

A **trinomial** is a polynomial with three terms.

In this handout we will discuss a method for factoring trinomials of the form $ax^2 + bx + c$.

Step 1: Multiply $a \cdot c$

Step 2: Find two numbers that when multiplied equal $a \cdot c$ and that when added equal b . Suppose the numbers are p and q . Two things need to be true.

- 1) $p \cdot q = a \cdot c$ AND
- 2) $p + q = b$

Step 3: Rewrite the expression using the numbers you found in the following way.

$$\begin{array}{ll} ax^2 + bx + c & \text{original expression} \\ ax^2 + px + qx + c & \text{re-written expression} \end{array}$$

Step 4: You now have 4 terms and are able to factor by grouping.

To factor by grouping do the following.

- *group the first two terms together and group the last two terms together.
- *factor the greatest common factor out of each pair
- *when you have done this the expressions inside the parenthesis will match and you now have two terms with a common factor. Factor out greatest common factor.

Example: Factor $6x^2 - 11x - 10$ using grouping.

Step 1: Multiply $a \cdot c = 6 \cdot (-10) = -60$

Step 2: Find two numbers that multiply to be -60 and add to be -11. Start this by looking at all factors of -60. Since we are looking for two numbers that multiply to be a negative, one of the numbers must be negative and one must be positive. After finding the factors of -60 then write the sum of the factors.

<u>factors of -60</u>	<u>sum of the factors of -60</u>
$(-1) \cdot (60)$	$(-1) + (60) = 59$
$(1) \cdot (-60)$	$(1) + (-60) = -59$
$(-2) \cdot (30)$	$(-2) + (30) = 28$
$(2) \cdot (-30)$	$(2) + (-30) = -28$
$(-3) \cdot (20)$	$(-3) + (20) = 17$
$(3) \cdot (-20)$	$(3) + (-20) = -17$
$(-4) \cdot (15)$	$(-4) + (15) = 11$
$(4) \cdot (-15)$	$(4) + (-15) = -11$
$(-5) \cdot (12)$	$(-5) + (12) = 7$
$(5) \cdot (-12)$	$(5) + (-12) = -7$
$(-6) \cdot (10)$	$(-6) + (10) = 4$
$(6) \cdot (-10)$	$(6) + (-10) = -4$

The pair that multiplies to be -60 and adds to be -11 is 4 and -15.

Step 3: Rewrite the expression using the pairs you found in step 2.

$$\begin{aligned} &6x^2 - 11x - 10 \\ &= 6x^2 + 4x - 15x - 10 \end{aligned}$$

Step 4: Factor by grouping.

$$\begin{aligned} &= 6x^2 + 4x - 15x - 10 \\ &= (6x^2 + 4x) + (-15x - 10) \text{ group the 1st 2 terms together and group the 2nd 2 terms together} \\ &= 2x(3x + 2) - 5(3x + 2) \text{ factor the GCF out of each grouping} \\ &= (3x + 2)(2x - 5) \text{ factor the GCF out of each of the two terms that remain} \end{aligned}$$

Practice Problems: Factor the following trinomials and check your answer by multiplying

1. $x^2 - 2x - 15$

2. $4x^2 - 7x + 3$

3. $18x^2 + 17x + 4$

4. $2x^2 - 3x - 27$

5. $21x^2 - 8x - 4$

6. $10x^2 + 17x + 3$