



Simplifying surds

Getting ready for A-Level Maths...

*"The most important investment you can make is in **yourself.**"*

Simplifying surds

What is a surd?

A **surd** is the answer to a root (square root, cube root etc) which is an **irrational** number (i.e. it is a non-terminating, non-recurring decimal).

Simplifying surds

Important rules

$$\sqrt{a} \times \sqrt{b} = \sqrt{a \times b}$$

$$\frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}}$$

Be careful...

$$\sqrt{a} + \sqrt{b} \neq \sqrt{a + b}$$

$$\sqrt{a} - \sqrt{b} \neq \sqrt{a - b}$$

Learn by heart...

1^2	$= 1 \times 1$	$= \mathbf{1}$
2^2	$= 2 \times 2$	$= \mathbf{4}$
3^2	$= 3 \times 3$	$= \mathbf{9}$
4^2	$= 4 \times 4$	$= \mathbf{16}$
5^2	$= 5 \times 5$	$= \mathbf{25}$
6^2	$= 6 \times 6$	$= \mathbf{36}$
7^2	$= 7 \times 7$	$= \mathbf{49}$
8^2	$= 8 \times 8$	$= \mathbf{64}$
9^2	$= 9 \times 9$	$= \mathbf{81}$
10^2	$= 10 \times 10$	$= \mathbf{100}$
11^2	$= 11 \times 11$	$= \mathbf{121}$
12^2	$= 12 \times 12$	$= \mathbf{144}$
13^2	$= 13 \times 13$	$= \mathbf{169}$
14^2	$= 14 \times 14$	$= \mathbf{196}$
15^2	$= 15 \times 15$	$= \mathbf{225}$

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How to simplify a surd

$$\sqrt{20}$$

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My turn

Simplify $\sqrt{50}$ by writing it in the form $a\sqrt{b}$ where b is prime. State the values of a and b .

$$\begin{aligned}\sqrt{50} &= \sqrt{25 \times 2} \\ &= \sqrt{25} \sqrt{2}\end{aligned}$$

$$\sqrt{50} = \underline{\underline{5\sqrt{2}}}$$

$$\begin{aligned}a &= 5 \\ b &= 2\end{aligned}$$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$
$10^2 = 100$
$11^2 = 121$
$12^2 = 144$
$13^2 = 169$
$14^2 = 196$
$15^2 = 225$

Your turn

Simplify $\sqrt{32}$ by writing it in the form $a\sqrt{b}$ where b is prime. State the values of a and b .

$$\begin{aligned}\sqrt{32} &= \sqrt{16 \times 2} \\ &= \sqrt{16} \sqrt{2}\end{aligned}$$

$$\sqrt{32} = \underline{\underline{4\sqrt{2}}}$$

$$\begin{aligned}a &= 4 \\ b &= 2\end{aligned}$$

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My turn

Simplify $6\sqrt{45}$ by writing it in the form $a\sqrt{b}$ where b is prime. State the values of a and b .

$$6\sqrt{45} = 6\sqrt{9 \times 5}$$
$$= 6\sqrt{9}\sqrt{5}$$

$$6\sqrt{45} = \underline{\underline{18\sqrt{5}}}$$

$$a = 18$$
$$b = 5$$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$
$10^2 = 100$
$11^2 = 121$
$12^2 = 144$
$13^2 = 169$
$14^2 = 196$
$15^2 = 225$

Your turn

Simplify $7\sqrt{99}$ by writing it in the form $a\sqrt{b}$ where b is prime. State the values of a and b .

$$7\sqrt{99} = 7\sqrt{9 \times 11}$$
$$= 7\sqrt{9}\sqrt{11}$$

$$7\sqrt{99} = \underline{\underline{21\sqrt{11}}}$$

$$a = 21$$
$$b = 11$$

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My turn

Simplify $\frac{\sqrt{450}}{3}$ by writing it in the form $a\sqrt{b}$ where b is prime. State the values of a and b .

