Adding and Subtracting Radicals

Knowing what radicals are and what operations we can do with them are not only important for being successful in Algebra 1, but also in higher math classes as well.

In this lesson, you will be learning about adding and subtracting radicals. There is 1 major rule that applies to adding and subtracting radicals.

*When adding/subtracting radicals, the numbers inside the radical have to be the **SAME** in order to combine the terms (similar to combining like terms or the denominator of fractions having to be the same before you combine numerators).*

Adding Radicals Example:

1) $\sqrt{20} + \sqrt{80}$

Since the 2 terms under the radical are not the same, we must pull out factors from these radicals so we can get the same number left under each radical.

*We do this by looking for **PERFECT SQUARE** factors of the number under the radical so we can pull those out and be left with a smaller number in the radical.*

Let's first try this process with 20. What are the factors of 20?

1, 2, 4, 5, 10 and 20

The biggest perfect square factor in this list is 4. Since 4 · 5 gives us 20, we can rewrite √20 and turn it into:

$$\sqrt{4} \cdot \sqrt{5}$$

If we multiply the inside of these radicals (which you are allowed to do!), you will get √20.

√4 will simplify to 2 and we cannot simplify √5 any further, so we can simplify the expression above to be:

$$2\sqrt{5}$$

Now let's try the same thing with √80. Find the factors of 80, pick out the highest perfect square factor and write out the factor multiplication in 2 radicals.

Factors of 80: 1, 2, 4, 5, 8, 10, 16, 20, 40 and 80

Since 16 is the biggest perfect square factor of 80 and 16 · 5 are 80, rewrite √80 as:

$$\sqrt{16} \cdot \sqrt{5}$$

The square root of 16 is 4, so we can simplify the expression to be:

$$4\sqrt{5}$$

Our final step is to take the 2 simplified radicals and add their coefficients together to get the right answer.

$$2\sqrt{5} + 4\sqrt{5} = 6\sqrt{5}$$

Subtracting radicals follows the same process except at the last step, you are SUBTRACTING coefficients instead of adding them together. Let's try one!

Subtracting Radicals Example:

2) $\sqrt{48} - \sqrt{12}$

Let's first focus on 48. Find the highest perfect square factor of 48 and the other number in its factor pair (what number times the highest perfect square factor gives you 48) and write them in 2 separate radicals.

You should have gotten:

$\sqrt{16} \cdot \sqrt{3}$ which simplified becomes $4\sqrt{3}$

Follow the same process for 12 and you should have gotten:

$\sqrt{4} \cdot \sqrt{3}$ which simplified becomes $2\sqrt{3}$

Subtract the 2 final answers to get:

$$4\sqrt{3} - 2\sqrt{3} = 2\sqrt{3}$$

Tips for Solving Problems:

1. Remember in order to add and subtract radicals, the numbers inside the radicals have to be the same, so the coefficients of the radicals can be added together.

2. The highest **PERFECT SQUARE** factor of a number refers to the **LARGEST** factor of a particular number that happens to be a perfect square. Use this number and the other number in its factor pair to rewrite the square root of the particular number you are given, that way the perfect square factor can become a coefficient to the other factor.

3. Adding/subtracting radicals is all about combining like terms once the radicals have been converted to radicals with the same number underneath them.