Essential Question: How do we factor polynomials?

Do Now: Complete each statement.

a) 
$$8m - 6 = 2(4m - 3)$$

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 b)  $36a^3+24a^2+12a = 12a(3a^2+2a+1)$ 

## Factoring Polynomial Expressions



### Think about this...

Factoring is the process of representing an expression as a product.

Example: 
$$2 \times 3 = 6$$
 The numbers 2 and 3 are factors of 6

We can also find the factors of polynomial expressions.

Example: 
$$2(y+3) = 2y+6$$
 The factors of  $2y+6$  are  $2$  and  $y+3$ 

Finding factors of a polynomial expression is like "undistributing".

The factored form of 2y + 6 is 2(y + 3).

# Factoring Polynomials by factoring out the GCF (Greatest Common Factor)

- Determine the GCF of all the terms
- Divide the polynomial by the GCF
- Write as a product: GCF(Quotient)

Example: Factor 
$$3y^2 + 12y$$

$$1^{st}$$
: Find the GCF of  $3y^2$  and  $12y$ :

 $2^{nd}$ : Divide the polynomial by the GCF 3y:

$$\frac{3y^2}{3y} + \frac{12y}{3y} \rightarrow y+4$$

3<sup>rd</sup>: Write as a product:

4th: Check by distributing

Factor each polynomial by factoring out the GCF.

1) 
$$25a + 15$$

check: 25a + 15

2) 
$$3x + 3y$$

check: 3x+3y

check: 18 x2-12x

4) 
$$12x^3 + 20x^2$$

$$4x^{2}(3x+5)$$

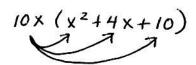
check: 12x3 + 20x2

#### 5) $8m^2 + 20m - 4$

$$4x^{2}(3x+5)$$
  $4(2m^{2}+5m-1)$ 

Check: 8 m2 + 20 m - 4

### 6) $10x^3 + 40x^2 + 100x$



check: 10x3 + 40x2+10x

## Factoring Trinomials using the AM Method

Simplify each polynomial expression.

a) 
$$(x + 4)(x + 2)$$

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

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

a) 
$$(x+4)(x+2)$$
 b)  $(x-4)(x+2)$  c)  $(x+4)(x-2)$  d)  $(x-2)(x-4)$ 

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

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

$$x^2 + 6x + 8$$
  $x^2 - 2x - 8$   $x^2 + 2x - 8$   $x^2 - 6x + 8$ 

$$x^2 - 6x + 8$$

Factoring a trinomial whose leading coefficient is 1 ( $ax^2 + bx + c$ , where a = 1)

Step 1: Start with 2 sets of parentheses whose first term is x.

**Step 2:** Identify all pairs of factors that multiply to the **c** value (last term).

Step 3: Determine which pair adds to the b value (middle term).

Step 4: Place the factors in the parentheses to create the binomials.

Step 5: Check by multiplying the factors (double distribute).

Factor the polynomials below.

Ask yourself, "What numbers MULTIPLY to the last term (c) and ADD to the middle term (b)?"

a) 
$$x^2 + 6x + 8 = 8$$
  
 $b = 6$ 
b)  $x^2 - 2x - 8$ 
c = -8
c)  $x^2 + 2x - 8$ 
c = -8
d)  $x^2 - 6x + 8$ 
b = -2
c = 8
$$(x + 4)(x + 2)$$

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

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

b) 
$$x^2 - 2x -$$

c) 
$$x^2 + 2x - 8$$

$$\frac{1}{2}$$
  $x^2 - 6x + 8$ 

$$(x + 4)(x + 2)$$

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

### \*\*Patterns to Notice:

- 1. If b and c are both positive, both of the binomials have \_\_\_\_\_ signs.
- 2. If c is negative, one binomial has a \_\_\_\_\_sign and one has a \_\_\_\_\_
- 3. If c is positive and b is negative, both binomials have a \_\_\_\_\_ sign.



#### Factor each trinomial.

1) 
$$x^{2}+7x+10$$

$$\begin{array}{c}
c=10 \\
\hline
1 & 10 \\
\hline
(x+5)(x+2)
\end{array}$$
2)  $x^{2}+6x+9$ 

$$\begin{array}{c}
q \\
\hline
1 & 19 \\
\hline
(x+3)(x+3)
\end{array}$$
3)  $x^{2}+x-6$ 

$$\begin{array}{c}
-1 & 16 \\
\hline
(x+3)(x-2)
\end{array}$$
4 (x+3)(x-2)  $\frac{1}{2}$ 

7) 
$$x^{2}-3x-10$$
  
 $(x-5)(x+2)$   $\frac{-10}{-100}$  8)  $x^{2}+12x+35$  9)  $x^{2}-3x-4$   $-4$   
 $(x+7)(x+5)$   $\frac{35}{135}$   $(x-4)(x+1)$   $\frac{1-4}{-14}$   $\frac{1}{-2}$   $\frac{1}{2}$ 

# Let's try some more challenging examples.

Helpful Hint: Look at the factored form of the polynomials in examples 1, 2 and 3.

- factor means to create a product.
- Factoring reverses the distributive property.
- The AM method is used to factor trinomials in the form of  $ax^2 + bx + c$  where a = 2

