

1.1 Introduction to Rational Numbers

(part 2)

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Learning Goal: *I will learn to*

- determine the square root of a rational number using estimation and technology

→ To **square** a number means to multiply it by itself.

For example:

"eight squared"

$$8^2 = 8 \times 8$$

$$= 64$$

$$\left(\frac{5}{7}\right)^2 = \frac{5}{7} \times \frac{5}{7}$$

$$= \frac{25}{49}$$

$$0.5^2 = 0.5 \times 0.5$$

$$= 0.25$$

→ A **perfect square** is a number that is the product of two equal rational factors.

For example:

4 9 16

↑ ↓ ↑

because $2 \times 2 = 4$ because $3 \times 3 = 9$ because $4 \times 4 = 16$.

$$\frac{25}{49}$$

↑ because $\frac{5}{7} \times \frac{5}{7} = \frac{25}{49}$

→ A **square root** is a one of two equal factors of a number (the number that, when multiplied by itself, equals a given value).

For example:

$$\sqrt{25} = 5$$

$$\sqrt{\frac{25}{49}} = \frac{\sqrt{25}}{\sqrt{49}}$$

$$= \frac{5}{7}$$

→ **Squares and square roots** can be modelled by the area and side length of a square.

For example:

4cm

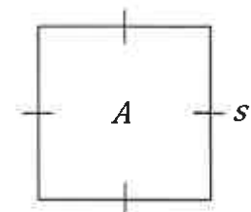
4	4	4	4
4	4	4	4
4	4	4	4
4	4	4	4

4cm

$$s = 4\text{cm}$$

$$A = 4^2$$

$$= 16\text{cm}^2$$



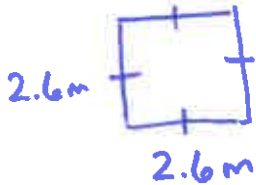
$$A = s^2$$

$$s = \sqrt{A}$$

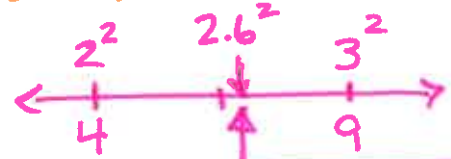
Example: Estimate the Square of a Rational Number

We can use knowledge of squaring a whole number to help estimate the square of a rational number.

A square trampoline has a side length of 2.6 m. Estimate the area of the trampoline, then use a calculator to check your estimate.



2.6 is between 2 and 3
2.6² is between 2² and 3²
2.6² is between 4 m² and 9 m²



Calculator
Check: $A = 2.6^2$
 $= 6.76 \text{ m}^2$

ESTIMATE: about 6.7 m²

Example: Determine the Square of a Perfect Square Rational Number

The square root of a perfect square rational number is the same as the whole number square root with a change in place value.

Determine the following:

a) $\sqrt{0.64}$

$$\sqrt{\frac{64}{100}} = \frac{\sqrt{64}}{\sqrt{100}}$$
$$= \frac{8}{10} = 8 \div 10 = \boxed{0.8}$$

b) $\sqrt{1.44}$

$$\sqrt{\frac{144}{100}} = \frac{12}{10}$$
$$= \boxed{1.2}$$

c) $\sqrt{0.09}$

$$\sqrt{\frac{9}{100}} = \frac{3}{10}$$
$$= \boxed{0.3}$$

Example: Estimate the Square Root of a Non-Perfect Square Rational Number

A non-perfect square is a rational number that cannot be expressed as the product of two equal rational numbers.

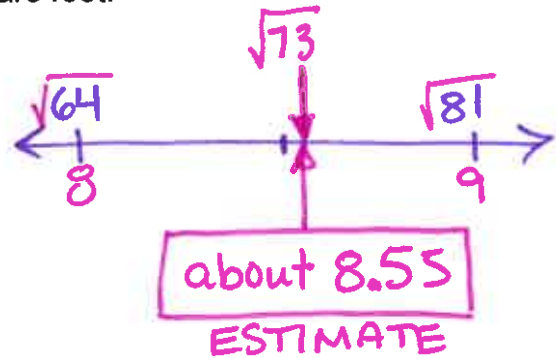
For example, you cannot square any rational number and get an answer of 3, 5, 1.5, or $\frac{7}{8}$.

We can use estimation to find the approximate square root.

Estimate the following:

a) $\sqrt{73}$

$\sqrt{73}$ is between $\sqrt{64} = 8$ and $\sqrt{81} = 9$



b) $\sqrt{0.73}$

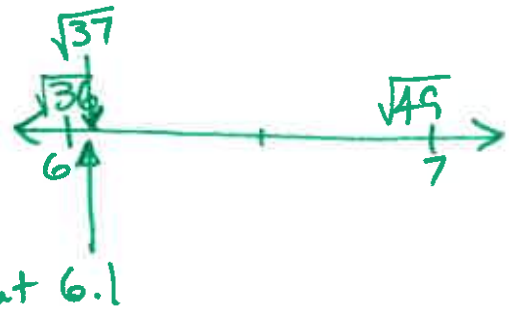
$\sqrt{\frac{73}{100}} \approx \frac{8.55}{10}$
 $\approx 8.55 \div 10$
 ≈ 0.855
ESTIMATE

calculator check:
 $\sqrt{0.73} = 0.8544\dots$

Show You Know

Estimate $\sqrt{0.37}$. Then use a calculator to verify your answer (round to the nearest thousandth).

$\sqrt{37}$ is between $\sqrt{36} = 6$ and $\sqrt{49} = 7$



$\sqrt{0.37} = \sqrt{\frac{37}{100}}$
 $\approx \frac{6.1}{10}$
 ≈ 0.61
ESTIMATE

calculator check:
 $\sqrt{0.37} = 0.60827\dots$

Perfect Squares

$$1^2 = 1 \times 1 = 1$$

$$2^2 = 4$$

$$3^2 = 9$$

$$4^2 = 16$$

$$5^2 = 25$$

$$6^2 = 36$$

$$7^2 = 49$$

$$8^2 = 64$$

$$9^2 = 81$$

$$10^2 = 100$$

$$11^2 = 121$$

$$12^2 = 144.$$