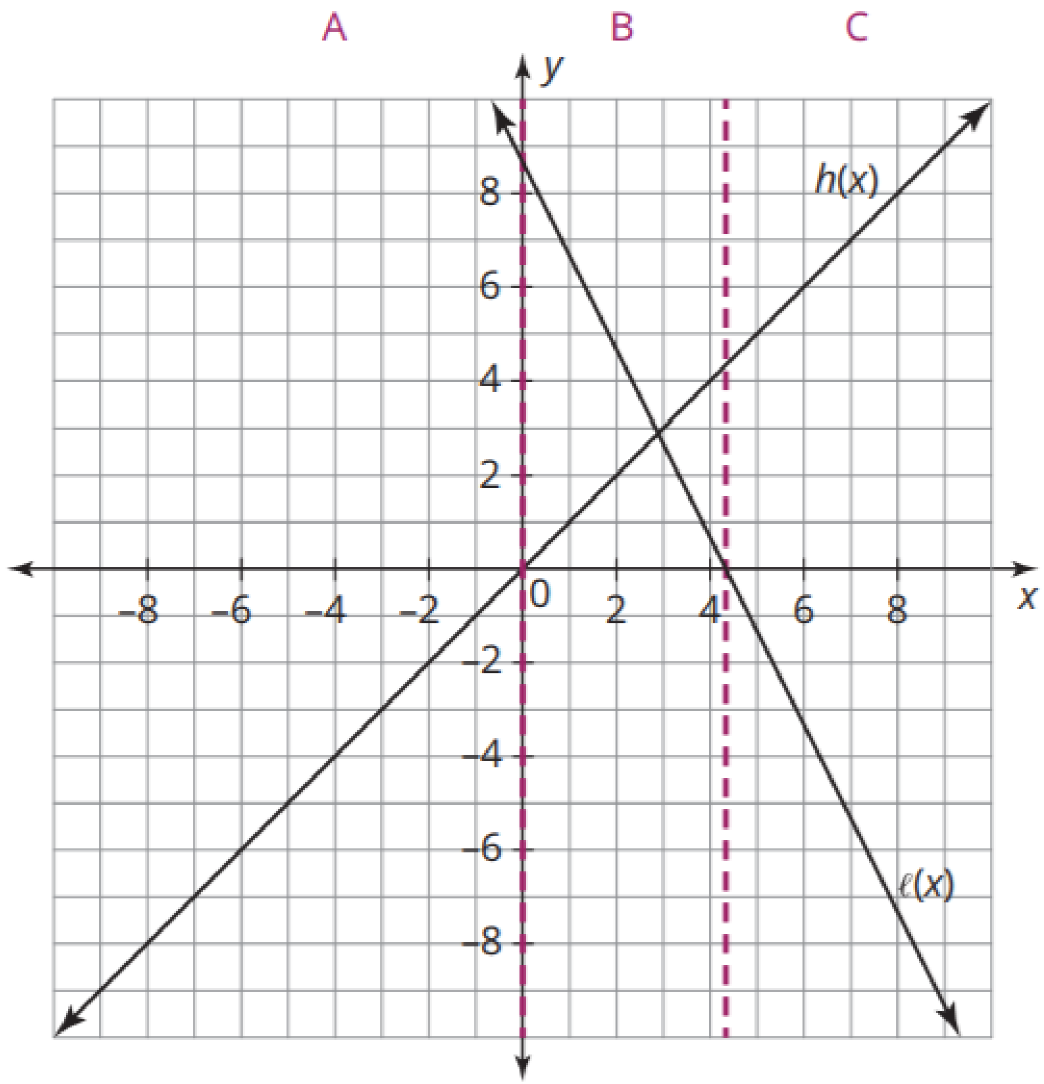
Is the product positive, negative, or zero? Does the point representing the product fall above, below, or on the x-axis?

