

## Lesson 3-1 (PART 1)

### Exponents and Order of Operations

Warm-Up: Simplify.

$$25 - (7 \cdot 2) =$$

$$14 \div 2 \cdot (4 - 1) =$$

<b>Exponent</b>	Tells you how many times a number (base) is used as a factor (multiplied by itself).	Example: $2^4$ $(-3)^{10}$ $y^2$
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exponent  
↓  
 $5^3 = 5 \cdot 5 \cdot 5 = 125$   
↑  
base

How do we read these?

$7^4$  Seven to the 4<sup>th</sup> power

$8^{10}$  eight to the tenth power

$4^2$  four squared OR four to the 2<sup>nd</sup> power

$x^3$  X cubed OR X to the 3<sup>rd</sup> power

Write using an exponent.

$$3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 3^5$$

Handwritten work:  $3 \cdot 3 = 9$ ,  $9 \cdot 3 = 27$ ,  $27 \cdot 3 = 81$ ,  $81 \cdot 3 = 243$ . A vertical line is drawn under each number. A box around 243 is labeled with 81 above it, and  $81 \cdot 3 = 243$  is written below.

$$11 \cdot 11 \cdot 11 = 11^3$$

Handwritten work:  $11 \cdot 11 = 121$ ,  $121 \cdot 11 = 1331$ . A vertical line is drawn under each number. A box around 1331 is labeled with 121 above it, and  $121 \cdot 11 = 1331$  is written below.

$$a \cdot a \cdot a = a^3$$

What if a number is raised to the power of 1?

$$x^1 = x$$

$$2^1 = 2$$

What if a number is raised to the power of 0?

$$x^0 = 1$$

$$2^0 = 1$$

Practice. You may use a calculator.

$$4^3 = 4 \cdot 4 \cdot 4$$

Handwritten work:  $4 \cdot 4 = 16$ ,  $16 \cdot 4 = 64$ . A box around 64 is shown.

$$10^2 = 10 \cdot 10 = 100$$

$$(2 + 3)^2 = 5^2 = 5 \cdot 5 = 25$$

$$14^0 = 1$$

$$2^4 = 2 \cdot 2 \cdot 2 \cdot 2$$

Handwritten work:  $2 \cdot 2 = 4$ ,  $4 \cdot 2 = 8$ ,  $8 \cdot 2 = 16$ . A box around 16 is shown.

Evaluate each expression for  $m=3$ ,  $n=2$  and  $r=4$ .

$$m^2 + n^2$$

$$3^2 + 2^2$$
$$9 + 4 = 13$$

$$(m + n)^2$$

$$(3 + 2)^2$$
$$5^2 = 25$$

$$n^2(m + r)$$

$$2^2(3 + 4)$$
$$2^2(7)$$
$$4(7) = 28$$

## Exponents with Negative Numbers

Are these the same thing?

$$\begin{aligned} & -3^2 \\ & \quad \downarrow \\ & -1 \cdot 3^2 \\ & -1 \cdot 9 \\ & \boxed{-9} \end{aligned}$$

$$\begin{aligned} & (-3)^2 \\ & -3 \cdot -3 \\ & \boxed{9} \end{aligned}$$

Is there a pattern?

$$(-2)^1 = \boxed{-2}$$

$$(-2)^2 = -2 \cdot -2 = \boxed{4}$$

$$(-2)^3 = -2 \cdot -2 \cdot -2 = \boxed{-8}$$

$$(-2)^4 = -2 \cdot -2 \cdot -2 \cdot -2 = \boxed{16}$$

$\swarrow$   
 $-8 \cdot -2$

When an exponent is present with a negative symbol **WITHOUT** parentheses, the answer is always **NEGATIVE**.

When an exponent is present with a negative symbol **INSIDE** parentheses, the answer is:

**NEGATIVE** when exponent is ODD

**POSITIVE** when exponent is EVEN

You Try! Decide whether the <sup>exponent</sup> answer is EVEN or ODD, then simplify.

$$(-2)^6 \quad \text{EVEN} \quad \text{or} \quad \text{ODD} \quad (-2)^6 = +64$$

$$(-3)^3 \quad \text{EVEN} \quad \text{or} \quad \text{ODD} \quad (-3)^3 = -27$$

$$(-1)^{97} \quad \text{EVEN} \quad \text{or} \quad \text{ODD} \quad (-1)^{97} = -1$$

Evaluate each expression for  $m=3$ ,  $n=2$  and  $r=4$ .

$$-m^2 \\ -3^2 = \boxed{-9}$$

$$(-r)^3 \\ (-4)^3 = \boxed{-64}$$

$$(n-r)^5 \\ (2-4)^5 \\ (-2)^5 = \boxed{-32}$$

Solve.

$$-6^1 = -6$$

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

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

$$-4^3 = -64$$

$$(-5)^0 = 1$$