

Math 9
3.3 Order of Operations with Exponents

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Learning Goals: I will learn to

- use order of operations to evaluate expressions with powers

Explore and Analyze

1. Using exactly four 2s, how can you make the whole numbers from 0 to 6?

You can use the four basic arithmetic operations as well as powers and brackets.

For example, you can express 14 as:

$$(2 + 2)^2 - 2 = 14$$

2. What is the largest number you can express using exactly four 2s?

$2 - 2^2 \div 2$	$2^2 - 2 - 2 = 0$
$2 - 2 + 2 \div 2$	$= 1$
$\frac{2}{2} + \frac{2}{2}$	$= 2$
$(2^2 + 2) \div 2$	$= 3$
$2 + 2^2 \div 2$	$= 4$
$2 \times 2 + 2 \div 2$	$= 5$
$2^2 \times 2 - 2$	$= 6$

$$2^{222} = 6.739... \times 10^{66}$$

coefficient: a number that multiplies an expression

→ In $-5(4)^2$ the coefficient is -5

Example 1: Evaluate Powers with Coefficients

Identify the coefficient in each expression, then evaluate.

a) $3(2)^4$

coeff = 3

$$\begin{aligned} & 3(2)^4 \\ & = 3 \times 16 \\ & = \boxed{48} \end{aligned}$$

b) $-3(-5)^2$

coeff = -3

$$\begin{aligned} & -3(-5)^2 \\ & = -3 \times 25 \\ & = \boxed{-75} \end{aligned}$$

c) $-4^4 = -1(4)^4$

coeff = -1

$$\begin{aligned} & = -4^4 \\ & = -1(4)^4 \\ & = -1 \times 256 \\ & = \boxed{-256} \end{aligned}$$

Show You Know

Evaluate each expression.

$$\begin{aligned} \text{a) } & 4 \times 3^2 \\ & \text{coeff} = 4 \\ & 4 \times \underline{3^2} \\ & = 4 \times 9 \\ & = \boxed{36} \end{aligned}$$

$$\begin{aligned} \text{b) } & 6(-2)^3 \\ & \text{coeff.} = 6 \\ & 6 \times \underline{(-2)^3} \\ & = 6 \times (-8) \\ & = \boxed{-48} \end{aligned}$$

$$\begin{aligned} \text{c) } & -7^2 \\ & \text{coeff} = -1 \\ & \underline{-7^2} \\ & = -1 \times 49 \\ & = \boxed{-49} \end{aligned}$$

Example 2: Evaluate Expressions with Powers

Evaluate.

B E D M A S

$$\begin{aligned} \text{a) } & 4^2 - 8 \div 2 + (-3^2) \\ & = \underline{4^2} - 8 \div 2 + (-9) \\ & = 16 - \underline{8 \div 2} + (-9) \\ & = \underline{16 - 4} + (-9) \\ & = 12 + (-9) \\ & = \boxed{3} \end{aligned}$$

$$\begin{aligned} \text{b) } & -2(-15 - 4^2) + 4(2 + 3)^3 \\ & = -2(\underline{-15 - 16}) + 4(\underline{5})^3 \\ & = \underline{-2 \times (-31)} + \underline{4 \times (125)} \\ & = 62 + 500 \\ & = \boxed{562} \end{aligned}$$

Show You Know

Evaluate.

$$\begin{aligned} \text{a) } & \underline{4^2} + (-\underline{4^2}) \\ & = 16 + (-16) \\ & = \boxed{0} \end{aligned}$$

$$\begin{aligned} \text{b) } & 8(\underline{5 + 2})^2 - 12 \div 2^2 \\ & = 8(\underline{7})^2 - 12 \div \underline{2^2} \\ & = \underline{8 \times (49)} - \underline{12 \div 4} \\ & = 392 - 3 \\ & = \boxed{389} \end{aligned}$$