

Math 1

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Standard Form

$$ax^2 + bx + c$$

~  
trinomial

binomial

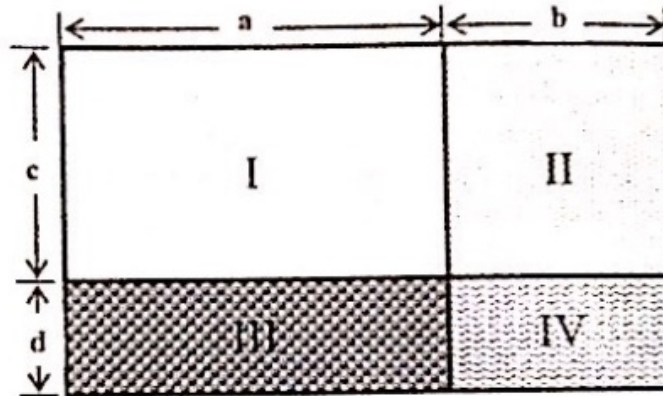
↓  
2 terms.

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### Investigation Distributing the Area

The large rectangle shown here is cut by lines parallel to its sides into four smaller rectangles. Use this area model to multiply and factor algebraic expressions. Each question below is based on this diagram.

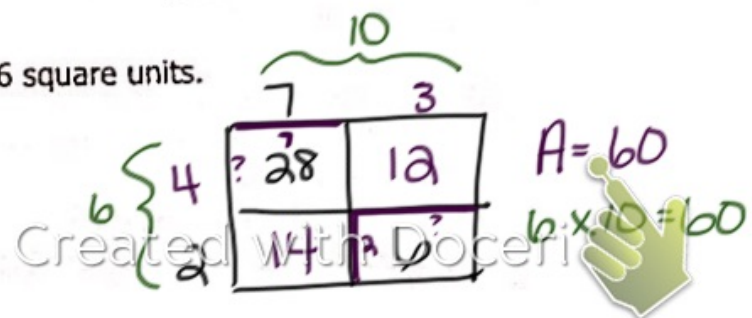
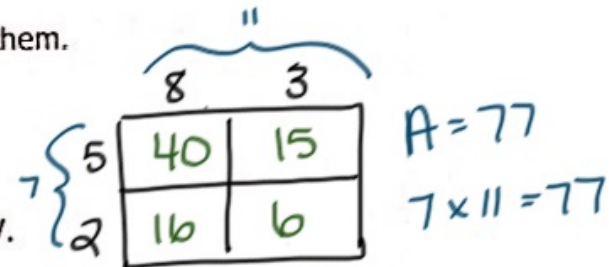


The big idea is that the area of a large rectangle can be found two ways:

- Multiply the length  $(a+b)$  by the width  $(c+d)$ .
- Find the area of each of the four smaller rectangles and add them.

#### Determining the area

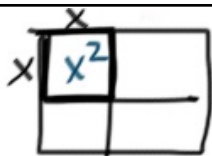
- Suppose  $a=8$ ,  $b=3$ ,  $c=5$ , and  $d=2$ .
  - Draw a diagram and label it with these numbers.
  - Determine the area of each smaller rectangle I, II, III, and IV.
  - Determine the total area of the large rectangle.
- Suppose area I = 28 square units,  $a = 7$ ,  $d=2$ , and area IV = 6 square units.
  - Draw a diagram and label it with the numbers.
  - Determine the missing lengths  $b$  and  $c$ .
  - Determine the areas of the smaller rectangles II and III.
  - Determine the total area of the large rectangle.



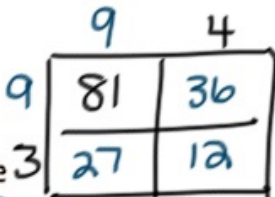
3. Suppose  $a$  and  $c$  are the same length  $x$ .

a. Which of the rectangles must be a square? Explain why. *I, all lengths are the same*

b. Write an expression for the area of the square.  $(x)(x) = x^2$



4. Suppose area I is a square with an area of 81 square units. If  $b=4$  and  $d=3$ , find the missing lengths and areas, including the total area.  $A = 156$



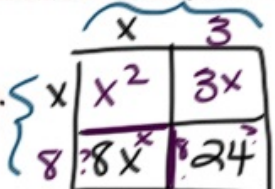
5. Suppose area I is a square with side length  $x$ , area III =  $8x$  square units, and area IV =  $24$  square units. Draw a diagram and label it with the given information.

a. Determine the missing lengths.

b. Write algebraic expressions for the length and width of the large rectangle.  $(x+3)(x+8)$

c. Determine the areas of the smaller rectangles.

