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

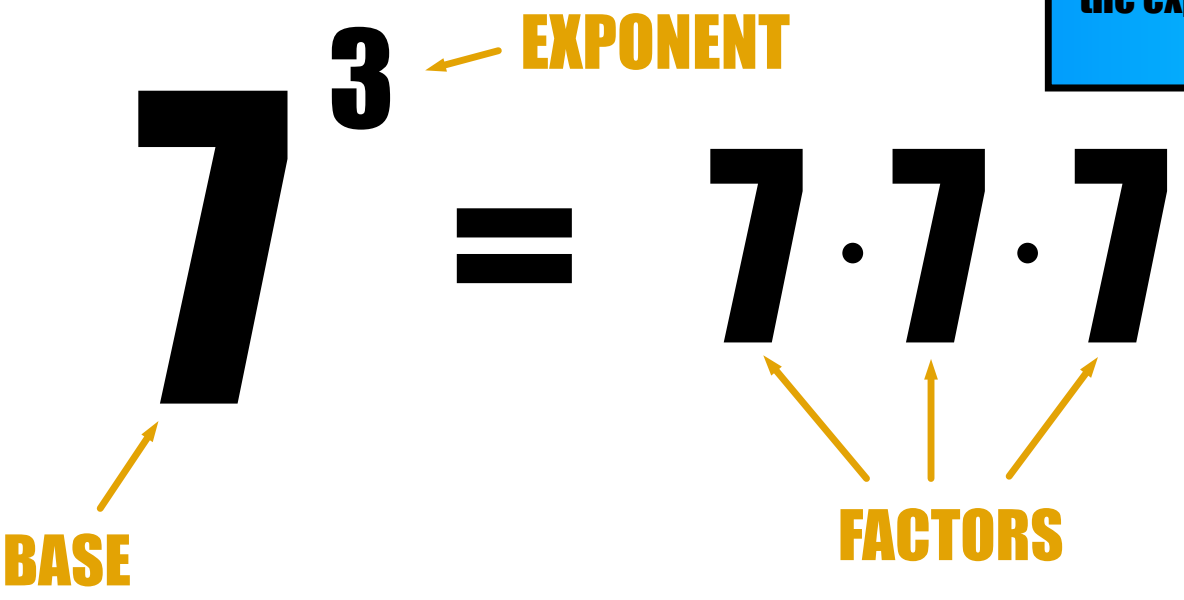
3^4

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.



BASICS OF EXPONENTS

Expand and then simplify.

ex1) $7^3 = 7 \cdot 7 \cdot 7$ ← expanded

$= 343$ ← simplified

ex2) $\left(\frac{1}{2}\right)^4 = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2}$

$= \frac{1}{16}$

ex3) $8^1 = 8$

ex4) $0^5 = 0 \cdot 0 \cdot 0 \cdot 0 \cdot 0$

$= 0$

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.

$= -5 \cdot 5$

$= -25$

ex6) $-(5^2)$

Base is 5.

$= -(5 \cdot 5)$

$= -25$

ex7) -5^2

Base is 5.

$= -5 \cdot 5$

$= -25$

ex8) $(-5)^2$

Base is -5.

$= (-5)(-5)$

$= 25$

SIMPLIFYING EXPRESSIONS INVOLVING EXPONENTS

Simplify.

PEMDAS

ex9) $3(6+2)^2$

$= 3(8)^2$

$= 3 \cdot 64$

$= 192$

ex10) $(3^3 - 20)^2$

$3 \cdot 3 \cdot 3$

$= (27 - 20)^2$

$= (7)^2$

$= 49$

EVALUATING EXPRESSIONS INVOLVING EXPONENTS

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

ex11) $5x^3y^2$

$= 5(2)^3(-3)^2$

$(2)^3$: $2 \cdot 2 \cdot 2$ $\quad$ $(-3)^2$: $(-3)(-3)$

$= 5(8)(9)$

$= 360$

EVALUATING EXPRESSIONS INVOLVING EXPONENTS

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

ex12) $2a^2 - b^3$

$= 2(-1)^2 - (-4)^3$

$(-1)^2$: $(-1)\cdot(-1)$; $(-4)^3$: $(-4)\cdot(-4)\cdot(-4)$

$= 2(1) - (-64)$

$= 2 - (-64)$

$= 2 + 64$

$= 66$

NEGATIVE BASES RAISED TO POWERS

Simplify.

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

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

228 -1's multiplied together

$= 1$

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

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

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**