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UNIT 2: POWERS AND EXPONENT LAWS

SECTION 2.5:
EXPONENT LAWS II

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MATH 9

WHAT'S THE POINT OF TODAY'S LESSON?

We will continue working on the Math 9 Specific Curriculum Outcome (SCO) "Numbers 1" OR "N1" which states:

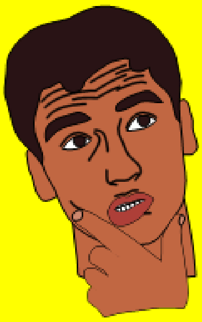
"Demonstrate an understanding of powers with integral bases (excluding base 0) and whole number exponents by: representing repeated multiplication using powers; using patterns to show that a power with an exponent of zero is equal to one; solving problems involving powers."

We will also continue working on the Math 9 Specific Curriculum Outcomes (SCOs) "Numbers 2" and "Numbers 4" OR "N2" and "N4" which state:

"Demonstrate an understanding of operations on powers with integral bases (excluding base 0) and whole number exponents."

AND

"Explain and apply the order of operations, including exponents, with and without technology."



What does THAT mean???

SCO N1 means that we will learn about the two parts of a power (the base, or "the big number", and the exponent, or "the little number"). We will show what a power means when we write it out using multiplication (ex: $3^2 = 3 \times 3$), and we will use patterns to prove, for example, that $3^0 = 1$. Finally, we will use what we know about powers to solve problems.

SCO N2 means that we will learn rules to work with powers with integer bases (other than 0) and exponents of 0 or higher.

SCO N4 means that we will use order of operations (as always) to solve problems that include powers both with and without calculators.

SECTION 2.5: EXPONENT LAWS II

(Powers of Powers, Products, and Quotients)

A power indicates repeated multiplication.

What is the standard form of $(2^3)^2$?

$$= 2^3 \times 2^3$$
$$= (2 \times 2 \times 2) \times (2 \times 2 \times 2)$$
$$= 2^6$$
$$= 64$$

4. EXPONENT LAW FOR POWER OF A POWER: To raise a power to a power, multiply the exponents. We express this law as:

$(a^m)^n = a^{mn}$

("mn" means "m x n")

where "a" is any integer other than 0, and "m" and "n" are any whole numbers.

Ex.: $(2^4)^5 = 2^{\boxed{20}}$

$[(-4)^5]^3 = (-4)^{\boxed{15}}$

The base of a power may be a product; for example, $(2 \times 3)^4$.

What is the standard form of $(2 \times 3)^4$?

$$
\begin{aligned}
& (2 \times 3)^4 \\
= \; & (2 \times 3) \times (2 \times 3) \times (2 \times 3) \times (2 \times 3) \\
= \; & (2 \times 2 \times 2 \times 2) \times (3 \times 3 \times 3 \times 3) \\
= \; & 2^4 \times 3^4 \\
= \; & 16 \times 81 \\
= \; & 1296
\end{aligned}
$$

What is the standard form of $(2^2 \times 3^3)^4$?

$$
\begin{aligned}
&(2^2 \times 3^3)^4 \\
&= (2^2 \times 3^3) \times (2^2 \times 3^3) \times (2^2 \times 3^3) \times (2^2 \times 3^3) \\
&= (2^2 \times 2^2 \times 2^2 \times 2^2) \times (3^3 \times 3^3 \times 3^3 \times 3^3) \\
&= 2^8 \times 3^{12} \\
&= 256 \times 531\ 441 \\
&= 136\ 048\ 896
\end{aligned}
$$

5. **EXPONENT LAW FOR POWER OF A PRODUCT:** **To raise a product to a power, distribute the exponent to each part of the product. We express this law as:**

(by multiplying)

$$(ab)^m = a^m b^m$$

where "a" and "b" are any integers other than 0, and "m" is any whole number.

Ex.: $(2 \times 4)^5 = 2^{\boxed{5}} \times 4^{\boxed{5}}$

$[(-7)^1 \times 5^1]^2 = (-7)^{\boxed{2}} \times 5^{\boxed{2}}$

$(2^2 \times 3^3)^4 = 2^{\boxed{8}} \times 3^{\boxed{12}}$

The base of a power may be a quotient; for example, $\left(\dfrac{5}{6}\right)^3$.

What is the standard form of $\left(\dfrac{5}{6}\right)^3$?

$$= \left(\frac{5}{6}\right)\left(\frac{5}{6}\right)\left(\frac{5}{6}\right)$$

$$= \frac{5 \cdot 5 . 5}{6 \cdot 6 \cdot 6}$$

$$= \frac{5^3}{6^3}$$

$$= \frac{125}{216}$$

What is the standard form of $\left(\frac{5^2}{6^3}\right)^4$ **?**

$$= \left(\frac{5^2}{6^3}\right)\left(\frac{5^2}{6^3}\right)\left(\frac{5^2}{6^3}\right)\left(\frac{5^2}{6^3}\right)$$

$$= \frac{5^2 \cdot 5^2 \cdot 5^2 \cdot 5^2}{6^3 \cdot 6^3 \cdot 6^3 \cdot 6^3}$$

$$= \frac{5^8}{6^{12}}$$

6. **EXPONENT LAW FOR POWER OF A QUOTIENT:** **To raise a quotient to a power, distribute the exponent to each part of the quotient. We express this law as:**

(by multiplying)

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

where "a" and "b" are any integers other than 0, and "n" is any whole number.

Ex.: $\left(\frac{1^1}{3^1}\right)^4 = \frac{1^{\boxed{4}}}{3^{\boxed{4}}}$ $\quad \frac{1^4}{3^4}$

$$\left(\frac{5^2}{6^3}\right)^4 = \frac{5^{\boxed{8}}}{6^{\boxed{12}}} \quad \frac{5^8}{6^{12}}$$

CONCEPT REINFORCEMENT:

MMS9:
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