

## 2-3 Factoring Polynomials

(Book 6.4 pg. 353-)

### Objectives:

- I can factor a polynomial by GCF, special factoring, and factor by grouping
- I can find multiple representations of factored polynomials

Factor the following:

$$x^2 - 7x + 10$$

$$(x-5)(x-2)$$

$$\begin{aligned} \text{check: } & x^2 - 2x - 5x + 10 \\ & = x^2 - 7x + 10 \end{aligned}$$

$$x^2 + x - 30$$

$$(x+6)(x-5)$$

$$\begin{aligned} \text{check: } & x^2 - 5x + 6x - 30 \\ & = x^2 + x - 30 \end{aligned}$$

$$2x^2 - 3x - 2$$

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

$$\begin{aligned} \text{check: } & 2x^2 - 4x + x - 2 \\ & = 2x^2 - 3x - 2 \end{aligned}$$

$$6x^2 - 7x - 5$$

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

$$\begin{aligned} \text{check: } & 6x^2 + 3x - 10x - 5 \\ & = 6x^2 - 7x - 5 \end{aligned}$$

## Greatest Common Factors pg. 355-356

A  $6x^3 + 15x^2 + 6x$

Factors:

$$6x^3 = 2 \cdot 3 \cdot x \cdot x \cdot x$$

$$15x^2 = 3 \cdot 5 \cdot x \cdot x$$

$$6x = 2 \cdot 3 \cdot x$$

What is in all of them?

$$\text{GCF: } 3 \cdot x = 3x$$

B  $2x^3 - 20x$

Factors:

$$2x^3 = 2 \cdot x \cdot x \cdot x$$

$$-20x = -1 \cdot 2 \cdot 2 \cdot 5 \cdot x$$

What is in both of them?

$$\text{GCF: } 2 \cdot x = 2x$$

Factor.

$$3x^3 + 7x^2 + 4x$$

$$3 \cdot x \cdot x \cdot x + 7 \cdot x \cdot x + 2 \cdot 2 \cdot x$$

$$\text{GCF} = x$$

Factor:

$$x(3x^2 + 7x + 4)$$

Check by multiplying:  $3x^3 + 7x^2 + 4x$   
(Same as original)

$$4a^4b + 8a^3b^3 - 10a^2b^4$$

$$2 \cdot 2 \cdot a \cdot a \cdot a \cdot a \cdot b + 2 \cdot 2 \cdot 2 \cdot a \cdot a \cdot a \cdot b \cdot b \cdot b - 2 \cdot 5 \cdot a \cdot a \cdot b \cdot b \cdot b \cdot b$$

$$\text{GCF} = 2a^2b$$

Factor:

$$2a^2b(2a^2 + 4ab^2 + 5b^3)$$

CHECK IT!

## Special Factoring Patterns pg. 355

Remember the factoring patterns you already know:

Difference of two squares:  $a^2 - b^2 = (a-b)(a+b)$

Ex:  $x^2 - 4 = (x-2)(x+2)$

Perfect square trinomials:  $a^2 + 2ab + b^2 = (a+b)^2$

Ex:  $x^2 + 6x + 9 = (x+3)(x+3) = (x+3)^2$

There are two other factoring patterns that will prove useful:

Sum of two cubes:  $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$

Difference of two cubes:  $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$

$a^3 - b^3 = (a-b)(a^2 + ab + b^2)$  Factor.

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

$x^3 - 27$   
 $a=x \quad b=3$

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

$27x^3 + 64$   
 $a=3x \quad b=4$

$(3x+4)(9x^2 - 12x + 16)$

\* take  $\sqrt[3]{}$  of each term to find a and b

$8x^3 + 64$   
 $a=2x \quad b=4$

$(2x+4)(4x^2 - 8x + 16)$

Not a perfect cube  
 $x^3 + 4$   
 Not factorable

Perfect Squares!  
 $4x^2 - 36$

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

## Factoring by Grouping pg. 357

(A)  $x^3 + x^2 + x + 1$

Write out the polynomial.

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

Group by common factor.

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

Factor.

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

Regroup.

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

(B)  $(x^4 + x^3) + (x + 1)$

$$x^3(x+1) + 1(x+1)$$

← they match, so they are a GCF. Factor it out!

$$(x+1)(x^3+1)$$

you can factor w/ perfect cubes

## Factor by Grouping.

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

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

$$x^2(x+3) + 1(3x+2)$$

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

Don't match,  
so not  
factorable!

Match! Factor out!

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

check by multiplying  
back out