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Lesson 7: The x-Factor

Solidify Understanding

Learning Focus

Find patterns in signs and numbers to help factor and multiply expressions.

Use area model diagrams to multiply binomials with different signs.

Use area model diagrams to factor trinomials when some of the terms are negative.

What happens to the factors of a quadratic expression when some of the terms are negative?

Open Up the Math
Launch, Explore, Discuss

Now that Optima's Quilts is accepting orders for rectangular blocks, their business in growing by leaps and bounds. Many customers want rectangular blocks that are bigger than the standard square block on one side. Sometimes they want one side of the block to be the standard length, x, with the other side of the block 2 inches bigger.

1. Draw and label this block. Write two different expressions for the area of the block.

Sometimes they want blocks with one side that is the standard length, x, and one side that is 2 inches less than the standard size.

2. Draw and label this block. Write two different expressions for the area of the block. Use your diagram and verify algebraically that the two expressions are equivalent.

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There are many other size blocks requested, with the side lengths all based on the standard length, x. Draw and label each of the following blocks. Use your diagrams to write two equivalent expressions for the area. Verify algebraically that the expressions are equal.

3. One side is 1 inch less than the standard size, and the other side is 2 inches more than the standard size.

4. One side is 2 inches less than the standard size, and the other side is 3 inches more than the standard size.

5. One side is 2 inches more than the standard size, and the other side is 3 inches less than the standard size.

6. One side is 3 inches more than the standard size, and the other side is 4 inches less than the standard size.

7. One side is 4 inches more than the standard size, and the other side is 3 inches less than the

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standard size.

8. An expression that has three terms in the form: $ax^2 + bx + c$ is called a trinomial. Look back at the trinomials you wrote in problems 3–7. How can you tell if the middle term (bx) is going to be positive or negative?

9. One customer had an unusual request. She wanted a block that is extended 2 inches on one side and decreased by 2 inches on the other. One of the employees thinks that this rectangle will have the same area as the original square, since one side was decreased by the same amount as the other side was increased. What do you think? Use a diagram to find two expressions for the area of this block.

10. The result of the unusual request made the employee curious. Is there a pattern or a way to predict the two expressions for area when one side is increased and the other side is decreased by the same number? Try modeling these two problems, look at your answer to problem 8, and see if you can find a pattern in the result.

a. $(x + 1)(x - 1)$ **b.** $(x + 3)(x - 3)$

11. What pattern did you notice? What is the result of $(x + a)(x - a)$?

12. Some customers want both sides of the block reduced. Draw the diagram for the following blocks, and find a trinomial expression for the area of each block. Use algebra to verify the trinomial expression that you found from the diagram.

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a. $(x-2)(x-3)$

b. $(x-1)(x-4)$

13. Look back over all the equivalent expressions that you have written so far, and explain how to tell if the third term in the trinomial expression x^2+bx+c will be positive or negative.

14. Optima's quilt shop has received a number of orders that are given as rectangular areas using a trinomial expression. Find the equivalent expression that shows the lengths of the two sides of the rectangles.

a. $x^2+9x+18$

b. $x^2+3x-18$

c. $x^2-3x-18$

d. $x^2-9x+18$

e. x^2-5x+4

f. x^2-3x-4

g. $x^2+2x-15$

15. Write an explanation of how to factor a trinomial in the form: x^2+bx+c where b and c can be either positive or negative numbers.

Ready for More?

$x^2+17x+72$ is a factorable trinomial with $c=72$. How many other factorable trinomials with

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$c = 72$ or -72 can you find? Write each one as both a trinomial and a product of two factors.

Takeaways

Multiplying binomials $(x + m)(x - n)$ to get a trinomial in the form $x^2 + bx + c$.

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The difference of squares pattern:

Steps for factoring a trinomial in the form $x^2 + bx + c$, where b and c can be either positive or negative:

With an open diagram:

1.
2.
3.
4.
5.

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Without a diagram:

Vocabulary

- **special products of binomials**

Bold terms are new in this lesson.

Lesson Summary

In this lesson, we learned to multiply binomials that had both positive and negative numbers in the factors. We found a useful pattern called “difference of squares” that occurs when the two factors have the same numbers but opposite signs. We learned to factor trinomials that have both positive and negative terms using sign and number patterns to be sure that the factored expression is equivalent to the trinomial.

Retrieval

For each of the linear equations, state the important features that are either given or most easily found from the form of the equation provided.

1. $g(x) = 3(x + 9) - 2$

2. $8x - 3y = 48$

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3. $h(x) = \frac{2}{3}x + 4$

4. Graph the parabola. Include the vertex and two accurate points on each side of the axis of symmetry.

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