

# PRINCIPLES - LESSON 2B

## INTRODUCTION TO EXPONENTS

**Multiplication = Sped-Up Addition**

**ADDITION**

$$2 + 2 + 2 + 2 + 2$$



**MULTIPLICATION**

$$2 \cdot 5$$



**When we want to add many of the same number together,  
we speed up the process through multiplication.**

# EXPONENTS ARE USED TO SPEED UP MULTIPLICATION

**Exponents = Sped-Up Multiplication**

**MULTIPLICATION**


$$3 \cdot 3 \cdot 3 \cdot 3$$

**EXPONENTS**


$$3^4$$

**Just as multiplication speeds up addition, exponents speed up multiplication.**

# PARTS OF A POWER

When two or more numbers are multiplied, each number is called a **factor**. An **exponent** is used to show how many times the factor, or **base**, is multiplied.

When all of the factors are written out separately, the expression has been **EXPANDED**.

$7^3 = 7 \cdot 7 \cdot 7$

The diagram illustrates the components of a power. On the left, the number 7 is labeled as the **BASE** with an arrow pointing to it. To its right, the number 3 is labeled as the **EXPONENT** with an arrow pointing to it. An equals sign follows. To the right of the equals sign, the expression 7 · 7 · 7 is shown. Three arrows point from the word **FACTORS** below to each of the three 7s in this expression.

# BASICS OF EXPONENTS

Expand and then simplify.

$$\begin{aligned}\text{ex1) } 7^3 &= 7 \cdot 7 \cdot 7 \leftarrow \text{expanded} \\ &= 343 \leftarrow \text{simplified}\end{aligned}$$

$$\begin{aligned}\text{ex2) } \left(\frac{1}{2}\right)^4 &= \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \\ &= \frac{1}{16}\end{aligned}$$

$$\text{ex3) } 8^1 = 8$$

$$\begin{aligned}\text{ex4) } 0^5 &= 0 \cdot 0 \cdot 0 \cdot 0 \cdot 0 \\ &= 0\end{aligned}$$

# NEGATIVE BASES



**IMPORTANT!**

The ONLY way to have a negative base

1. Negative sign must be **INSIDE**  $(-)$
2. Exponent must be **OUTSIDE**  $( )^2$

Expand and then simplify.

ex5)  $-(5)^2$

Base is 5.

$$= -5 \cdot 5$$

$$= \textcircled{-25}$$

ex6)  $-(5^2)$

Base is 5.

$$= -(5 \cdot 5)$$

$$= \textcircled{-25}$$

ex7)  $-5^2$

Base is 5.

$$= -5 \cdot 5$$

$$= \textcircled{-25}$$

ex8)  $(-5)^2$

Base is -5.

$$= (-5)(-5)$$

$$= \textcircled{25}$$

# SIMPLIFYING EXPRESSIONS INVOLVING EXPONENTS

Simplify.

PEMDAS

$$\text{ex9) } 3(6 + 2)^2$$

$$= 3(8)^2$$

$$= 3 \cdot 64$$

$$= 192$$

$$\text{ex10) } (3^3 - 20)^2$$

$$= (27 - 20)^2$$

$$= (7)^2$$

$$= 49$$

# EVALUATING EXPRESSIONS INVOLVING EXPONENTS

Evaluate the expression for  $x=2$ ,  $y=-3$ .

$$\begin{aligned}\text{ex11) } 5x^3y^2 &= 5(2)^3(-3)^2 \\ &\quad \uparrow_{2 \cdot 2 \cdot 2} \quad \uparrow_{(-3)(-3)} \\ &= 5(8)(9) \\ &= 360\end{aligned}$$

# EVALUATING EXPRESSIONS INVOLVING EXPONENTS

Evaluate the expression for a = -1, b = -4.

$$\begin{aligned}\text{ex12) } 2a^2 - b^3 &= 2(-1)^2 - (-4)^3 \\ &\quad \quad \quad \uparrow^{(-1)\cdot(-1)} \quad \quad \quad \uparrow^{(-4)\cdot(-4)\cdot(-4)} \\ &= 2(1) - (-64) \\ &= 2 - (-64) \\ &= 2 + 64 \\ &= \textcircled{66}\end{aligned}$$



# NEGATIVE BASES RAISED TO POWERS

**Simplify.**

ex13)  $(-1)^{228}$

$$= \underbrace{(-1)(-1)(-1)\dots(-1)(-1)}$$

228  $-1$ 's multiplied together.

$$= 1$$

ex14)  $(-1)^{553}$

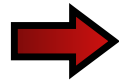
$$= \underbrace{(-1)(-1)(-1)\dots(-1)(-1)}$$

553  $-1$ 's multiplied together.

$$= -1$$

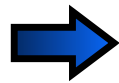
# NEGATIVE BASES RAISED TO POWERS

**NEGATIVE BASE  
TO ODD POWER**



**NEGATIVE ANSWER**

**NEGATIVE BASE  
TO EVEN POWER**



**POSITIVE ANSWER**