

FACTORING BY GROUPING

Do Now: Factor $x^2(x+5) - 7(x+5)$
 $(x+5)(x^2-7)$

Factoring a Polynomial with Four Terms by Grouping

1. Factor out the GCF, if possible.
2. Create smaller groups within the problem- group the first two terms together and the last two terms together.
3. Factor out the GCF from each of the two groups.
Note: if the third term is negative, factor out a negative.
4. If the binomial factors are the same, you can express your answer as the product of the common binomial factor and the remaining terms.
5. Determine if the remaining terms can be factored any further.

Ex 1. $x^3 - 5x^2 + 3x - 15$
 $x^2(x-5) + 3(x-5)$
 $(x-5)(x^2+3)$

Ex 2. $4x^2 + 20x - 3xy - 15y$
 $4x(x+5) - 3y(x+5)$
 $(x+5)(4x-3)$

Ex 3. $x^3 + 2x^2 - 9x - 18$
 $x^2(x+2) - 9(x+2)$
 $(x+2)(x^2-9)$ DOTS!
 $(x+2)(x+3)(x-3)$

Factoring a Polynomial with Three Terms by Grouping

1. Factor out the GCF, if possible
 2. Given $ax^2 + bx + c$, find the product of ac .
 3. Find two factors of ac that add to up to b .
 4. Split the middle term into two terms using these factors.
 5. Create smaller groups within the problem- group the first two terms together and the last two terms together.
 6. Factor out the GCF from each of the two groups.
- Note: if the third term is negative, factor out a negative.*
7. If the binomial factors are the same, you can express your answer as the product of the common binomial factor and the remaining terms.
 8. Determine if the remaining terms can be factored any further.

Ex 4.

$$8x^2 - 10x - 3$$

$$8x^2 - 12x + 2x - 3$$

$$4x(2x - 3) + 1(2x - 3)$$

$$(2x - 3)(4x + 1)$$

$$\begin{array}{r} -24 \\ -12 \times 2 \\ -10 \end{array}$$

Ex 5.

$$5x^2 + 11x + 2$$

$$5x^2 + 10x + 1x + 2$$

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

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

$$\begin{array}{r} 10 \\ 10 \times 1 \\ 11 \end{array}$$

FACTORING BY GROUPING MIXED PRACTICE

Factor each expression by grouping:

1) $6a^3 - 9a^2 + 2ab - 3b$

$$3a^2(2a - 3) + b(2a - 3)$$

$$(3a^2 + b)(2a - 3)$$

2) $3x^2 - 5x - 12$

$$3x^2 - 9x + 4x - 12$$

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

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

$$\begin{array}{r} -36 \\ -9 \times 4 \\ -5 \end{array}$$

$$3) x^3 + 3x^2 - 4x - 12$$

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

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

$$\boxed{(x+2)(x-2)(x+3)}$$

$$4) 2x^2 + 15x + 7$$

$$2x^2 + 14x + x + 7$$

$$2x(x+7) + 1(x+7)$$

$$\boxed{(2x+1)(x+7)}$$

$$\begin{array}{r} 14 \\ \times 1 \\ \hline 14 \\ 15 \end{array}$$

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

$$x^2(x-1) + 1(x-1)$$

$$\boxed{(x^2+1)(x-1)}$$

$$6) 3x^2 + xy - 12x - 4y$$

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

$$\boxed{(x-4)(3x+y)}$$

$$7) 11x + 2 + 9x^2$$

$$9x^2 + 11x + 2$$

$$9x^2 + 9x + 2x + 2$$

$$9x(x+1) + 2(x+1)$$

$$\boxed{(9x+2)(x+1)}$$

must be
in standard
form!

$$\begin{array}{r} 18 \\ 9 \times 2 \\ \hline 11 \end{array}$$

$$8) 8a^2b^4 - 4b^4 + 14a^2 - 7$$

$$4b^4(2a^2-1) + 7(2a^2-1)$$

$$\boxed{(4b^4+7)(2a^2-1)}$$

9) $7x^2 - 22x + 3$

$$7x^2 - 21x - x + 3$$

$$7x(x-3) - 1(x-3)$$

$$(7x-1)(x-3)$$

10) $15mx + 10nx - 6my - 4ny$

$$5x(3m+2n) - 2y(3m+2n)$$

$$(5x-2y)(3m+2n)$$

11) $-9x + 18x^2 - 2$

← put into standard form!

$$18x^2 - 9x - 2$$

$$18x^2 - 12x + 3x - 2$$

$$6x(3x-2) + 1(3x-2)$$

$$(6x+1)(3x-2)$$

*-36
-12 3
-9*

12) $2ab + 3a + 18b + 27$

$$a(2b+3) + 9(2b+3)$$

$$(a+9)(2b+3)$$

13) $4x^2 - 7x - 2$

$$4x^2 - 8x + x - 2$$

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

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

*-8
-8 1
-7*

14) $xy + x + 3y + 3$

$$x(y+1) + 3(y+1)$$

$$(x+3)(y+1)$$

$$15) 2x^2 + 13x + 21$$

$$2x^2 + 6x + 7x + 21$$

$$2x(x+3) + 7(x+3)$$

$$(2x+7)(x+3)$$

$$\begin{array}{c} 42 \\ 6 \times 7 \\ 13 \end{array}$$

$$16) 2am + 8m + 8an + 32n$$

$$2(am+4m+4an+16n)$$

$$2(m(a+4) + 4n(a+4))$$

$$2(m+4n)(a+4)$$

$$17) 11x^2 - 98x - 9$$

$$11x^2 - 99x + x - 9$$

$$11x(x-9) + 1(x-9)$$

$$(11x+1)(x-9)$$

$$\begin{array}{c} -99 \\ -99 \times 1 \\ -98 \end{array}$$

$$18) 12s^2 - 27s - 8st + 18t$$

$$3s(4s-9) - 2t(4s-9)$$

$$(3s-2t)(4s-9)$$

$$19) 2x^3 - x^2 - 2x + 1$$

$$x^2(2x-1) - 1(2x-1)$$

$$(x^2-1)(2x-1)$$

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