Area of the Missing Square

ID: 11750

Time required
40 minutes

Activity Overview

Students will be introduced to an area model for representing a quadratic equation. Students will explore the relationship between the value of b and c, in $y = x^2 + bx + c$, form of the quadratic equation. The relationship will be examined with integer and non-integer values in order to help students recognize a pattern. Students will then apply their knowledge by answering several questions using the relationship.

Topic: Quadratic Equations

- *Completing the Square*
- *Factoring*
- *Perfect Square Trinomials*

Teacher Preparation and Notes

- *The teacher should be prepared to introduce the first problem of the document so students understand the "algebra tile" area representation of a quadratic equation. Teachers could use algebra tiles to introduce the activity if available.*
- *This activity explores completing the square when the coefficient of x^2 is one. The teacher should use the pattern recognition by the students to extend the activity to coefficient values other than one after the activity.*
- ***To download the student worksheet and Cabri Jr. file, go to education.ti.com/exchange and enter "11750" in the quick search box.***

Associated Materials

- *Alg2Week14_Square_worksheet_TI84.doc*
- *SQUARE (Cabri Jr. file)*

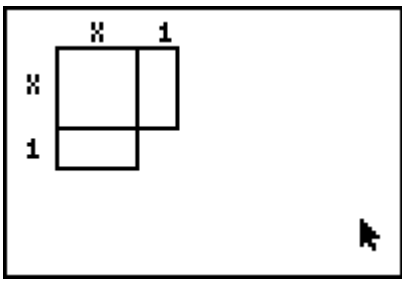
Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

- *Bridge on the River Quad (TI-84 Plus family) — 9530*
- *Completing the Square (TI-Nspire technology) — 11532*
- *Parabola Graphing: Completing the Square (TI-Nspire technology) — 9493*

Problem 1 – Introduction

Introduce the area model of a quadratic equation. The use of squares for x^2 and integers, and rectangles for x terms should be explained. Discuss the length of each side of the figures and the area of each figure. Also note to students that when the square is completed it can be factored into a perfect square.

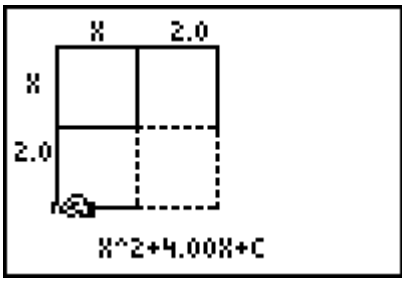


Discussion Questions:

- What is the area of each figure?
- How can the area of the missing square be found?
- How are the side lengths of each figure related?
- How does the factored form relate to the length and width of the completed square?
- How does the quadratic relate to the area of the square?

Problem 2 – Integer Lengths

In this problem, students will use the ALPHA key to grab the point in the lower left corner of the square to increase the length of the square. They will find the area of the square needed to complete the square. Students should observe the relationship between the coefficient of x and c, completing the table on the worksheet.

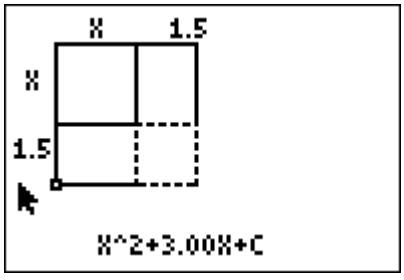


Discussion Questions:

- How does the coefficient of x in the area equation change each time the width increases by one?
- How is the area of the square or missing square related to the width?

Problem 3 – Non-integer Lengths

In this problem, students will use the ALPHA key to increase the length of the square to non-integers. They will find the area of the square needed to complete the square. Students should observe the relationship between the coefficient of x and c. Students will answer questions about the pattern they found.

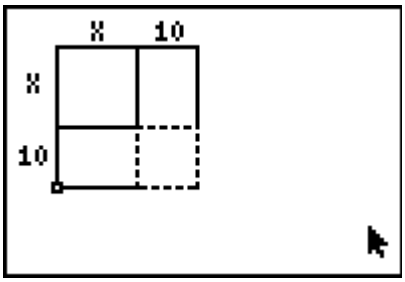


Discussion Questions:

- How does the coefficient of *x* in the Area equation change each time the width increases?
- How is the area of the square in the lower left corner or missing square related to the displayed width?
- How is the coefficient of *x* related to the length of the square in the lower right corner?
- How is the coefficient of *x* related to the value of *c*?
- What is a formula or method for finding the value of *c* without using the calculator?

Problem 4 – Applying Your Knowledge

In this problem, students will answer questions applying their knowledge for completing the square.



The discussion after reviewing the solutions to the application problems should prepare to extend the activity, at a future time, to completing the square for quadratics with coefficients of x^2 not equal to one.

Discussion Questions:

- How would you complete the square if the coefficient of x^2 is not equal to one?

Solutions – student worksheet

1. A square of length and width 1 completes the square.
2. $x^2 + 2x + 1$
3. The coefficient is double the length of the grey square.
4. If you take half of the coefficient and square it you get *c*.
5. $c = \left(\frac{b}{2}\right)^2$
6. 100
7. 49
8. 7.29
9. $\frac{25}{4}$
10. $x^2 + 4\sqrt{2}x + c$
11. 24
12. Add three. Half of 4 squared is 4 and we already have 1 so add three to get 4.
13. $\left(\frac{b}{2}\right)^2$