Lesson Summary

EXPONENTIAL NOTATION FOR WHOLE NUMBER EXPONENTS: Let \( m \) be a nonzero whole number. For any number \( a \), the expression \( a^m \) is the product of \( m \) factors of \( a \), i.e.,

\[
a^m = a \cdot a \cdot \ldots \cdot a \quad \text{\( m \) times}
\]

The number \( a \) is called the base, and \( m \) is called the exponent or power of \( a \).

When \( m \) is 1, “the product of one factor of \( a \)” just means \( a \), i.e., \( a^1 = a \). Raising any nonzero number \( a \) to the power of 0 is defined to be 1, i.e., \( a^0 = 1 \) for all \( a \neq 0 \).

1. Complete the table by filling in the blank cells. Use a calculator when needed.

<table>
<thead>
<tr>
<th>Exponential Form</th>
<th>Expanded Form</th>
<th>Standard Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 3^5 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( (1.9)^2 )</td>
<td>( 4 \times 4 \times 4 )</td>
<td></td>
</tr>
<tr>
<td>( \left(\frac{1}{2}\right)^5 )</td>
<td></td>
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</tbody>
</table>

2. Why do whole numbers raised to an exponent get greater, while fractions raised to an exponent get smaller?

3. The powers of 2 that are in the range 2 through 1,000 are 2, 4, 8, 16, 32, 64, 128, 256, and 512. Find all the powers of 3 that are in the range 3 through 1,000.

4. Find all the powers of 4 in the range 4 through 1,000.

5. Write an equivalent expression for \( n \times a \) using only addition.

6. Write an equivalent expression for \( w^b \) using only multiplication.
   a. Explain what \( w \) is in this new expression.
   b. Explain what \( b \) is in this new expression.

7. What is the advantage of using exponential notation?

8. What is the difference between \( 4x \) and \( x^4 \)? Evaluate both of these expressions when \( x = 2 \).
Lesson Summary

**Numerical Expression:** A *numerical expression* is a number, or it is any combination of sums, differences, products, or divisions of numbers that evaluates to a number.

Statements like "3 ÷" or "3 ÷ 0" are not numerical expressions because neither represents a point on the number line. Note: Raising numbers to whole number powers are considered numerical expressions as well since the operation is just an abbreviated form of multiplication: $2^3 = 2 \cdot 2 \cdot 2$.

**Value of a Numerical Expression:** The *value of a numerical expression* is the number found by evaluating the expression.

For example: $\frac{1}{3} \cdot (2 + 4) + 7$ is a numerical expression, and its value is 9.

Problem Set

Evaluate each expression.

1. $3 \times 5 + 2 \times 8 + 2$
2. $(1.75 + 2 \times 0.25 + 5 \times 0.05) \times 24$
3. $(2 \times 6) + (8 \times 4) + 1$
4. $((8 \times 1.95) + (3 \times 2.95) + 10.95) \times 1.06$
5. $((12 + 3)^2 - (18 + 3^2)) \times (4 + 2)$