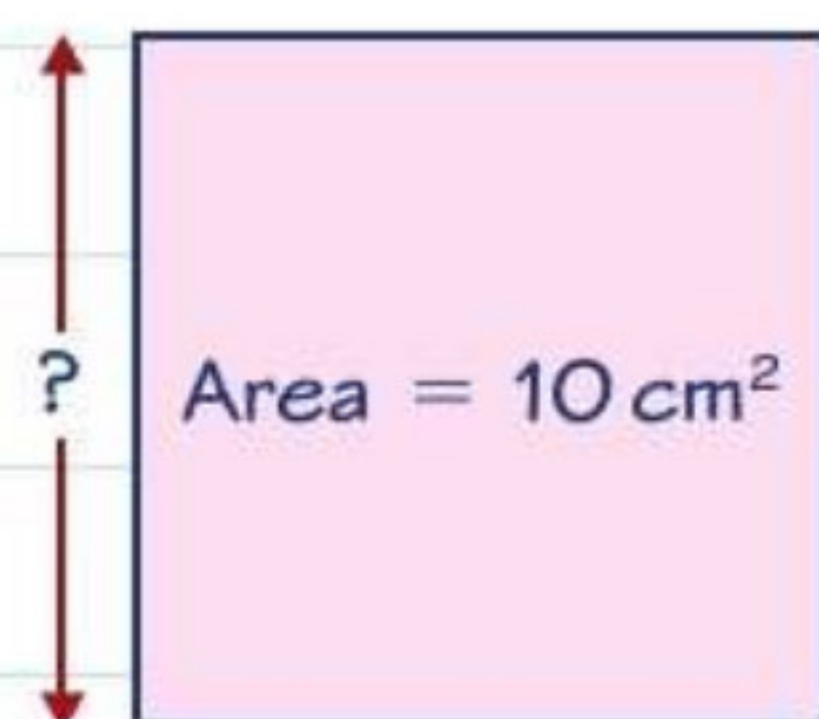




# Surds 1

You can give exact answers to calculations by leaving some numbers as square roots.



This square has a side length of  $\sqrt{10}$  cm. You can't write  $\sqrt{10}$  exactly as a decimal number. It is called a **surd**.

## Rules for simplifying square roots

These are the most important rules to remember when dealing with surds:

**1**  $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$        $\sqrt{8} = \sqrt{4} \times \sqrt{2} = 2\sqrt{2}$

**2**  $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$        $\sqrt{\frac{3}{25}} = \frac{\sqrt{3}}{\sqrt{25}} = \frac{\sqrt{3}}{5}$

You need to remember these rules for your exam.

## Worked example

Target grade **7**

Show that  $\sqrt{45} = 3\sqrt{5}$   
Show each stage of your working clearly. (2 marks)

$$\begin{aligned}\sqrt{45} &= \sqrt{9 \times 5} \\ &= \sqrt{9} \times \sqrt{5} \\ &= 3\sqrt{5}\end{aligned}$$

This question says 'Show that...' so you can't use your calculator. You need to show each step of your working clearly:

1. Look for a factor of 45 which is a square number:  $45 = 9 \times 5$
2. Use the rule  $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$  to split the square root into two square roots.
3. Write  $\sqrt{9}$  as a whole number.

**Rationalising the denominator** of a fraction means making the denominator a whole number.

You can do this by multiplying the top and bottom of the fraction by the surd part in the denominator.

$$\frac{5}{3\sqrt{2}} = \frac{5\sqrt{2}}{6}$$

The surd part of the denominator is  $\sqrt{2}$

Remember that  $\sqrt{2} \times \sqrt{2} = 2$   
So  $3\sqrt{2} \times \sqrt{2} = 3 \times 2 = 6$

## Good form

Most surd questions ask you to write a number or answer in a certain **form**.

This means you need to find **integers** for all the letters in the expression.

$6\sqrt{3}$  is in the form  $k\sqrt{3}$   
 $k = 6$

The integers can be positive or negative.

$4 - 9\sqrt{2}$  is in the form  $p + q\sqrt{2}$   
 $p = 4$  and  $q = -9$

You can check your answer by writing down the integer value for each letter.

## Now try this

Find factors of 32 and 98 which are **square** numbers.

Target grade **8**

- 1 Write  $\sqrt{32} + \sqrt{98}$  in the form  $p\sqrt{2}$  where  $p$  is an integer. Show each stage of your working clearly. (2 marks)
- 2 Show that  $\frac{35}{\sqrt{7}} = 5\sqrt{7}$  (2 marks)

Target grade **9**

- 3  $x$  is an integer such that  $\frac{\sqrt{x} \times \sqrt{18}}{\sqrt{3}} = 8\sqrt{3}$   
Find the value of  $x$ . (4 marks)

Rationalise the denominator by multiplying top and bottom by  $\sqrt{7}$