Study Guide

Addition and Subtraction with Radicals
02/29/2012

Radicals: Addition/Subtraction - B

A radical sign looks like a check mark with a line across the top. The radical sign is used to communicate square roots. Students must be able to simplify and combine radicals with similar terms.

To add or subtract radicals, the numbers and variables under the radical sign (known as the radicand) must be identical. The square root of 3 and the square root of 27 can not be added together in their present form because their radicands (in this case, 3 and 27) are not identical. However, the square root of 27 can be simplified to 3 multiplied by the square root of 3. The two terms can now be added together because both radicands are equal to 3. Taking the square root of 3 and adding it to 3 multiplied by the square root of 3 results in 4 multiplied by the square root of 3 in the same way that x + 3x = 4x.

$$\sqrt{3} + \sqrt{27} =$$
$$\sqrt{3} + \sqrt{3^2 \cdot 3} =$$
$$\sqrt{3} + 3\sqrt{3} =$$
$$4\sqrt{3}$$

Example 1: Subtract.

$$2\sqrt{48m^3x} - \sqrt{27m^3x}$$
$$\text{Step 1: } 2\sqrt{16 \cdot 3 \cdot m^2 \cdot m \cdot x} - \sqrt{3 \cdot 9 \cdot m^2 \cdot m \cdot x}$$
$$\text{Step 2: } 2\sqrt{4^2 \cdot 3 \cdot m^2 \cdot m \cdot x} - \sqrt{3 \cdot 3^2 \cdot m^2 \cdot m \cdot x}$$
$$\text{Step 3: } 2 \cdot 4 \cdot |m|\sqrt{3 \cdot m \cdot x} - 3 \cdot |m|\sqrt{3 \cdot m \cdot x}$$
$$\text{Step 4: } 8|m|\sqrt{3mx} - 3|m|\sqrt{3mx}$$
$$\text{Step 5: } (8|m| - 3|m|)\sqrt{3mx}$$
$$\text{Step 6: } 5|m|\sqrt{3mx}$$

Step 1: Simplify the terms under the radicals by finding the largest possible perfect square number that will divide into 48 (16) and the largest possible perfect square number that will divide into 27 (9). Then simplify the variables that are under the radicals by separating out any square terms.
Step 2: Replace 16 with 4 squared and 9 with 3 squared.
Step 3: Simplify the first radical by taking a 4 and an |m| out and multiplying them by the 2 already in front of that radical. Simplify the second radical by taking a 3 and an |m| out and multiplying them on the outside of the radical. The m is in an absolute value symbol because we cannot have a negative answer when we take the square root and taking the absolute value removes any possibility of a negative answer.
Step 4: Rewrite the radicals after completing all multiplications.
Step 5: Now, subtract 3|m| from 8|m| and leave the terms under the radicals alone.
Step 6: Write the difference of 8|m| and 3|m| in front of the radical.

*Remember, when simplifying that m + |m| does not equal 2m because m and |m| are not like terms.

Example 2: Find the approximate square root to the nearest tenth for each term. Then combine the terms.

$$\sqrt{5} + \sqrt{46} + \sqrt{89} - \sqrt{53}$$
(1) 2.2 + 6.8 +9.4 - 7.3
(2) 2.2 + 6.8 +9.4 - 7.3 = 11.1

Step 1: Take the square root of each term using a square root chart or your calculator. Round each term to

the nearest tenth.
Step 2; Combine like terms.

Example 3: Add.

$3\sqrt[3]{192} + 2\sqrt[3]{375}$

(1) $3\sqrt[3]{64 \cdot 3} + 2\sqrt[3]{125 \cdot 3}$

(2) $4 \cdot 3\sqrt[3]{3} + 5 \cdot 2\sqrt[3]{3}$

(3) $12\sqrt[3]{3} + 10\sqrt[3]{3}$

(4) $22\sqrt[3]{3}$

Step 1: Simplify the terms under the radicand by finding the largest cubed number that will divide into 192 (which is 64). Do the same for 375 (it is 125).
Step 2: Simplify the first radical by taking out the cubed root of 64 (4) and multiplying it by 3. Simplify the second radical by taking out the cubed root of 125 (5) and multiplying it by 2.
Step 3: Rewrite the radicals after completing all multiplications.
Step 4: Add 12 and 10 together since the radicands are the same. The radicands do not get changed.

Answer: $22\sqrt[3]{3}$