

AIM: HOW DO WE FACTOR BY GROUPING?

Do Now: Factor each of the following **completely**.

a)  $2x^2 - 18$   
 $2(x^2 - 9)$   
 $2(x+3)(x-3)$

b)  $2x^2 - 8x + 6$   
 $2(x^2 - 4x + 3)$   
 $2(x-3)(x-1)$

FACTORING BY GROUPING

When do we use it?

4 or 6 terms with no GCF

STEPS	EXAMPLE
1. Split the polynomial in half, ensuring there is a GCF on each side.  2. Find the GCF of each half  3. Combine like binomials  4. Write the remaining parts in a separate parenthesis	$ax + ay + bx + by$ $\underline{a(x+y)} + \underline{b(x+y)}$ $(a+b)(x+y)$

\*1)  $x^3 - m + x^2m - x^2$  Rearrange to force GCF!

$x^3 - x - m + x^2m$   
 $x(x^2 - 1) + m(-1 + x^2)$   
 same!  
 $(x+m)(x^2 - 1)$   
 $(x+m)(x+1)(x-1)$

2)  $x^2 + 2x - mx - 2m$   
 $x(x+2) - m(x+2)$   
 $(x-m)(x+2)$



6 TERM EXAMPLES:

**\*\*Make sure that you factor *completely*\*\***

Factor:  $ax^2 + 3ax + 2a + bx^2 + 3bx + 2b$

$$\begin{aligned} & \underbrace{\hspace{10em}} \quad \underbrace{\hspace{10em}} \\ & a(x^2 + 3x + 2) + b(x^2 + 3x + 2) \\ & (a+b)(x^2 + 3x + 2) \\ & \boxed{(a+b)(x+2)(x+1)} \end{aligned}$$

An alternate approach. If we rearrange the terms in 3 groups of two as follows:

Factor:  $ax^2 + bx^2 + 3ax + 3bx + 2a + 2b$

$$\begin{aligned} & \underbrace{\hspace{2em}} \quad \underbrace{\hspace{2em}} \quad \underbrace{\hspace{2em}} \\ & x^2(a+b) + 3x(a+b) + 2(a+b) \\ & (x^2 + 3x + 2)(a+b) \\ & \boxed{(x+2)(x+1)(a+b)} \end{aligned}$$

PRACTICE:

4)  $m^2 + abm - mx - abx$   
 $m^2 - mx + abm - abx$   
 $m(m-x) + ab(m-x)$   
 $\boxed{(m+ab)(m-x)}$

5)  $x^3 + 3x^2 - 4x + 4x^2y + 12xy - 16y$   
 $x(x^2 + 3x - 4) + 4y(x^2 + 3x - 4)$   
 $(x + 4y)(x^2 + 3x - 4)$   
 $\boxed{(x+4y)(x+4)(x-1)}$

6)  $3c^3 - 2c^2 - 12c + 8$   
 $c^2(3c-2) - 4(3c-2)$   
 $(c^2-4)(3c-2)$   
 $\boxed{(c+2)(c-2)(3c-2)}$

7)  $k^4 - 4k^2 + 8k^3 - 32k + 12k^2 - 48$   
 $k^2(k^2-4) + 8k(k^2-4) + 12(k^2-4)$   
 $(k^2 + 8k + 12)(k^2-4)$   
 $\boxed{(k+6)(k+2)(k+2)(k-2)}$

\*8)  $x^2z^3 + xz^2 + x^3z^2 - 2x^2z^2 - 2xz^3 + z^3$   
 $x^2z^3 - 2xz^3 + z^3 + xz^2 + x^3z^2 - 2x^2z^2$   
 $z^2(x^2z - 2xz + z + x + x^3 - 2x^2)$   
 $z^2(z(x^2 - 2x + 1) + x(1 + x^2 - 2x))$   
 $\rightarrow z^2(z+x)(x^2 - 2x + 1)$   
 $\boxed{z^2(z+x)(x-1)(x-1)}$   
 yikes!