Expressions and Order of Operations

Goal: Evaluate expressions with powers.

Vocabulary

Power: A product formed from repeated multiplication by the same number or expression

Exponent: A number or expression that represents how many times the base is used as a factor

Base: The number or expression that is used as a factor in a repeated multiplication

Numerical expression: An expression that consists of numbers and operations

Evaluate: To find the value of an expression

Order of operations: A set of rules for evaluating an expression involving more than one operation

Variable: A symbol, usually a letter, that represents one or more numbers

Algebraic expression: An expression that consists of numbers, variables, and operations

EXAMPLE 1 **Writing Powers**

Write the product as a power and describe it in words.

a. $5 \cdot 5 = 5^2$ 5 to the second power, or 5 $\boxed{\text{squared}}$.

b. $\boxed{8 \cdot 8 \cdot 8} = 8^3$ 8 to the $\boxed{\text{third power}}$, or 8 cubed.

c. $x \cdot x \cdot x \cdot x = x^4$ x to the $\boxed{\text{fourth}}$ power

EXAMPLE 2 **Finding the Value of a Power**

Find the value of three to the fourth power.

$3^4 =$ | $3 \cdot 3 \cdot 3 \cdot 3$ | Write 3 as a factor 4 times.

$= \boxed{81}$ Multiply.

Guided Practice Write the product as a power, describe it in words, and then find the value of the power.

1. $4 \cdot 4 \cdot 4 \cdot 4 \cdot 4$	**2.** $11 \times 11 \times 11$	**3.** $7 \cdot 7$
4. 15×15	**5.** $5 \cdot 5 \cdot 5 \cdot 5$	**6.** $10 \cdot 10 \cdot 10$

Order of Operations

1. Evaluate expressions inside $\boxed{\text{grouping}}$ symbols.

2. Evaluate $\boxed{\text{powers}}$.

3. $\boxed{\text{Multiply}}$ and divide from left to right.

4. Add and $\boxed{\text{subtract}}$ from left to right.

EXAMPLE 3 **Using the Order of Operations**

Evaluate the expression.

a. $9 - 18 \div 6 \times 2 = 9 - \boxed{3} \times 2$ Divide $\boxed{18}$ by $\boxed{6}$.

$\qquad\qquad\qquad = 9 - \boxed{6}$ Multiply $\boxed{3}$ and $\boxed{2}$.

$\qquad\qquad\qquad = \boxed{3}$ Subtract $\boxed{9}$ and $\boxed{6}$.

b. $\dfrac{6 \times 10}{7 + 5} = \dfrac{\boxed{60}}{7 + 5}$ Evaluate numerator.

$\qquad\quad = \dfrac{\boxed{60}}{\boxed{12}}$ Evaluate denominator.

$\qquad\quad = \boxed{5}$ Divide.

c. $48 \div [120 \div (4 \cdot 5)] = 48 \div [120 \div \boxed{20}]$ Multiply inside the innermost set of grouping symbols.

$\qquad\qquad\qquad\qquad = 48 \div \boxed{6}$ Divide inside brackets.

$\qquad\qquad\qquad\qquad = \boxed{8}$ Divide.

Guided Practice **Evaluate the expression.**

7. $15 + 9 \div 3$	**8.** $32 - 9 \times 2 + 7$	**9.** $5 \cdot 8 - 2 \cdot 14$
10. $64 \div (9 + 7)$	**11.** $11 \cdot [(15 - 3) \div 3]$	**12.** $\dfrac{41 + 13}{9 \times 3}$

EXAMPLE 4 **Evaluating Algebraic Expressions**

Evaluate the expression when $x = 6$ and $y = 3$.

a. $9x - 14 = 9(\boxed{6}) - 14$ Substitute $\boxed{6}$ for x.

$= \boxed{54} - 14$ Multiply.

$= \boxed{40}$ Subtract.

b. $4x + 7y = 4(\boxed{6}) + 7(\boxed{3})$ Substitute $\boxed{6}$ for x and $\boxed{3}$ for y.

$= \boxed{24} + \boxed{21}$ Multiply.

$= \boxed{45}$ Add.

Guided Practice Evaluate the expression when $a = 14$ and $b = 4$.

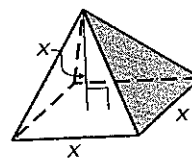|	
13. $7a$	**14.** ba
15. $b(a + 6)$	**16.** $\dfrac{5a}{a - b}$

EXAMPLE 5 **Evaluating a Real-Life Expression**

Volume A pyramid has the dimensions shown. Use the expression to find the volume, in cubic inches, of the pyramid when $x = 6$.

Volume $= \frac{1}{3}x^3$

Solution

$\frac{1}{3}x^3 = \frac{1}{3}(\boxed{6})^3$ Substitute $\boxed{6}$ for x.

$= \frac{1}{3}(\boxed{216})$ Evaluate the power.

$= \boxed{72}$ Simplify.

The volume of the pyramid is $\boxed{72}$ cubic inches.

Homework