Adding and Subtracting Radical Expressions

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WHAT'S COVERED

In this lesson, you will learn how to add or subtract radical expressions. Specifically, this lesson will cover:

1. Adding and Subtracting Radical Expressions

Adding and subtracting radicals is very similar to adding and subtracting with variables. Consider the following example:

➔ **EXAMPLE** Evaluate the following expression that has variables:

$$5x + 3x - 2x \quad \text{Combine like terms}$$

$$6x \quad \text{Our Solution}$$

➔ **EXAMPLE** Evaluate the following expression that has radicals:

$$5\sqrt{11} + 3\sqrt{11} - 2\sqrt{11} \quad \text{Combine like terms}$$

$$6\sqrt{11} \quad \text{Our Solution}$$

Notice that when we combined the terms with $\sqrt{11}$ it was just like combining terms with x. When adding and subtracting with radicals we can combine like radicals just as like terms. We add and subtract the coefficients in front of the radical, and the radical stays the same.

➔ **EXAMPLE**

$$7\sqrt[5]{6} + 4\sqrt[5]{3} - 9\sqrt[5]{3} + \sqrt[5]{6} \quad \text{Combine like radicals } 7\sqrt[5]{6} + \sqrt[5]{6} \text{ and } 4\sqrt[5]{3} - 9\sqrt[5]{3}$$

$$8\sqrt[5]{6} - 5\sqrt[5]{3} \quad \text{Our Solution}$$

We cannot simplify this expression anymore as the radicals do not match. Often problems we solved have no like radicals, however, if we first simplify the radicals, we may find we do in fact have like radicals.

➔ **EXAMPLE**

Simplify radicals, find perfect square factors.

$$\frac{5\sqrt{45}+6\sqrt{18}-2\sqrt{98}+\sqrt{20}}{5\sqrt{9\cdot5}+6\sqrt{9\cdot2}-2\sqrt{49\cdot2}+\sqrt{4\cdot5}}$$ Take roots where possible

$$5\cdot3\sqrt{5}+6\cdot3\sqrt{2}-2\cdot7\sqrt{2}+2\sqrt{5}$$ Combine like terms

$$17\sqrt{5}+4\sqrt{2}$$ Our Solution

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2. Adding and Subtracting With Higher Indices

This exact process can be used to add and subtract radicals with higher indices. Indices is the plural of index, which indicates the type of root.

↱ EXAMPLE

$$4\sqrt[3]{54}-9\sqrt[3]{16}+5\sqrt[3]{9}$$ Simplify each radical, finding perfect cube factors.

$$4\sqrt[3]{27\cdot2}-9\sqrt[3]{8\cdot2}+5\sqrt[3]{9}$$ Take roots where possible

$$4\cdot3\sqrt[3]{2}-9\cdot2\sqrt[3]{2}+5\sqrt[3]{9}$$ Multiply coefficients

$$12\sqrt[3]{2}-18\sqrt[3]{2}+5\sqrt[3]{9}$$ Combine like terms $12\sqrt[3]{2}-18\sqrt[3]{2}$

$$-6\sqrt[3]{2}+5\sqrt[3]{9}$$ Our Solution

📋 SUMMARY

When **adding and subtracting radical expressions**, you can combine them if they are like terms. Radicals are like terms if they have the same radicand and the same index. They have to have the same number underneath the radical sign, and they have to have the same index, meaning they're both a square root or a cubed root or a fifth root. Sometimes you can break down a radicand into factors to simplify the radicand, in which case you might be then able to combine it with another like term.

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