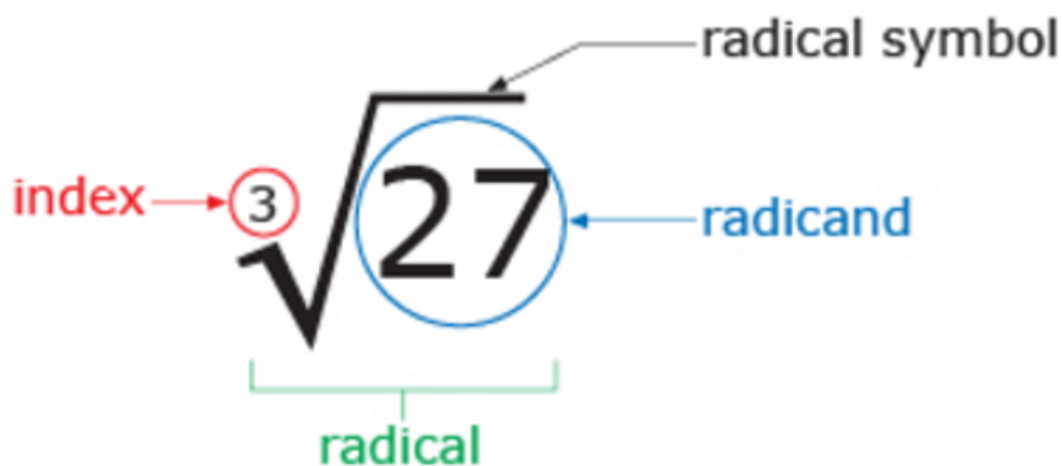


Radical Operations

Simplifying

Parts of a Radical



How to simply:

1. Identify the index.
2. Break down the radicand to factors.
3. Group like factors.
4. If group has the same number of members as the index then a representative for the group will be placed in front.
5. Any factors that do not have a group remain inside the radical.

Examples:

<p>1. $\sqrt{48h^3k}$ $j^3(jj)j$</p> <p>$\begin{matrix} 4 & 12 \\ 4 & 3 \end{matrix}$</p> <p>$4j\sqrt{3hk}$</p> <p>$2 \cdot 2 \cdot 2 \cdot 2 \cdot 3h(jj)jK$</p> <p>$2 \cdot 2 \cdot j \sqrt{3hjk}$</p> <p>$4j\sqrt{3hjk}$</p>	<p>2. $\sqrt[3]{128p^5}$</p> <p>$\begin{matrix} 4 & 32 \\ & 4 & 8 \\ & & 4 & 2 \end{matrix}$</p> <p>$\sqrt[3]{4 \cdot 4 \cdot 4 \cdot 2 \cdot p \cdot p \cdot p \cdot p \cdot p}$</p> <p>$4p\sqrt[3]{2p^2}$</p>
<p>3. $\sqrt[3]{-250x^7y^6z}$</p> <p>$\begin{matrix} -5 & 50 \\ & -5 & 10 \\ & & -5 & 2 \end{matrix}$</p> <p>$-5x^2y^2\sqrt[3]{2xz}$</p> <p>$X \cdot X \cdot X \cdot X \cdot X \cdot X \cdot X \cdot Y \cdot Y \cdot Y \cdot Y \cdot Y \cdot Y \cdot Z$</p>	<p>4. $\sqrt[5]{162a^8bc^3}$</p> <p>$15a^2c\sqrt[5]{ba^2b}$</p>

$X^2 = X \cdot X$

Adding and Subtracting

You can only add or subtract radical with the same **INDEX** and **RADICAND**

How to add or subtract:

1. Simplify the radicals

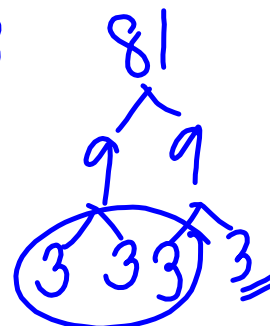
2. Identify radicals and radicand (Same index & Radicand)

3. Add/subtract the coefficients of like radicals.

$$6\sqrt{6} - 6\sqrt{6}$$

<p>5. $-3\sqrt{7} - 4\sqrt{7}$</p> <p style="text-align: center; font-size: 2em;">$-7\sqrt{7}$</p>	<p>6. $-3\sqrt[3]{81} + 3\sqrt[3]{48} - 3\sqrt[3]{48}$</p> <p style="text-align: center;">$-9\sqrt[3]{3}$</p>
<p>7. $-3\sqrt{45} + 2\sqrt{20} + 3\sqrt{8}$</p> <p style="text-align: center;">$-9\sqrt{5} + 4\sqrt{5} + 6\sqrt{2}$</p> <p style="text-align: center; border: 1px solid black; padding: 5px; width: fit-content; margin: auto;">$-5\sqrt{5} + 6\sqrt{2}$</p>	<p>8. $-3\sqrt[3]{7} + 4\sqrt[3]{-3} + 3\sqrt[3]{81} + 2\sqrt[3]{7}$</p> <p style="text-align: center;">$-3\sqrt[3]{7} - 4\sqrt[3]{3} + 9\sqrt[3]{3} + 2\sqrt[3]{7}$</p> <p style="text-align: center; border: 1px solid black; padding: 5px; width: fit-content; margin: auto;">$-1\sqrt[3]{7} + 5\sqrt[3]{3}$</p>

