

**Do Now:** Complete each statement.

$$\text{b) } 36a^3 + 24a^2 + 12a = 12a\left(\frac{3a^2}{1} + \frac{2a}{1} + 1\right)$$

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

## FACTORS

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  $2(y + 3)$ .

- Determine the GCF of all the terms
- Divide the polynomial by the GCF
- Write as a product:  $GCF(\text{Quotient})$

1<sup>st</sup>: Find the GCF of  $3y^2$  and  $12y$ :  $3y$

2<sup>nd</sup>: 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:

$$3y(y+4)$$

4<sup>th</sup>: Check by distributing:

$$3y(y+4)$$
$$3y^2 + 12y$$

Factor each polynomial by factoring out the GCF.

1)  $25a + 15$

$$5(5a + 3)$$

check:  $25a + 15$

2)  $3x + 3y$

$$3(x + y)$$

check:  $3x + 3y$

3)  $18x^2 - 12x$

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

check:  $18x^2 - 12x$

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

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

check:  $12x^3 + 20x^2$

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

$$4(2m^2 + 5m - 1)$$

check:  $8m^2 + 20m - 4$

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

$$10x(x^2 + 4x + 10)$$

check:  $10x^3 + 40x^2 + 100x$

### Factoring Trinomials using the AM Method

Simplify each polynomial expression.

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

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

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

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

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

$$x^2 - 2x - 8$$

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

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

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

d)  $(x - 2)(x - 4)$

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

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

### 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)  $x^2 + 6x + 8$   $c = 8$   
 $b = 6$

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

b)  $x^2 - 2x - 8$   $c = -8$   
 $b = -2$

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

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

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

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

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

**\*\*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 + sign.
3. If  $c$  is positive and  $b$  is negative, both binomials have a - sign.



Factor each trinomial.

1)  $x^2 + 7x + 10$   $c = 10$   
 $(x+5)(x+2)$

2)  $x^2 + 6x + 9$   
 $(x+3)(x+3)$

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

4)  $x^2 - 7x + 12$   
 $(x-3)(x-4)$

5)  $x^2 - 9x + 18$   
 $(x-6)(x-3)$

6)  $x^2 + 7x + 6$   
 $(x+6)(x+1)$

7)  $x^2 - 3x - 10$   
 $(x-5)(x+2)$

8)  $x^2 + 12x + 35$   
 $(x+7)(x+5)$

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

Let's try some more challenging examples.

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

10)  $x^4 + 7x^2 + 10$   
 $(x^2+5)(x^2+2)$

11)  $x^4 + 6x^2 + 9$   
 $(x^2+3)(x^2+3)$

12)  $x^6 + x^3 - 6$   
 $(x^3+3)(x^3-2)$

• To 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  $a =$  1.