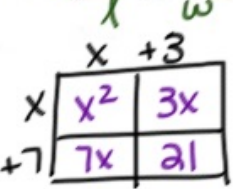
d. Write two equivalent expressions for the area of the large rectangle.



$x^2 + 3x + 8x + 24 = x^2 + 11x + 24 = (x+3)(x+8)$

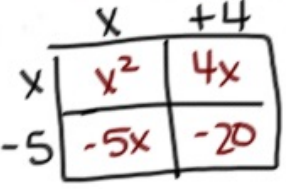
6. Show how the area model can be used to multiply each of the following. Write two equivalent expressions for the area of the large rectangle.

a.  $(x+3)(x+7)$



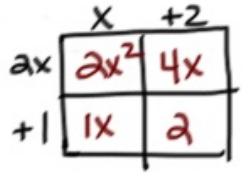
$x^2 + 3x + 7x + 21 = x^2 + 10x + 21$

b.  $(x+4)(x-5)$



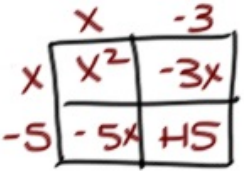
$x^2 + 4x - 5x - 20 = x^2 - x - 20$

c.  $(x+2)(2x+1)$




$2x^2 + 4x + 1x + 2 = 2x^2 + 5x + 2$

d.  $(x-3)(x-5)$



$x^2 - 3x - 5x + 15 = x^2 - 8x + 15$

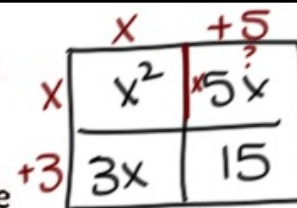
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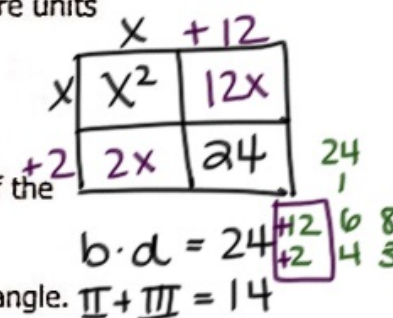


**Determining the dimensions**

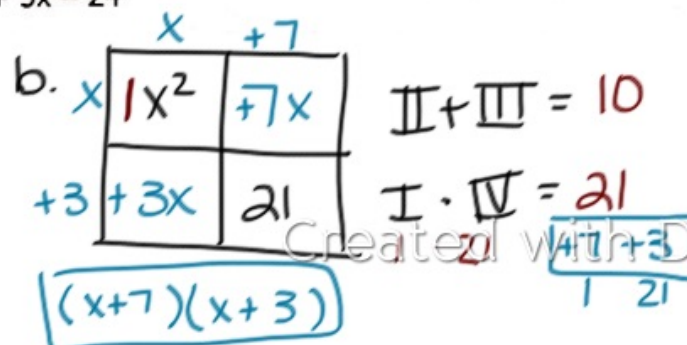
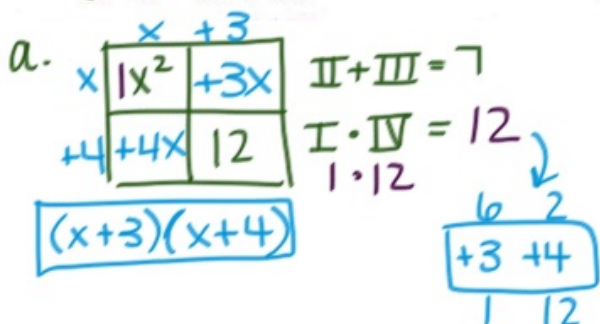
7. Suppose the total area is represented by the expression  $x^2 + 5x + 3x + 15$ .
- Draw a diagram and label it according to the information provided in the expression.
  - Determine the missing lengths.
  - Write an algebraic expression for the total area of the large rectangle as a product of the length and width.  $(x+3)(x+5)$



