

**Elementary Algebra**  
**Skill-Builder # PF – 2**  
**Factoring by Grouping**

This technique is usually applied when there are four or more terms in a polynomial expression.

**Examples** Factor the following.

1.  $2x + 2y + wx + wy$

Solution: The polynomial has four terms and the terms do not have a GCF. Let's try grouping the first two terms and the last two terms:

$$(2x + 2y) + (wx + wy)$$

We see that in the first group 2 is the GCF while in the second group  $w$  is the GCF. Factoring out the respective GCF's from each group, we get

$$2(x + y) + w(x + y)$$

and we see that the binomial  $x + y$  can be factored out giving the factored form

$$(x + y)(2 + w).$$

2.  $8x - 6y - 12ax + 9ay$

Solution: Let us proceed as in Example 1 above - group the first two and last two terms and then factor out the GCF from each group.

$$\begin{aligned} &8x - 6y - 12ax + 9ay \\ &= (8x - 6y) - (12ax - 9ay) \quad \text{Note the sign changes inside the parentheses.} \\ &= 2(4x - 3y) - 3a(4x - 3y) \\ &= (4x - 3y)(2 - 3a) \end{aligned}$$

3.  $4a + 16b - xa - 4xb$

Solution: We proceed as before, noting that when we group the last two terms and put a minus sign outside the parentheses, then the signs inside the parentheses of these terms should change.

$$\begin{aligned} &4a + 16b - xa - 4xb \\ &= (4a + 16b) - (xa + 4xb) \\ &= 4(a + 4b) - x(a + 4b) \\ &= (4 - x)(a + 4b) \end{aligned}$$

4.  $10wx - 3y - 5x + 6wy$

Solution: Note for this example that we need to do some rearranging of terms before we can take out any GCF's from any group. Let's try grouping the first and third terms and the second and fourth terms.

$$\begin{aligned} &10wx - 3y - 5x + 6wy \\ &= (10wx - 5x) - (3y - 6wy) \\ &= 5x(2w - 1) - 3y(1 - 2w) \\ &= 5x(2w - 1) + 3y(2w - 1) \\ &= (2w - 1)(5x + 3y) \end{aligned}$$

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Factor completely:

1. $ab + ac + 5b + 5c$	2. $3xy - 6xw + 2y - 4w$
3. $4xp + 6x - 2p - 3$	4. $8abc - 12ab - 10c + 15$
5. $12x^2 - 9x + 3y - 4xy$	6. $15np + 25p - 6n^2 - 10n$
7. $12a^2 - 5b^2 - 6a + 10ab^2$	8. $-8x + 9y - 2xy + 36$

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**Answers**

1. $(a+5)(b+c)$	2. $(3x+2)(y-2w)$
3. $(2x-1)(2p+3)$	4. $(4ab-5)(2c-3)$
5. $(3x-y)(4x-3)$	6. $(5p-2n)(3n+5)$
7. $(6a+5b^2)(2a-1)$	8. $(9-2x)(4+y)$

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