

Rationalising the denominator

Starter

1. **(Review of last lesson)** Expand and simplify where possible:

(a) $(2 + 4\sqrt{6})(5 - 3\sqrt{6})$

(b) $(2\sqrt{5} + 7)^2$

2. State the value of: (a) $6 \times \frac{4}{4}$ (b) $53 \times \frac{187}{187}$ (c) $k \times \frac{a}{a}$

3. State the value of: (a) $\sqrt{7} \times \sqrt{7}$ (b) $\sqrt{56} \times \sqrt{56}$ (c) $\sqrt{k} \times \sqrt{k}$

Notes

Mathematicians don't like surds in the denominator: e.g. $\frac{5}{\sqrt{11}}$

The process of simplifying such surds is called **rationalising the denominator**. Basically the denominator starts out as an **irrational** number and ends up being a **rational** number.

Consider $\frac{5}{\sqrt{11}}$.

To make the denominator a rational number, we need to multiply it by $\sqrt{11}$: $\frac{5}{\sqrt{11}} \times \frac{\sqrt{11}}{\sqrt{11}}$

To keep the number the same, we must **also** multiply the numerator by $\sqrt{11}$: $\frac{5}{\sqrt{11}} \times \frac{\sqrt{11}}{\sqrt{11}}$

This is because **multiplying by 1 keep a number the same**.

The full working is: $\frac{5}{\sqrt{11}} = \frac{5}{\sqrt{11}} \times \frac{\sqrt{11}}{\sqrt{11}} = \frac{5\sqrt{11}}{11}$ **multiply fractions as normal**

When there is an integer in front of the surd in the denominator (e.g. $2\sqrt{15}$) just multiply by the surd.

E.g. $\frac{5}{2\sqrt{15}} = \frac{5}{2\sqrt{15}} \times \frac{\sqrt{15}}{\sqrt{15}}$ is better than $\frac{5}{2\sqrt{15}} = \frac{5}{2\sqrt{15}} \times \frac{2\sqrt{15}}{2\sqrt{15}}$, though the latter is not incorrect.

E.g. 1 Rationalise and simplify these surds:

(a) $\frac{1}{\sqrt{7}}$

(b) $\frac{3\sqrt{5}}{\sqrt{3}}$

(c) $\frac{3}{4\sqrt{2}}$

(d) $\frac{\sqrt{5}}{4\sqrt{10}}$

(e) $\frac{9 + \sqrt{5}}{\sqrt{13}}$

(f) $\frac{7 - \sqrt{2}}{3\sqrt{6}}$

Working: (a) $\frac{1}{\sqrt{7}} = \frac{1}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} = \frac{\sqrt{7}}{7}$

Video:

[Surds - rationalising denominators](#)

[Solutions to Starter and E.g.s](#)

Exercise

9-1 class textbook:

p16 E1.4 Qu 1-4, 5a-i, k, l, 7, 9

A*-G class textbook:

p15 E1.3 Qu 4-6, 8a-i, k, l, 9, 10

9-1 homework book:

p6 E1.4 Qu 1, 3a-k, 4-8

A*-G homework book:

p4 E1.3 Qu 1-5, 6a-k

Summary

Rationalising the denominator: $\frac{a}{\sqrt{b}} = \frac{a}{\sqrt{b}} \times \frac{\sqrt{b}}{\sqrt{b}} = \frac{a\sqrt{b}}{b}$