$$\frac{\sqrt{450}}{3} = \frac{\sqrt{225 \times 2}}{3}$$

$$= \frac{\sqrt{225}\sqrt{2}}{3}$$

$$= \frac{15\sqrt{2}}{3}$$

$$\frac{\sqrt{450}}{3} = \underline{\underline{5\sqrt{2}}}$$

$$\begin{aligned} a &= 5 \\ b &= 2 \end{aligned}$$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$
$10^2 = 100$
$11^2 = 121$
$12^2 = 144$
$13^2 = 169$
$14^2 = 196$
$15^2 = 225$

Your turn

Simplify $\frac{\sqrt{288}}{4}$ by writing it in the form $a\sqrt{b}$ where b is prime. State the values of a and b .

$$\frac{\sqrt{288}}{4} = \frac{\sqrt{144 \times 2}}{4}$$

$$= \frac{\sqrt{144}\sqrt{2}}{4}$$

$$= \frac{12\sqrt{2}}{4}$$

$$\frac{\sqrt{288}}{4} = \underline{\underline{3\sqrt{2}}}$$

$$\begin{aligned} a &= 3 \\ b &= 2 \end{aligned}$$

Simplifying surds

My turn

Show that $\sqrt{27} + \sqrt{192} = a\sqrt{b}$. State the values of a and b .

$$\begin{aligned}\sqrt{27} + \sqrt{192} &= \sqrt{9 \times 3} + \sqrt{64 \times 3} \quad \text{WI} \\ &= \sqrt{9}\sqrt{3} + \sqrt{64}\sqrt{3} \\ &= 3\sqrt{3} + 8\sqrt{3} \\ \sqrt{27} + \sqrt{192} &= \underline{\underline{11\sqrt{3}}}\end{aligned}$$

$$\begin{aligned}a &= 11 \\ b &= 3\end{aligned}$$

$$\text{WI: } 3 \overline{)192}^{64}$$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$
$10^2 = 100$
$11^2 = 121$
$12^2 = 144$
$13^2 = 169$
$14^2 = 196$
$15^2 = 225$

Your turn

Show that $\sqrt{28} + \sqrt{63} = a\sqrt{b}$. State the values of a and b .

$$\begin{aligned}\sqrt{28} + \sqrt{63} &= \sqrt{4 \times 7} + \sqrt{9 \times 7} \\ &= \sqrt{4}\sqrt{7} + \sqrt{9}\sqrt{7} \\ &= 2\sqrt{7} + 3\sqrt{7} \\ \sqrt{28} + \sqrt{63} &= \underline{\underline{5\sqrt{7}}}\end{aligned}$$

$$\begin{aligned}a &= 5 \\ b &= 7\end{aligned}$$

Simplifying surds

Review Exercise

1. Write down the first 15 square numbers from memory.
2. Simplify $\sqrt{72}$ by writing it in the form $a\sqrt{b}$ where b is prime. State the values of a and b .
3. Simplify $5\sqrt{63}$ by writing it in the form $a\sqrt{b}$ where b is prime. State the values of a and b .
4. Simplify $\frac{\sqrt{392}}{2}$ by writing it in the form $a\sqrt{b}$ where b is prime. State the values of a and b .
5. Show that $\sqrt{32} + \sqrt{128} = a\sqrt{b}$. State the values of a and b .

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Review Exercise (Answers)

1. Write down the first 15 square numbers from memory
 $1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225$
2. Simplify $\sqrt{72}$ by writing it in the form $a\sqrt{b}$ where b is prime.
State the values of a and b . $6\sqrt{2}$
3. Simplify $5\sqrt{63}$ by writing it in the form $a\sqrt{b}$ where b is prime.
State the values of a and b . $15\sqrt{7}$
4. Simplify $\frac{\sqrt{392}}{2}$ by writing it in the form $a\sqrt{b}$ where b is prime.
State the values of a and b . $7\sqrt{2}$
5. Show that $\sqrt{32} + \sqrt{128} = a\sqrt{b}$ where b is prime.
State the values of a and b . $12\sqrt{2}$