Math 4d. Class work 23.

1. **Exponent.**

Exponentiation is a mathematical operation, written as $\boldsymbol{b^n}$, involving two numbers, the **base** *b* and the **exponent** *n*. When *n* is a positive integer, exponentiation corresponds to repeated multiplication of the base: that is, $\boldsymbol{b^n}$ is the product of multiplying *n* bases:

$$b^n = \underbrace{b \times \cdots \times b}_{n}$$

In that case, $\boldsymbol{b^n}$ is called the *n*-th power of *b*, or *b* raised to the power *n*.

Properties of exponent:

If the same base raised to the different power and then multiplied:

$$b^3 \times b^4 = (b \times b \times b) \times (b \times b \times b \times b) = b \times b \times b \times b \times b \times b \times b = b^{3+4} = b^7$$

Or in a more general way:

$$b^n \times b^m = b^{n+m}$$

If the base raised to the power of n then raised again to the power of m:

$$(b^2)^3 = (b \cdot b)^3 = (b \cdot b) \cdot (b \cdot b) \cdot (b \cdot b) = b^{2 \cdot 3} = b^6$$

$$(b^n)^m = b^{n \cdot m}$$

$$b^1 = b; \qquad b^0 = 1, for\ any\ b\ exept\ 0.$$

If two different bases raised to the same power, then:

$$(a \cdot b)^3 = (a \cdot b) \cdot (a \cdot b) \cdot (a \cdot b) = a \cdot a \cdot a \cdot b \cdot b \cdot b = a^3 b^3$$

$$(a \cdot b)^n = a^n b^n$$

The exponent indicates how many copies of the base are multiplied together. For example, $3^5 = 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 243$. The base 3 appears 5 times in the repeated multiplication, because the exponent is 5. Here, 3 is the *base*, 5 is the *exponent*, and

243 is the *power* or, more specifically, *the fifth power of 3*, *3 raised to the fifth power*, or *3 to the power of 5*.

$2^3 \cdot 2^2 = 2^{3+2} = 2^5$

$5^2 \cdot 5 =$

$2^5 \cdot 2^3 \cdot 2 =$

$(2^3)^4 = 2^3 \cdot 2^3 \cdot 2^3 \cdot 2^3 = 2^{3 \cdot 4} = 2^{12}$

$(3^7)^2 =$

$(n^5)^3 =$

1. Write the following expressions in a shorter way:

   Example: $7 \cdot 7 \cdot 7 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9 = 7^3 \cdot 8^4 \cdot 9^5$

   $2 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 7 \cdot 7;$

   $\underbrace{3 \cdot 3 \cdot \ldots \cdot 3}_{n\ times} \cdot \underbrace{5 \cdot 5 \cdot \ldots \cdot 5}_{m\ times}$

   $\underbrace{(-4) \cdot (-4) \cdot \ldots \cdot (-4)}_{k\ times} \cdot \underbrace{6 \cdot 6 \cdot \ldots \cdot 6}_{l\ times}$

2. Compare the numbers:

   $a.\ 5^3 \quad 5 \cdot 3$

   $b.\ 12^2 \quad 12 \cdot 2$

   $c.\ 2^5 \quad 5^2$

   $d.\ 3^4 \quad 4^3$

   $e.\ 5^3 \quad 5 \cdot 3$

   $f.\ 2^4 \quad 4^2$