

## Section 1 – 3: Absolute Value and Powers

### The Absolute Value Symbol

The symbol for absolute value is a pair of vertical lines  $| |$ . These **absolute value brackets** act like the parenthesis that we use in order of operation problems. The absolute value brackets have a special purpose that makes them different from a regular set of parenthesis.

**The absolute value brackets tell you to change the **single** number inside the absolute value brackets to a positive number.**

#### Example 1

$$|-5|$$

change the single number  
inside to a positive number

$$|-5|=5$$

#### Example 2

$$|-12|$$

change the single number  
inside to a positive number

$$|-12|=12$$

#### Example 3

$$|10|$$

change the single number  
inside to a positive number

$$|10|=10$$

**Note:** The absolute value brackets change the single negative number into a positive number but have no effect on a positive number.

**you must simplify what is inside a parenthesis first  
to get a single number**

Absolute value brackets act as parenthesis  
so they follow the rules for order of operations which states that  
**you must simplify what is inside a parenthesis first**  
before you make the **single number remaining positive**.

#### Example 4

$$|3-5|$$

simplify inside

$$|-2|$$

make the single number positive

$$|3-5|=2$$

#### Example 5

$$|-7+2|$$

simplify inside

$$|-5|$$

make the single number positive

$$|-7+2|=5$$

#### Example 6

$$|-5-9|$$

simplify inside

$$|-14|$$

make the single number positive

$$|-5-9|=14$$

#### Example 7

$$|7+3-6|$$

simplify inside

$$|4|$$

make the single number positive

$$|7+3-6|=4$$

## Simplifying Absolute Value Expressions

If there is a number directly outside the absolute value brackets it means to multiply the number outside the absolute value brackets by the number that results from making the single number inside the absolute value brackets positive.

1. Simplify the expression inside the absolute value brackets to get **a single number**.
2. You then change the number inside the absolute value brackets into a positive number and keep that number inside a parentheses ( ).
3. Multiply the number outside the parentheses by the number inside the parentheses ( ).

### Example 1

$$5|-7|$$

simplify inside

$$5|-6|$$

make the single number positive

$$5(6)$$

Multiply

$$5|-7|=30$$

### Example 2

$$-3|9-2|$$

simplify inside

$$-3|7|$$

make the single number positive

$$-3(7)$$

Multiply

$$-3|9-2|=-21$$

### Example 3

$$4|3-5|$$

$$4|-2|$$

$$4(2)$$

$$8$$

### Example 4

$$-5|3-8|$$

$$-5|-5|$$

$$-5(5)$$

$$-25$$

### Example 5

$$-|3-10|$$

$$-|-7|$$

$$-(7)$$

$$-7$$

# Exponents

An exponent is a number raised above a second number that we call the base.

## Example 1

2                  Exponent  
5                  Base

the base is 5 the exponent is 2

## Example 2

3                  Exponent  
(-2)              (Base)

the base is -2 the exponent is 3

## Example 3

4                  Exponent  
- (3)              - (Base)

the base is 3 the exponent is 4

## Example 4

2                  Exponent  
- 5                - (Base)

the base is 5 the exponent is 2

**important Note for Example 4:** A negative sign **in front** of the base is **not included with the base** unless the base is inside a parentheses. The negative sign in front of the base is understood to mean multiply the products of the base by  $-1$ . **This is a very common source for errors in this chapter.**

## Exponential Expressions

A number (factor) multiplied by itself many times can be written in an abbreviated form by using a base and an exponent. The abbreviated form is called an **exponential expression**.

81 can be written in its prime factored form as  $81 = (3)(3)(3)(3)$

The abbreviated form is written with the factor 3 written as the base and the number of times the factor is multiplied written as the exponent (or power).

$81 = (3)(3)(3)(3)$  can be written as  $81 = 3^4$

where **3 is the base** and **4 is the exponent** or power

8 can be written in its prime factored form as  $8 = (2)(2)(2)$

The abbreviated form is written with the factor 2 written as the base and the number of times the factor is multiplied written as the exponent (or power).

$8 = (2)(2)(2)$  can be written as  $8 = 2^3$

where **2 is the base** and **3 is the exponent** or power.