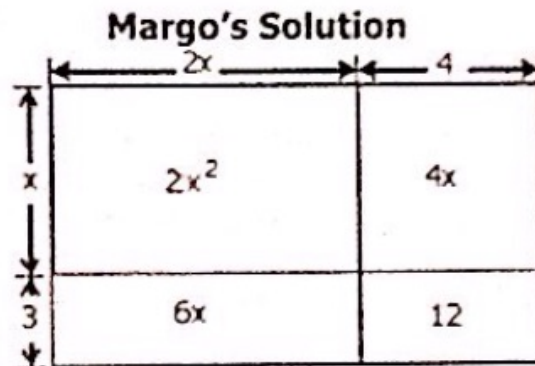
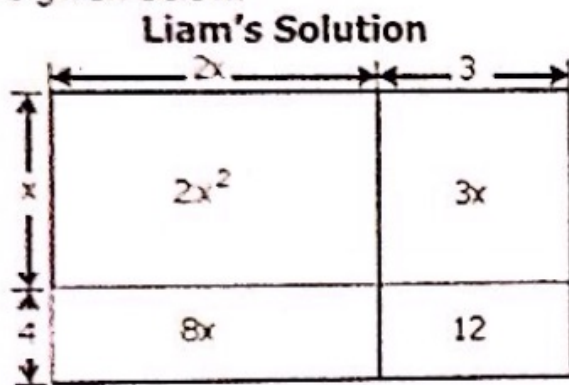
8. Suppose the total area is represented by the expression  $x^2 + 14x + 24$ . If area I is  $x^2$  square units and area IV is 24 square units,
- what must be true about area II and area III?  $II + III = 14$  or  $b$ -value.
  - what must be true about lengths  $b$  and  $d$ ?  $b \cdot d = 24$  or  $c$ -value
  - Write algebraic expressions for the length and width of the large rectangle.
  - Write an algebraic expression for the total area of the large rectangle as the product of the length and width.  $x^2 + 14x + 24 = (x+12)(x+2)$



9. Consider each of the following expressions as representing the total area of the large rectangle. Write an equivalent expression for the total area as a product of the length and width.
- $x^2 + 7x + 12$
  - $x^2 + 10x + 21$
  - $x^2 - 9x + 20$
  - $x^2 + 5x - 24$



10. Quadratic expressions are commonly written in the form  $ax^2+bx+c$  where  $a \neq 0$ . Students were using the area model to write equivalent expressions for  $2x^2+11x+12$ . Liam's and Margo's models are given below.



- How are the models similar and how are they different?
- Which model is correct?
- Using the model you determined was correct, write an equivalent expression for  $2x^2+11x+12$  as the product of two linear factors.

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**Check Your Understanding**

a) Draw an area model for each of the following expressions and write two equivalent expressions for the total area.

i.  $(x+3)(x+2)$

ii.  $(m+2)(m-4)$

iii.  $(5 + r)(-2 + r)$

iv.  $(n+4)(n+5)$

b) Find values for the missing numbers that will make the given expressions equivalent.

i.  $x^2 + 12x + \underline{\hspace{1cm}} = (x + 4)(x + \underline{\hspace{1cm}})$

ii.  $x^2 + \underline{\hspace{1cm}}x - 8 = (x + 4)(x + \underline{\hspace{1cm}})$

c) Determine the length and width of the rectangle whose area is represented by the expression  $x^2 + 8x + 7$ .

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## Multiplying Binomials $(a+b)(c+d)$

	$a$	$+b$
$c$	I	II
$+d$	III	IV

$I = a \times c$   
 $II = b \times c$   
 $III = a \times d$   
 $IV = b \times d$

\* Sum up all of the areas  
 (then combine like terms  $II + III$ )

## Factor \* $ax^2 + bx + c$

	?	?
?	Given $ax^2$	?
?	?	Given $c$

$II + III = b$

$I \cdot IV = axc$

List all the Pairs of factors

\* Work from inside out \*

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9c.  $x^2 - 9x + 20$

	$x$	$-4$	
$x$	$x^2$	$-4x$	$II + III = -9$ $I \cdot IV = 20$ $1 \cdot 20$
$-5$	$-5x$	$+20$	

$-4$	$-5$
2	10
1	20

$(x-5)(x-4)$

9d.  $x^2 + 5x - 24$

	$x$	$-3$	
$x$	$x^2$	$-3x$	$II + III = 5$ $I \cdot IV = -24$
$+8$	$+8x$	$-24$	

$-3$	$+8$
1	24
2	12
6	4

$(x-3)(x+8)$

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