

Order of Operations: Exponents and Radicals

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WHAT'S COVERED

In this lesson, you will learn how to evaluate an expression with exponents or radicals using order of operations. Specifically, this lesson will cover:

1. Exponents and Radicals

The order of operations outlines an order we should follow to evaluate expressions with multiple operations. We often use **PEMDAS** to remember the order of operations:

The "exponents" part of PEMDAS also includes radicals. We don't typically include "radicals" in the acronym, because all radicals can be written as exponents (fractional exponents, specifically). So as long as we remember that exponents and radicals are related, we can remember to evaluate both exponents and radicals after parentheses, but before multiplication, division, addition, and subtraction.

Let's focus first on evaluating expressions containing exponents:

→ EXAMPLE

$$2^3 + 4^2 \quad \text{Evaluate } 2^3$$

$$8 + 4^2 \quad \text{Evaluate } 4^2$$

$$8 + 16 \quad \text{Add 8 to 16}$$

$$24 \quad \text{Our Solution}$$

→ EXAMPLE

$$25 - 3^2 \cdot 2 \quad \text{Evaluate } 3^2 \text{ first}$$

$$25 - 9 \cdot 2 \quad \text{Multiply } 9 \text{ by } 2$$

$$25 - 18 \quad \text{Subtract 18 from 25}$$

$$7 \quad \text{Our Solution}$$

When we encounter radicals (roots, such as square roots or cube roots), we treat them as being on the same level as exponents in the order of operations, and evaluate them before multiplication, division, addition and

subtraction. This is illustrated in the examples below:

➤ EXAMPLE

$$15 + \sqrt{16} \cdot 2$$

Evaluate the square root first

$$15 + 4 \cdot 2$$

Multiply 4 by 2

$$15 + 8$$

Add 15 and 8

$$23$$

Our Solution

➤ EXAMPLE

$$6 \cdot \sqrt{25} \div 2$$

Evaluate the square root first

$$6 \cdot 5 \div 2$$

Multiply 6 by 5

$$30 \div 2$$

Divide 30 by 2

$$15$$

Our Solution

What do we do when an expression contains both exponents and radicals? Because exponents and radicals are at the same level according to the order of operations, we can think of their relationship as similar to multiplication and division, or addition and subtraction: we evaluate exponents and radicals as we see them reading left to right.

➤ EXAMPLE

$$5 + \sqrt{49} \cdot 2^3$$

Evaluate the square root first

$$5 + 7 \cdot 2^3$$

Evaluate the exponent

$$5 + 7 \cdot 8$$

Multiply 7 by 8

$$5 + 56$$

Add 5 and 56

$$61$$

Our Solution



TERM TO KNOW

PEMDAS

An acronym to remember the order of operations: parentheses, exponents, multiplication and division, addition and subtraction.



SUMMARY

When following **order of operations, exponents and radicals** (roots, such as square roots and cube roots) are considered at the same time. This means that we must evaluate all exponents and all radicals before moving on to the remaining operations in an expression, following the order of operations.

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