3. **Describe the product $h(x) \cdot \ell(x)$ at the intersection point of the two linear functions. Plot the point that represents the product of the two functions at this point on the coordinate plane.**

4. **Describe the product $h(x) \cdot \ell(x)$ at the zeros of the two linear functions. Plot the point that represents the products of the two functions at these points on the coordinate plane.**

5. **Use the information from Questions 2 and 3 to sketch the function $h(x) \cdot \ell(x)$ on the coordinate plane.**

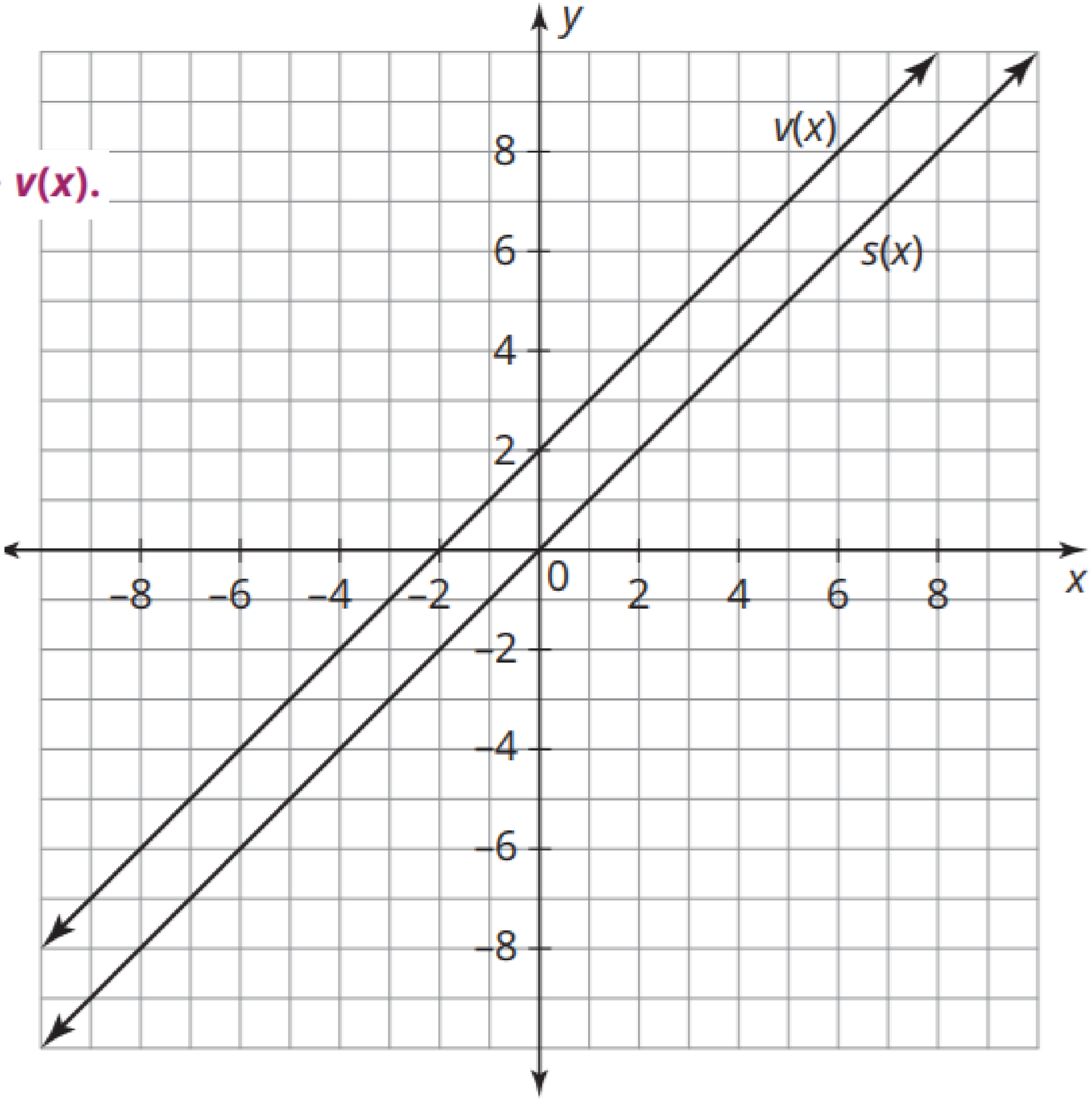
6. How does the Zero Product Property relate to the *x*-intercepts of the three functions?



Remember:

The Zero Product Property states that if the product of two or more factors is equal to zero, then at least one factor must be equal to zero.

7. Analyze the graphs of *s*(*x*) and *v*(*x*).



a. Sketch the graph of *p*(*x*) if $p(x) = s(x) \cdot v(x)$.

b. Identify the x-intercepts of $p(x)$. Explain the relationship between the x-intercepts of $p(x)$ and the x-intercepts of $s(x)$ and $v(x)$.

c. Identify the vertex of $p(x)$. What is the relationship between the vertex of $p(x)$ and the functions $s(x)$ and $v(x)$?

Assignment: Complete the "Practice" problem at the end of the lesson