$(-1 \cdot -1 \cdot -1)\sqrt[3]{3}$



Multiply

In order to multiply radicals you must have the same **INDEX**

How to multiply:

1. Multiply the outside of the radicals and multiply the inside of the radicals
2. Simplify the radicals

9. $-3\sqrt{2n^3} \cdot 3\sqrt{8n^2}$ $-9\sqrt{16n^5}$

$$\boxed{-36n^2\sqrt{n}}$$

10. $-3\sqrt{15n}(-\sqrt{5}-3\sqrt{6n})$

$$\boxed{3\sqrt{75n} + 9\sqrt{90n^2}}$$

$$\boxed{15\sqrt{3n} + 27n\sqrt{10}}$$

$-3 \cdot -1\sqrt{15n} \cdot 5$ $-3 \cdot -3\sqrt{15n} \cdot 6n$

$75n$ 90

$\begin{array}{c} 5 \quad 15 \\ \diagdown \quad \diagup \\ 5 \quad 3 \end{array}$ $\begin{array}{c} 9 \quad 10 \\ \diagdown \quad \diagup \\ 3 \quad 3 \end{array}$

Divide

How to rationalize the denominator:

Single radical

1. Multiply the numerator and denominator by denominators radical

2. Simplify the numerator and denominator

11. $\frac{2\sqrt{15}}{\sqrt{48}} \cdot \frac{\sqrt{48}}{\sqrt{48}} = \frac{2\sqrt{720}}{\sqrt{48 \cdot 48}}$

$\frac{24\sqrt{5}}{48} = \frac{1\sqrt{5}}{2}$
 $\frac{\sqrt{5}}{2}$

$\frac{3\sqrt{2} \cdot 2}{5\sqrt{2}} = \frac{2\sqrt{2} \cdot 2}{5\sqrt{2}}$
 $\frac{4\sqrt{2}}{5\sqrt{2}}$
 $\frac{4}{5}$

12. $\frac{4 - 4\sqrt[3]{2}}{5\sqrt[3]{2}} \cdot \frac{\sqrt[3]{4}}{\sqrt[3]{4}}$

$\frac{\sqrt[3]{4}(4 - 4\sqrt[3]{2})}{\sqrt[3]{4} \cdot 5\sqrt[3]{8}} = \frac{4\sqrt[3]{4} - 4\sqrt[3]{8}}{10}$

$\frac{4\sqrt[3]{4} - 8}{10}$
 $\frac{2\sqrt[3]{4} - 4}{5}$

Complex Number

$\frac{12}{2 \cdot 3 \cdot 2}$

$\frac{5\sqrt[3]{2}}{5\sqrt[3]{2}}$

$\frac{5\sqrt[3]{8}}{5 \cdot 2}$

Complex Number**How to rationalize the denominator:****Single radical****1. Multiply the numerator and denominator by conjugate of the denominators****2. Simplify the numerator and denominator**

<p>13. $\frac{4}{5+4\sqrt{5}} \cdot \frac{(5-4\sqrt{5})}{(5-4\sqrt{5})}$</p> <p>TOP $4(5-4\sqrt{5})$ $20-16\sqrt{5}$</p> <p>BOTTOM $(5+4\sqrt{5})(5-4\sqrt{5})$ $25-20\sqrt{5}+20\sqrt{5}-16\sqrt{5}^2$ $25-16(5)$ $25-80$ -55</p> <p>$\frac{20-16\sqrt{5}}{-55}$</p>	<p>14. $\frac{2+3\sqrt{3}}{4-5\sqrt{3}} \cdot \frac{4+5\sqrt{3}}{4+5\sqrt{3}}$</p> <p>TOP $(2+3\sqrt{3})(4+5\sqrt{3})$ $8+10\sqrt{3}+12\sqrt{3}+15\sqrt{9}$ $8+22\sqrt{3}+15 \cdot 3$ $8+22\sqrt{3}+45$ $53+22\sqrt{3}$</p> <p>BOTTOM $(4-5\sqrt{3})(4+5\sqrt{3})$ $16+20\sqrt{3}-20\sqrt{3}-25\sqrt{9}$ $16-25\sqrt{9}$ $16-25(3)$ $16-75$ -59</p>
<p>$\frac{-20+16\sqrt{5}}{55}$</p>	<p>$\frac{53+22\sqrt{3}}{-59} = \frac{-53-22\sqrt{3}}{59}$</p>