

Factoring by Grouping

Factoring a Four-Term Polynomial by Grouping

1. Arrange the four terms so that the first two terms have a common factor and the last two terms have a common factor.
2. For each pair of terms, determine the GCF and factor it out.
3. If step 2 produces a binomial factor common to both terms, factor it out.
4. If step 2 does not produce a binomial factor common to both terms, try grouping the terms of the original polynomial in different possible ways.
5. If step 4 does not produce a binomial factor common to both terms, the polynomial will not factor by this procedure.

Factor by grouping:

$$12x^2 - 8x + 9x - 6$$

$$\underline{12x^2 - 8x} + \underline{9x - 6}$$

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

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

To check your answer, use FOIL to multiply
 $(3x - 2)(4x + 3)$

Notice that each term created in the FOIL process is one of the four terms of the original grouping problem!

1. Look over the four terms. Do you see something in common right away in the 1st two terms and in the 2nd two terms? If not, you might want to rearrange the terms.
2. Underline the 1st two terms and underline the 2nd two terms. (This may seem strange, but it has been proven to help avoid errors.)
3. Identify the GCF of the 1st two terms. Write it down. Then, write the factor that is left. In this case, the GCF is 4x and (3x-2) is the factor that is left when the 4x is factored out.
4. *Immediately* write that factor under the last two terms. That is, put the (3x-2) under the 2nd two terms.
5. Identify what GCF would need to be pulled out of the 2nd two terms to have the (3x-2) remain. +3 would need to be pulled out. So write +3 in front of the 2nd (3x-2). Be sure to include the sign when identifying the GCF.
6. Now, remove the GCF of the two larger terms. What is in common in 4x(3x-2) and +3 (3x-2)? The (3x-2).
7. Factor out that GCF

Factor by grouping:

$\underline{2a + 2b} + \underline{wa + wb}$ $2(a + b) + w(a + b)$ $(a + b)(2 + w)$ $(a + b)(w + 2)$	$\underline{3wt - 3wa} + \underline{t - a}$ $3w(t - a) + 1(t - a)$ <p>Be sure to keep the 1.</p> $(t - a)(3w + 1)$	$x^2y - 6 + 3x^2 - 2y$ <p>Rearrange.</p> $\underline{3x^2 + x^2y} - \underline{6 - 2y}$ $x^2(3 + y) - 2(3 + y)$ <p>Usually the variable is first: $(y + 3)(x^2 - 2)$</p>	$\underline{-3a + 3} + \underline{ax - x}$ <p>Factor out the negative.</p> $-3(a - 1) + x(a - 1)$ <p>Variable first.</p> $(x - 3)(a - 1)$
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TAKE the time to complete each of these. The more you practice, the easier factoring will be.

TRY: Factor by grouping.

$$4a + xa + 12 + 3x$$

$$6a - 6y + ax - xy$$

$$aw - 5b + bw - 5a$$

$$pq - 8p - 10q + 80$$

$$bc + 6c - 4b - 24$$

$$pr - 2r - ap + 2a$$

$$st + 3s - t - 3$$

$$4ab + 32a + 3b + 24$$

$$3cu - 2u + 27c - 18$$