Rationalising the denominator

Year 10 Maths
Advanced

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Learning Objectives

By the end of the lesson I would hope that you have an understanding and be able to apply to questions the following concepts:

- Understand how we can remove the surd from the denominator by multiplying by itself.
- Be able to rationalise the denominator

Recap

In previous lessons we have looked at the basics of surds. Namely, how to

- Add,
- Subtract,
- Multiply, and
- Divide

We looked at the distributive law and how we can use it to multiply out sets of brackets.

To date, we've only had the surd on the top of a fraction. Which is good!

Convention (Barry!) states that we **cannot** have a surd on the bottom of a fraction (denominator).

$\frac{\sqrt{15}}{3}$

$\frac{3}{1.5}$

$\frac{3}{\sqrt{15}}$

$\frac{\frac{1}{2}}{3}$

RECAP: Multiplying a surd by itself

One of the most important results from Mathematics is that when we multiply a surd by itself, we effectively remove the root sign.

This proves to be an effective tool in removing a surd from the bottom of a fraction.

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

$$= \sqrt{9}$$

$$= 3$$

$$\left(\sqrt{3}\right)^2 = 3$$

Multiplying a fraction by a number which doesn't change the size of the fraction!?

Quick Quiz:

What number can you multiply a fraction by which can change the size of the fraction but not the ratio of its numerator and denominator?

Multiplying a fraction by a number which doesn't change the size of the fraction!?

Quick Quiz:

What number can you multiply a fraction by which can change the size of the fraction but not the ratio of its numerator and denominator?

Answer:

The number one.

$$\frac{1}{2} \times \frac{1}{1} = \frac{1}{2}$$

$$\times 2 \left(\frac{1}{2} \times \frac{3}{3} = \frac{3}{6} \right)$$

One can take many forms

Just like Professor Severus Snape who is quoted as being "the ultimate Shapeshifter in the Harry Potter universe" it is awesome that the number one (1) can take many forms.

$$\frac{1}{1} \qquad \frac{a}{a} \qquad \frac{\sqrt{2}}{\sqrt{2}}$$

Image taken from commons.wikipedia.org
Quote taken from scriptmag.com

Rationalising the denominator

Rationalise the denominator in the following.

- $\frac{2}{\sqrt{3}}$
- $\frac{3\sqrt{2}}{\sqrt{5}}$
- $\frac{2\sqrt{7}}{5\sqrt{2}}$
- $\frac{1-\sqrt{3}}{\sqrt{3}}$

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

$$\frac{3\sqrt{2}}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{3\sqrt{10}}{5}$$

$$\frac{2\sqrt{7}}{5\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{\cancel{2}^{1}\sqrt{14}}{5 \times \cancel{2}_{1}}$$

$$= \frac{\sqrt{14}}{5}$$

$$\frac{(1-\sqrt{3})}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$= \frac{\sqrt{3}(1-\sqrt{3})}{3}$$

$$= \frac{\sqrt{3}-3}{3}$$

Examples have been extracted, with permission, from the Cambridge Essential Mathematics Series of textbooks