Algebra I Notes #4 page 1 Factors and Exponents Unit 1

Consider the following examples.

$2^1 = 2$	$x^1 = x$
$2^2 = 2 \cdot 2$	$x^2 = x \cdot x$
$2^3 = 2 \cdot 2 \cdot 2$	$x^3 = x \cdot x \cdot x$
$2^4 = 2 \cdot 2 \cdot 2 \cdot 2$	$x^4 = x \cdot x \cdot x \cdot x$
$2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	$x^5 = x \cdot x \cdot x \cdot x \cdot x$
$2^6 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	$x^6 = x \cdot x \cdot x \cdot x \cdot x \cdot x$
$2^7 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	$x^7 = x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x$
$2^8 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	$x^8 = x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x$
$2^9 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	$x^9 = x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x$

Let's take a closer look.

exponent

$$2^5 = \underbrace{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}_{\text{factors}}$$

base

Here is a quick definition.

$$x^1 = x$$

If k is a whole number greater than 1, then

$$x^k = \underbrace{x \cdot x \cdot x \cdot \ldots \cdot x}_{\text{k factors}}$$

Simplify each of the following. (Remember that we can change the order and the grouping of the factors using the commutative and the associative properties of multiplication.)

1. $\mathbf{p \cdot p \cdot p \cdot p \cdot p \cdot p \cdot p \cdot p = p^8}$

2. $\mathbf{x \cdot x \cdot x \cdot x \cdot x \cdot y \cdot y \cdot y = x^5y^3}$

3. $\mathbf{5 \cdot a \cdot a \cdot 3 \cdot b \cdot b \cdot b =}$
   $\mathbf{(5 \cdot 3) \cdot (a \cdot a) \cdot (b \cdot b \cdot b) = 15a^2b^3}$

4. $\mathbf{2 \cdot x \cdot x \cdot x \cdot x \cdot x \cdot 4 \cdot y =}$
   $\mathbf{(2 \cdot 4) \cdot (x \cdot x \cdot x \cdot x \cdot x) \cdot y = 8x^5y}$

5. $\mathbf{(3x)(4x) = (3 \cdot 4) \cdot (x \cdot x) = 12x^2}$

6. $\mathbf{(3x)(4y) = (3 \cdot 4) \cdot x \cdot y = 12xy}$

Evaluate each of the following. (Evaluate means to "find the value of.")

7. $\mathbf{2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32}$

8. $\mathbf{1^3 = 1 \cdot 1 \cdot 1 = 1}$

9. $\mathbf{4^1 = 4}$

10. $\mathbf{10^3 = 10 \cdot 10 \cdot 10 = 1{,}000}$

Algebra I Notes #4 page 2 Properties of Zero Unit 1

Zero and Addition

$7 + 0 = 7$ $5 + 0 = 5$ $0 + 3 = 3$ $0 + 8 = 8$

Rule: $x + 0 = x$ and $0 + x = x$.

$8 + -8 = 0$ $3 + -3 = 0$ $-2 + 2 = 0$ $-5 + 5 = 0$

Rule: $x + -x = 0$ and $-x + x = 0$.

$-x$ is the opposite of x or the additive inverse of x.

Zero and Subtraction

$7 – 0 = 7$ $5 – 0 = 5$ $0 – 3 = -3$ $0 – 8 = -8$

Rule: $x – 0 = x$ and $0 – x = -x$.

Zero and Multiplication

$8 \cdot 0 = 0$ $3 \cdot 0 = 0$ $0 \cdot 5 = 0$ $0 \cdot 2 = 0$

Rule: $x \cdot 0 = 0$ and $0 \cdot x = 0$.

Zero and Division

Consider the division problem **$18 \div 6$**. The answer is **3** because **$3 \cdot 6 = 18$**.

Now try the division problem **$5 \div 0$**. The answer, if it exists, must multiply by **0** to give a product of **5**. Clearly this number does not exist !! We say that **$5 \div 0$ is undefined**.

Now try the division problem **$0 \div 0$**. The answer, if it exists, must multiply by **0** to give a product of **0**. Clearly, **any number works** !! We say that **$0 \div 0$ is also undefined**.

Rule: Division by zero is undefined.

Consider the division problem **$0 \div 5$**. The answer, if it exists must multiply by **5** to give a product of **0**. Clearly the answer is **0**. Similarly, **$0 \div 8 = 0$** and **$0 \div 7 = 0$**.

Rule: If $x \neq 0$, then $0 \div x = 0$. (Zero divided by any other number is zero.)