Definition

Rationalizing the denominator means removing any radical term from the denominator of the fraction.

There are many types of rationalizing the denominator.

In this lesson we will learn how to rationalize the denominator of a fraction.
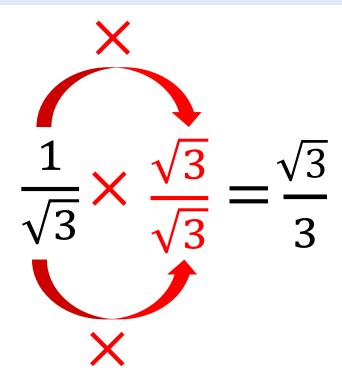
How to rationalize the denominator of a fraction?

❖ If the denominator is in form of $a\sqrt{b}$; $b > 0$:

Multiply the numerator and the denominator by $\sqrt{b}$ since $\sqrt{b} \times \sqrt{b} = b$

Example 1:

$$\frac{1}{\sqrt{3}}$$

$$\frac{1}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{3}$$

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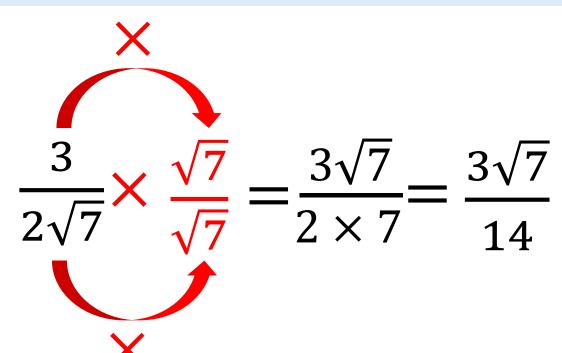# How to rationalize the denominator of a fraction?

❖ If the denominator is in form of $a\sqrt{b}$; $b > 0$:

Multiply the numerator and the denominator by $\sqrt{b}$ since $\sqrt{b} \times \sqrt{b} = b$

Example 2:

$$\frac{3}{2\sqrt{7}}$$

$$\frac{3}{2\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} = \frac{3\sqrt{7}}{2 \times 7} = \frac{3\sqrt{7}}{14}$$

How to rationalize the denominator of a fraction?

❖ If the denominator is in form of $a\sqrt{b}$; $b > 0$:

Multiply the numerator and the denominator by $\sqrt{b}$ since $\sqrt{b} \times \sqrt{b} = b$
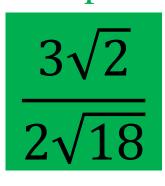
Example 3:

$$\frac{3\sqrt{2}}{2\sqrt{18}}$$

Before rationalizing the denominator, it is preferable to simplify $\sqrt{18}$

$$\frac{3\sqrt{2}}{2\sqrt{18}} = \frac{3\sqrt{2}}{2 \times 3\sqrt{2}} = \frac{1}{2}$$ ✓

No need to rationalize

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How to rationalize the denominator of a fraction?

❖ If the denominator is in form of $a \pm b\sqrt{c}$; $c > 0$:
Multiply the numerator and the denominator by a $\mp$ b$\sqrt{c}$ the conjugate of $a \pm b\sqrt{c}$ according to the remarkable identity:
$$(x - y)(x + y) = x^2 - y^2$$

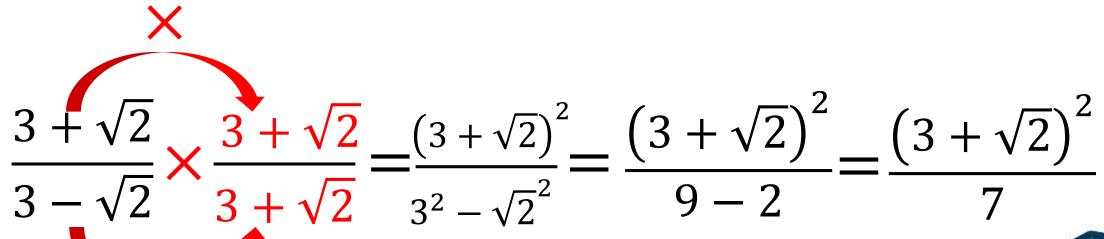Example 1:

$\dfrac{1}{1+\sqrt{3}}$

$$\frac{1}{1+\sqrt{3}} \times \frac{1-\sqrt{3}}{1-\sqrt{3}} = \frac{1-\sqrt{3}}{1^2-\sqrt{3}^2} = \frac{1-\sqrt{3}}{1-3} = \frac{1-\sqrt{3}}{-2}$$
$$= -\frac{1-\sqrt{3}}{2}$$

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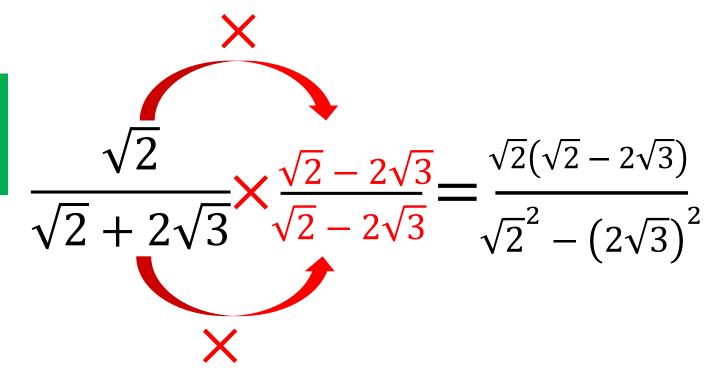
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Example 2:

$$\dfrac{3 + \sqrt{2}}{3 - \sqrt{2}}$$

$$\dfrac{3 + \sqrt{2}}{3 - \sqrt{2}} \times \dfrac{3 + \sqrt{2}}{3 + \sqrt{2}} = \dfrac{\left(3 + \sqrt{2}\right)^2}{3^2 - \sqrt{2}^2} = \dfrac{\left(3 + \sqrt{2}\right)^2}{9 - 2} = \dfrac{\left(3 + \sqrt{2}\right)^2}{7}$$

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Example 3:

$$\frac{\sqrt{2}}{\sqrt{2}+2\sqrt{3}}$$

$$\frac{\sqrt{2}}{\sqrt{2}+2\sqrt{3}} \times \frac{\sqrt{2}-2\sqrt{3}}{\sqrt{2}-2\sqrt{3}} = \frac{\sqrt{2}(\sqrt{2}-2\sqrt{3})}{\sqrt{2}^2-(2\sqrt{3})^2}$$

$$= \frac{2-2\sqrt{6}}{4-12} = \frac{2-2\sqrt{6}}{-8} = \frac{2(1-\sqrt{6})}{-8} = -\frac{1-\sqrt{6}}{4}$$

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