

Algebra Section 9-8 Notes

Factoring by Grouping

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Sometimes....

...you use the Distributive Property to **factor by grouping** if two groups of terms have the same factor.

$$\begin{aligned}y^3 + 3y^2 + 4y + 12 &= (y^3 + 3y^2) + (4y + 12) \\&= y^2(y + 3) + 4(y + 3) \\&= (y^2 + 4)(y + 3)\end{aligned}$$

To factor by grouping, look for a common binomial factor of two pairs of terms

Example One: Factoring a Four-Term Polynomial

Factor $4n^3 + 8n^2 - 5n - 10$.

$$\begin{aligned}4n^3 + 8n^2 - 5n - 10 &= (4n^3 + 8n^2) - (5n + 10) = 4n^2(n + 2) - 5(n + 2) \\&= (4n^2 - 5)(n + 2)\end{aligned}$$

Check by using FOIL:

$$\begin{aligned}(4n^2 - 5)(n + 2) &= 4n^2 \cdot n + 4n^2 \cdot 2 - 5 \cdot n - 5 \cdot 2 \\&= 4n^3 + 8n^2 - 5n - 10\end{aligned}$$

You try: Factor by grouping.

a. $5t^4 + 20t^3 + 6t + 24$

b. $2w^3 + w^2 - 14w - 7$

c. $5x^3 - 25x^2 + 2x - 10$

Before you factor by grouping you might need to **factor the GCF** of all the terms of a polynomial. Remember, a polynomial is not completely factored until there are no common factors other than 1.

Example Two: Factoring Completely

Factor $12p^4 + 10p^3 - 36p^2 - 30p$.

$$\begin{aligned}12p^4 + 10p^3 - 36p^2 - 30p &= 2p(6p^3 + 5p^2 - 18p - 15) \\&= 2p[p^2(6p + 5) - 3(p + 5)] \\&= 2p(p^2 - 3)(6p + 5)\end{aligned}$$

Factor out the GCF, $2p$.

Factor by grouping.

Factor again.

You try: Factor completely.

$$45m^4 - 9m^3 + 30m^2 - 6m$$

You can also factor by grouping to find factors of a trinomial of the form $ax^2 + bx + c$.
You might want to try this method when you have difficulty factoring a trinomial using the method presented in Section 9.6 (the so-called “box” method).

Let's use these steps to factor a trinomial such as $48x^2 + 46x + 5$

Step 0: $a = 48, b = 46, c = 5$ (GCF = 1)

Step 1: Find the product $a \cdot c$
 $48 \cdot 5 = 240$

Step 2: Find the factors of ac that have the sum b (as we did in the “box” method):

1, 240	4, 60
2, 120	5, 48
3, 80	6, 40 ← This is the one! $6+40 = 46$

Step 3: Rewrite the trinomial by breaking up the middle term into two pieces (by factors).

$$\begin{aligned}48x^2 + 46x + 5 &= 48x^2 + (6 + 40)x + 5 \\&= 48x^2 + 6x + 40x + 5\end{aligned}$$

Step 4: Factor by grouping.

$$\begin{aligned}48x^2 + 6x + 40x + 5 &= (48x^2 + 6x) + (40x + 5) \\&= 6x(8x + 1) + 5(8x + 1) \\&= (6x + 5)(8x + 1)\end{aligned}$$

Example 3: Factoring a Trinomial by Grouping

Factor $24q^2 + 25q - 25$.

You try!

a. $63d^2 + 44d + 5$

b. $11k^2 + 49k + 20$

c. $4y^2 + 33y - 70$