## Exponential Expressions with a positive base with No Parenthesis

If the number under the exponent is **positive** you **multiply that positive base times itself** the number of times as the exponent.

### Example 1

$5^2$  the base is 5 the exponent is 2

$$5^2 = (5)(5) = 25$$

### Example 2

$7^2$  the base is 7 the exponent is 2

$$7^2 = (7)(7) = 49$$

### Example 3

$2^3$  the base is 2 the exponent is 3

$$2^3 = (2)(2)(2) = 8$$

### Example 4

$2^4$  the base is 2 the exponent is 4

$$2^4 = (2)(2)(2)(2) = 16$$

## Exponential Expressions with a Positive Base Inside Parenthesis

If the base is inside a pair of parenthesis you **multiply that base times itself** the number of times as the exponent. A negative sign in front of the base is **included with the base if the base is inside a parentheses**.

### Example 1

$(4)^2$  the base is (4) the exponent is 2

$$(4)^2 = (4)(4) = 16$$

### Example 2

$(-7)^2$  the base is (-7) the exponent is 2

$$(-7)^2 = (-7)(-7) = 49$$

### Example 3

$(-2)^3$  the base is (-2) the exponent is 3

$$(-2)^3 = (-2)(-2)(-2) = -8$$

### Example 4

$(-3)^4$  the base is (-3) the exponent is 4

$$(-3)^4 = (-3)(-3)(-3)(-3) = 81$$

### Example 5

$(-1)^3$  the base is (-1) the exponent is 3

$$(-1)^3 = (-1)(-1)(-1) = -1$$

### Example 6

$(3)^3$  the base is (3) the exponent is 3

$$(3)^3 = (3)(3)(3) = 27$$

## Exponential Expressions with a negative base inside a parentheses

If the base is a negative number and **inside a parentheses** than **the negative sign is included with the base**. To find the value of the expression you multiply that negative number times itself the number of times as the exponent.

### Example 1

$(-2)^3$  the base is  $(-2)$  the exponent is 3

$$(-2)^3 = (-2)(-2)(-2) = -8$$

### Example 2

$(-3)^4$  the base is  $(-3)$  the exponent is 4

$$(-3)^4 = (-3)(-3)(-3)(-3) = 81$$

### Example 3

$(-1)^3$  the base is  $(-1)$  the exponent is 3

$$(-1)^3 = (-1)(-1)(-1) = -1$$

### Example 4

$(-3)^3$  the base is  $(3)$  the exponent is 3

$$(-3)^3 = (3)(3)(3) = 27$$

## Exponential Expressions with a Negative base with no Parenthesis

### Example 1

$-3^2$  the base is  $3$  the exponent is 2

$$-3^2 = -(3)(3) = -9$$

### Example 2

$-4^2$  the base is  $4$  the exponent is 2

$$-4^2 = -(4)(4) = -16$$

### Example 3

$-5^2$  the base is  $5$  the exponent is 2

$$-5^2 = -(5)(5) = -25$$

### Example 4

$-10^2$  the base is  $10$  the exponent is 2

$$-10^2 = -(10)(10) = -100$$

### Example 5

$-2^4$  the base is  $2$  the exponent is 4

$$-2^4 = -(2)(2)(2)(2) = -16$$

### Example 6

$-1^4$  the base is  $1$  the exponent is 4

$$-1^4 = -(1)(1)(1)(1) = -1$$

**A negative sign in front of the base is not included with the base if the base is not inside a parentheses.**

The negative sign in front of the base is understood to mean multiply the base without the negative sign times itself the number of times as the exponent and then multiply that number by  $-1$ . **This is a very common source for errors in this chapter.**

**Example 1**

$$-5^2$$

the  $-$  sign is NOT included with the 5

$$-5^2 = -1(5)^2 = -25$$

**Example 2**

$$-3^2$$

the  $-$  sign is NOT included with the 3

$$-3^2 = -1(3)^2 = -9$$

**Example 3**

$$-4^2$$

the  $-$  sign is NOT included with the 4

$$-4^2 = -1(4)^2 = -16$$