

# GCSE Maths: Rationalising the denominator and exact answers (Higher): answers

GCSE Maths - Standard Form, Indices and Surds - Higher - Lesson 6.9

**Answers.** Final answers to the worksheet questions. Full step-by-step solutions for every question are free at [websink.site/gcse/maths/ch06-standard-form-indices-surds/higher/rationalising-the-denominator-and-exact-answers/](https://websink.site/gcse/maths/ch06-standard-form-indices-surds/higher/rationalising-the-denominator-and-exact-answers/)

## Exercise 6Q Rationalising the denominator Non-calculator

**1** Rationalise the denominator of each fraction. Simplify your answers.

(a)  $\frac{6}{\sqrt{3}}$

**Answer:**  $2\sqrt{3}$

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

**Answer:**  $\frac{\sqrt{7}}{7}$

(c)  $\frac{10}{\sqrt{5}}$

**Answer:**  $2\sqrt{5}$

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

**Answer:**  $\frac{2\sqrt{3}}{3}$

(e)  $\frac{12}{\sqrt{6}}$

**Answer:**  $2\sqrt{6}$

(f)  $\frac{3}{\sqrt{2}}$

**Answer:**  $\frac{3\sqrt{2}}{2}$

**2** Rationalise the denominator of each fraction. Simplify your answers.

(a)  $\frac{1 + \sqrt{3}}{\sqrt{2}}$

**Answer:**  $\frac{\sqrt{2} + \sqrt{6}}{2}$

(b)  $\frac{2 + \sqrt{5}}{\sqrt{5}}$

**Answer:**  $\frac{5 + 2\sqrt{5}}{5}$

(c)  $\frac{\sqrt{2} + \sqrt{6}}{\sqrt{2}}$

**Answer:**  $1 + \sqrt{3}$

(d)  $\frac{3 + \sqrt{5}}{\sqrt{5}}$

**Answer:**  $\frac{5 + 3\sqrt{5}}{5}$

3 Rationalise the denominator of each fraction. Simplify your answers.

(a)  $\frac{1}{3 + \sqrt{5}}$

**Answer:**  $\frac{3 - \sqrt{5}}{4}$

(b)  $\frac{6}{4 - \sqrt{2}}$

**Answer:**  $\frac{12 + 3\sqrt{2}}{7}$

(c)  $\frac{2}{1 + \sqrt{3}}$

**Answer:**  $-1 + \sqrt{3}$

(d)  $\frac{1}{2 - \sqrt{3}}$

**Answer:**  $2 + \sqrt{3}$

(e)  $\frac{5}{3 + \sqrt{2}}$

**Answer:**  $\frac{15 - 5\sqrt{2}}{7}$

4 Rationalise the denominator of each fraction. Simplify your answers.

(a)  $\frac{2 + \sqrt{3}}{1 + \sqrt{3}}$

**Answer:**  $\frac{1 + \sqrt{3}}{2}$

(b)  $\frac{1 + \sqrt{5}}{2 - \sqrt{5}}$

**Answer:**  $-7 - 3\sqrt{5}$

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

**Answer:**  $\frac{10 + \sqrt{2}}{14}$

5 Write each fraction in the form  $a + b\sqrt{c}$ , where  $a$ ,  $b$  and  $c$  are integers.

(a)  $\frac{1}{2 + \sqrt{3}}$

**Answer:**  $2 - \sqrt{3}$

(b)  $\frac{4}{3 - \sqrt{5}}$

**Answer:**  $3 + \sqrt{5}$

6 Show that  $\frac{1}{\sqrt{3} - 1} = \frac{\sqrt{3} + 1}{2}$ .

**Answer:**  $\frac{1 + \sqrt{3}}{2}$

- 7 Chloe multiplies only the bottom of  $\frac{1}{\sqrt{5}}$  by  $\sqrt{5}$  and writes  $\frac{1}{5}$ . Explain her mistake and rationalise the fraction correctly.

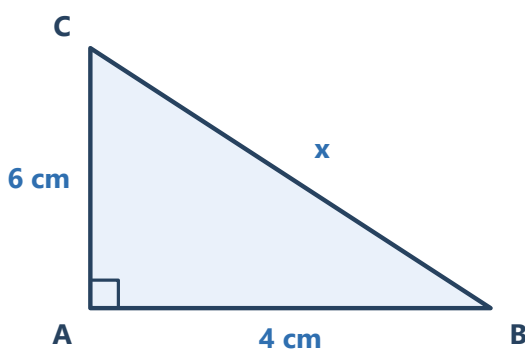
**Answer:** She changed the value of the fraction. Correct answer:  $\frac{\sqrt{5}}{5}$

- 8 Explain why you can multiply the top and the bottom of a fraction by the same number without changing its value.

**Answer:** The fraction we multiply by is (number)/(number) = 1, and multiplying by 1 does not change a value.

### Exercise 6R Exact answers with surds Non-calculator

- 1 Work out the exact length of the side marked  $x$ . Simplify your answers.



- (a) shorter sides 4 cm and 6 cm; find the hypotenuse

**Answer:**  $2\sqrt{13}$  cm

- (b) shorter sides 5 cm and 5 cm; find the hypotenuse

**Answer:**  $5\sqrt{2}$  cm

- (c) shorter sides 1 cm and 3 cm; find the hypotenuse

**Answer:**  $\sqrt{10}$  cm

- (d) hypotenuse 7 cm and one side 3 cm; find the other side

**Answer:**  $2\sqrt{10}$  cm

- 2 A square has sides of length 5 cm. Work out the exact length of its diagonal.

**Answer:**  $5\sqrt{2}$  cm

- 3 An equilateral triangle has sides 2 cm. Its height splits it into two right-angled triangles. Work out the exact height, and then the exact area of the equilateral triangle.

- (a) height

**Answer:**  $\sqrt{3}$  cm

- (b) area

**Answer:**  $\sqrt{3}$  cm<sup>2</sup>

- 4 A triangle has a base of  $\sqrt{12}$  cm and a perpendicular height of  $\sqrt{3}$  cm. Show that its area is 3 cm<sup>2</sup>.

**Answer:**  $3 \text{ cm}^2$

- 5 A right-angled triangle has shorter sides  $\sqrt{6} \text{ cm}$  and  $\sqrt{10} \text{ cm}$ . Show that its hypotenuse is exactly  $4 \text{ cm}$ .

**Answer:**  $\sqrt{(6 + 10)} = \sqrt{16} = 4$

- 6 Show that each of these is equal to a multiple of  $\sqrt{5}$ .

(a)  $\sqrt{45} + \sqrt{20}$

**Answer:**  $5\sqrt{5}$

(b)  $3\sqrt{20} - \sqrt{45}$

**Answer:**  $3\sqrt{5}$

(c)  $\sqrt{80} \div 2 + \sqrt{5}$

**Answer:**  $3\sqrt{5}$

- 7 Give an example to show that the product of two irrational numbers can be rational.

**Answer:**  $\sqrt{2} \times \sqrt{8} = \sqrt{16} = 4$

- 8 The area of a circle is  $12\pi \text{ cm}^2$ . Show that its radius is  $2\sqrt{3} \text{ cm}$  and find its exact circumference.

(a) radius

**Answer:**  $2\sqrt{3} \text{ cm}$

(b) circumference

**Answer:**  $4\pi\sqrt{3} \text{ cm}$

- 9 Show that  $\frac{1}{\sqrt{2} + 1} + \frac{1}{\sqrt{2} - 1} = 2\sqrt{2}$ .

**Answer:**  $2\sqrt{2}$