

## Addition and Subtraction of Radicals

We add and subtract radicals in the same way that we add and subtract algebraic expressions, we add “like” terms. Two or more radical expressions are said to be “like” terms if they have the same indices and radicands.

$$\begin{aligned}\sqrt{7} &\& 3\sqrt{7} \text{ are like terms} \\ \sqrt{7}, \sqrt[3]{7} &\& \sqrt{11} \text{ are not like terms}\end{aligned}$$

Examples:

$$\begin{aligned}3\sqrt{2} + 2\sqrt{2} - \sqrt{2} \\ (3 + 2 - 1)\sqrt{2} \\ 4\sqrt{2}\end{aligned}$$

$$\begin{aligned}7\sqrt[3]{5} + 3\sqrt[3]{5} + \sqrt[3]{5} - \sqrt{5} \\ (7 + 3 + 1)\sqrt[3]{5} - \sqrt{5} \quad \text{Note: the last term is not like the others} \\ 11\sqrt[3]{5} - \sqrt{5}\end{aligned}$$

Occasionally, we can take expression that do not look “like” and do a transformation and make them “like”. (Just like a magic trick)

$$\begin{aligned}\sqrt{8} &\& \sqrt{50} \text{ do not appear to be “like” terms} \\ \text{but } \sqrt{8} &= \sqrt{4 \cdot 2} = \sqrt{4} \cdot \sqrt{2} = 2\sqrt{2} \\ \sqrt{50} &= \sqrt{25 \cdot 2} = \sqrt{25} \cdot \sqrt{2} = 5\sqrt{2} \text{ so they are really “like” terms}\end{aligned}$$

Examples:

$$\begin{aligned}3\sqrt{50} + 7\sqrt{8} \\ 3(5\sqrt{2}) + 7(2\sqrt{2}) \\ 15\sqrt{2} + 14\sqrt{2} \\ 29\sqrt{2}\end{aligned}$$

$$\begin{aligned}2\sqrt[3]{16} + \sqrt{54} \\ 4\sqrt[3]{2} + 3\sqrt[3]{2} \\ 7\sqrt[3]{2}\end{aligned} \quad \begin{aligned}2\sqrt[3]{16} &= 2\sqrt[3]{8 \cdot 2} = 2\sqrt[3]{8}\sqrt[3]{2} = 2 \cdot 2\sqrt[3]{2} = 4\sqrt[3]{2} \\ \sqrt[3]{54} &= \sqrt[3]{27 \cdot 2} = \sqrt[3]{27}\sqrt[3]{2} = 3\sqrt[3]{2}\end{aligned}$$

$$4\sqrt{12} + 5\sqrt{8} - \sqrt{50}$$

$$8\sqrt{3} + 10\sqrt{2} - 5\sqrt{2}$$

$$8\sqrt{3} + 5\sqrt{2}$$

$$4\sqrt{12} = 4\sqrt{4 \cdot 3} = 4 \cdot 2\sqrt{3} = 8\sqrt{3}$$

$$5\sqrt{8} = 5\sqrt{4 \cdot 2} = 5 \cdot 2\sqrt{2} = 10\sqrt{2}$$

$$\sqrt{50} = \sqrt{25 \cdot 2} = 5\sqrt{2}$$

Like Terms

An example from algebra

$$7\sqrt{u^3} + u\sqrt{27u} - 5\sqrt{3u^2}$$

$$7u\sqrt{3u} + 3u\sqrt{3u} - 5u\sqrt{3}$$

$$10u\sqrt{3u} - 5u\sqrt{3}$$

$$7\sqrt{u^3} = 7 \cdot \sqrt{3} \cdot \sqrt{u^3} = 7u\sqrt{3u}$$

$$u\sqrt{27u} = u\sqrt{9 \cdot 3} \sqrt{u} = 3u\sqrt{3u}$$

$$5\sqrt{3u^2} = 5\sqrt{3} \sqrt{u^2} = 5u\sqrt{3}$$

Like Terms