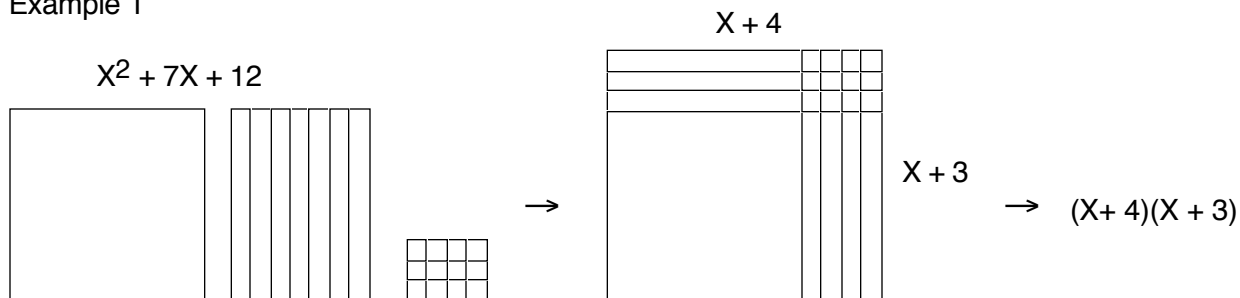


Lesson 20 Factor Polynomials

Factoring Trinomials We will be finding the factors of $X^2 + 7X + 12$ using the blocks with the algebra inserts snapped into the back. This is the opposite of multiplying two binomials to find the product, which is a trinomial. In Lesson 19 you were given the factors, and you were to find the product. Now, you are given the product and are asked to find the factors.

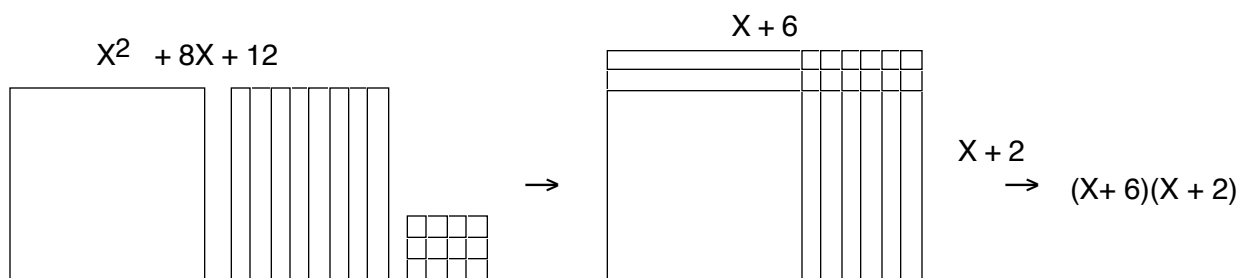
First build $X^2 + 7X + 12$. This is the product, which is given. Now build a rectangle using all the blocks. Then find the factors by reading the length of the over dimension and the up dimension.

Example 1



Example 2

Now find the factors of $X^2 + 8X + 12$. Represent with the manipulatives, build a rectangle, and read the factors.



Notice the relationship between the last term (12), the middle term (7X or 8X), and the factors. This always works when the coefficient of X^2 is 1.

$$X^2 + 7X + 12 = (X + 4)(X + 3) \quad \begin{array}{l} \text{The last term is found by multiplying } 3 \times 4. \\ \text{The middle term by adding } 3X + 4X. \end{array}$$

$$X^2 + 8X + 12 = (X + 6)(X + 2) \quad \begin{array}{l} \text{The last term is found by multiplying } 6 \times 2. \\ \text{The middle term by adding } 6X + 2X. \end{array}$$

The factors of the last term are the addends of the middle term.

More on Multiplying Polynomials Polynomials may be multiplied vertically (A), or horizontally (B), using the distributive property.

Example 3

$$\begin{array}{r}
 \text{A)} \quad \begin{array}{r} 2X + 3 \\ X + 2 \\ \hline 4X + 6 \\ 2X^2 + 3X \\ \hline 2X^2 + 7X + 6 \end{array} \\
 \text{B)} \quad (X + 2)(2X + 3) = (X)(2X + 3) + (2)(2X + 3) = \underbrace{(2X^2 + 3X) + (4X + 6)}_{2X^2 + 7X + 6}
 \end{array}$$

When multiplying horizontally, there are four partial products just as before, but they are arrived at using a formula called FOIL: F - first, O - outside, I - inside, L - last. Each letter corresponds to a partial product.

$$\begin{array}{ll}
 \text{F} & \text{In } \overbrace{(X + 2)(2X + 3)}, \quad X \cdot 2X \text{ is the First term times the first term} & 2X^2 \\
 \text{O} & \text{In } \overbrace{(X + 2)(2X + 3)}, \quad X \cdot 3 \text{ is the Outside term times the outside term} & 3X \\
 \text{I} & \text{In } (X + 2)\overbrace{(2X + 3)}, \quad 2 \cdot 2X \text{ is the Inside term times the inside term} & 4X \\
 \text{L} & \text{In } (X + 2)\overbrace{(2X + 3)}, \quad 2 \cdot 3 \text{ is the Last term times the last term} & 6 \\
 & & \underbrace{2X^2 + 3X + 4X + 6}_{2X^2 + 7X + 6}
 \end{array}$$

Example 4

$$\begin{array}{r}
 \text{A)} \quad \begin{array}{r} X + 3 \\ X + 4 \\ \hline 4X + 12 \\ X^2 + 3X \\ \hline X^2 + 7X + 12 \end{array} \\
 \text{B)} \quad (X + 4)(X + 3) = (X)(X + 3) + (4)(X + 3) = \underbrace{(X^2 + 3X) + (4X + 12)}_{X^2 + 7X + 12}
 \end{array}$$