

6.4 Factoring Trinomials of the Form $ax^2 + bx + c$ by Grouping

OBJECTIVE 1: Using the Grouping Method

This method will be used if you have four terms, or if you have a $\neq 1$.

To Factor Trinomials by Grouping

Step 1. Factor out the greatest common factor if there is one other than 1.

Step 2. For the resulting trinomial $ax^2 + bx + c$, find two numbers whose product is $a \cdot c$ and whose sum is b .

Step 3. Write the middle term, bx , using the factors found in Step 2.

Step 4. Factor by grouping.

Example 1: Factor $3x^2 + 31x + 10$

$$\begin{array}{c} \frac{a}{3} \quad \frac{b}{31} \quad \frac{c}{10} \\ (3x^2 + x) + (30x + 10) \\ x(3x + 1) + 10(3x + 1) \\ \hline (x + 10)(3x + 1) \end{array}$$

$$\begin{array}{c} a \cdot c \\ 3 \cdot 10 \\ 30 \\ \hline 1 \quad 30 \\ \hline 31 \\ \hline b \end{array}$$

Practice 1: $5x^2 + 61x + 12$

$$\begin{array}{c} (5x^2 + x) + (60x + 12) \\ x(5x + 1) + 12(5x + 1) \\ \hline (x + 12)(5x + 1) \end{array}$$

$$\begin{array}{c} 30 \\ \hline 1 \quad 30 \\ \hline 2 \quad 15 \\ \hline 3 \quad 10 \\ \hline 5 \quad 6 \\ \hline 60 \\ \hline 1 \quad 60 \\ \hline 2 \quad 30 \\ \hline 3 \quad 20 \\ \hline 4 \quad 15 \\ \hline 5 \quad 12 \end{array}$$

Example 2: Factor $8x^2 - 14x + 5$

$$(8x^2 - 4x)(-10x + 5)$$

$$4x(2x - 1) - 5(2x - 1)$$

$$(4x - 5)(2x - 1)$$

~~$$\begin{array}{r} a \cdot c \\ 8 \cdot 5 \\ 40 \\ -4 \quad -10 \\ -14 \\ b \end{array}$$~~

Practice 2: $12x^2 - 19x + 5$

~~$$\begin{array}{r} a \cdot c \\ 12 \cdot 5 \\ 60 \\ -4 \quad -15 \\ -19 \\ b \end{array}$$~~

$$(12x^2 - 4x)(5x + 5)$$

$$4x(3x - 1) - 5(3x - 1)$$

$$(4x - 5)(3x - 1)$$

$$\begin{array}{r} 40 \\ -1 \quad -40 \\ -2 \quad -20 \\ -4 \quad -10 \\ -5 \quad -8 \end{array}$$

$$\begin{array}{r} 60 \\ -1 \quad -60 \\ -2 \quad -30 \\ -3 \quad -20 \\ -4 \quad -15 \\ -5 \quad -12 \\ -6 \quad -10 \end{array}$$

Example 3: Factor $6x^2 - 2x - 20$

$$2(3x^2 - x - 10)$$

$$2[(3x^2 - 6x) + (5x - 10)]$$

$$2[3x(x - 2) + 5(x - 2)]$$

$$2(3x + 5)(x - 2)$$

~~$$\begin{array}{r} a \cdot c \\ 3 \cdot -10 \\ -30 \\ 5 \quad -6 \\ -1 \\ b \end{array}$$~~

$$\begin{array}{r} -30 \\ 1 \quad -30 \\ 2 \quad -15 \\ 3 \quad -10 \\ 5 \quad -6 \end{array}$$

Practice 3: $30x^2 - 14x - 4$

~~$$\begin{array}{r} a \cdot c \\ 15 \cdot -2 \\ -30 \\ +3 \quad -10 \\ -7 \\ b \end{array}$$~~

$$2(15x^2 - 7x - 2)$$

$$2[(15x^2 + 3x) - 10x - 2]$$

$$2[3x(5x + 1) - 2(5x + 1)]$$

$$2(3x - 2)(5x + 1)$$

$$\begin{array}{r} -30 \\ 1 \quad -30 \\ 2 \quad -15 \\ 3 \quad -10 \\ 5 \quad -6 \end{array}$$

Example 4: Factor $18y^4 + 21y^3 - 60y^2$

Plot1 Plot2 Plot3
V1 = -120/X

X	Y1
15	
20	143
24	
30	
40	
50	

press + for abs

$$3y^2 [6y^2 + 7y - 20]$$

$$3y^2 [6y^2 - 8y + 15y - 20]$$

$$3y^2 [2y(3y-4) + 5(3y-4)]$$

$$\rightarrow 3y^2(2y+5)(3y-4)$$

~~a.c
6 · -20
-120~~

~~-8 + 15~~

7
b

Practice 4: $40m^4 + 5m^3 - 35m^2$

~~a.c
8 · -7
-56~~

~~-7 + 8~~

b

$$5m^2(8m^2 + m - 7)$$

$$5m^2(8m^2 + 8m - 7m - 7)$$

$$5m^2(8m(m+1) - 7(m+1))$$

$$\rightarrow 5m^2(8m-7)(m+1)$$

Plot1 Plot2 Plot3
V1 = 56/X

X	Y1
-12	4.6667
-11	5.0909
-10	5.6
-9	6.2222
-8	7
-7	8
-6	9.3333

X = -7

Example 5: Factor $4x^2 + 20x + 25$

$$(4x^2 + 10x) + (10x + 25)$$

$$2x(2x+5) + 5(2x+5)$$

$$(2x+5)(2x+5)$$

$$(2x+5)^2$$

~~a.c
4 · 25
100~~

~~10 10~~

~~20~~

b

100

1	100
2	50
4	25
5	20
10	10

Practice 5: $16x^2 + 24x + 9$

~~16 · 9
144~~

~~12 12~~

24

$$(16x^2 + 12x) + (12x + 9)$$

$$4x(4x+3) + 3(4x+3)$$

$$(4x+3)(4x+3)$$

$$(4x+3)^2$$

✓ Vocabulary, Readiness & Video Check

multiply * add +

For each trinomial $ax^2 + bx + c$, choose two numbers whose product is $a \cdot c$ and whose sum is b .

1. $x^2 + 6x + 8$	a. 4, 2	b. 7, 1	c. 6, 2	d. 6, 8	a
2. $x^2 + 11x + 24$	a. 6, 4	b. 24, 1	c. 8, 3	d. 2, 12	c
3. $2x^2 + 13x + 6$	a. 2, 6	b. 12, 1	c. 13, 1	d. 3, 4	b
4. $4x^2 + 8x + 3$	a. 4, 3	b. 4, 4	c. 12, 1	d. 2, 6	d

6.4 HW Assignment:

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