

# Square Numbers and Square Roots

A **square number** is the result when a number has been multiplied by itself.

We use a power of 2 to show this.

 **Example**

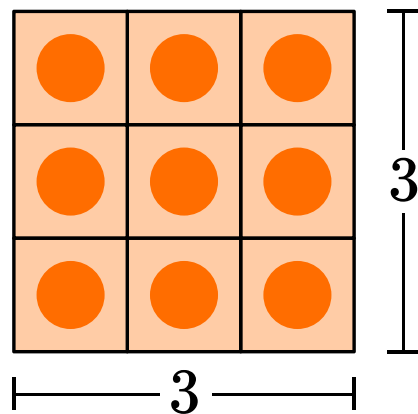
$$3 \times 3 = 3^2 = 9$$

**Square rooting** is the inverse operation of squaring a number.

We use the symbol  $\sqrt{\quad}$

 **Example**

$$\sqrt{9} = 3$$



The area of this  $3 \times 3$  **square** is 9 small squares:  $3^2 = 9$

# Cube Numbers and Cube Roots

A **cube number** is the result when a number has been multiplied by itself twice.

We use a power of 3 to show this.

 **Example**

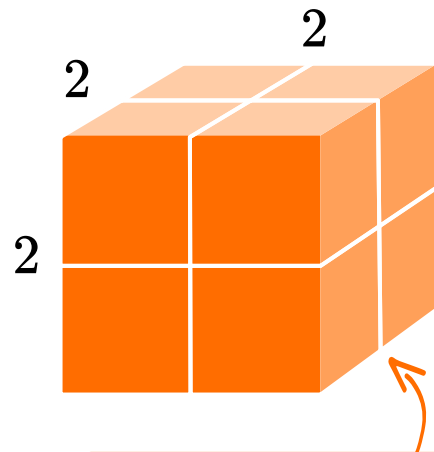
$$2 \times 2 \times 2 = 2^3 = 8$$

**Cube rooting** is the inverse operation of cubing a number.

We use the symbol  $\sqrt[3]{\quad}$

 **Example**

$$\sqrt[3]{8} = 2$$



The volume of this  $2 \times 2 \times 2$  **cube** is 8 small cubes:  $2^3 = 8$

# Powers and Roots

We can use **powers** to express a **repeated multiplication** of a number.


 Examples

$$2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$$

 2 is multiplied by itself 5 times.

We say “2 to the power of 5”.

$$3^4 = 3 \times 3 \times 3 \times 3 = 81$$

 3 is multiplied by itself 4 times.

We say “3 to the power of 4”.

Finding the **root** is the inverse operation.

 Examples

$$\sqrt[5]{32} = 2 \text{ because } 2 \text{ multiplied by itself } 5 \text{ times is } 32$$

$$\sqrt[4]{81} = 3 \text{ because } 3 \text{ multiplied by itself } 4 \text{ times is } 81$$

# Negative Powers

If a number is raised to a **negative power**, we find its **reciprocal**.


**Reciprocal** means **multiplicative inverse**.

 **Example**

The reciprocal of 4 is  $\frac{1}{4}$  because  $4 \times \frac{1}{4} = 1$

$$\text{So } 4^{-1} = \frac{1}{4}$$

Another way to think about reciprocals is that multiplying by  $\frac{1}{4}$  is the same as dividing by 4

 **Example**

$$3^{-2} = \frac{1}{3^2} = \frac{1}{9}$$

This means “the reciprocal of  $3^2$ ”

# Fractional Powers

When using **fractional powers**, the **denominator** is the **root** of the number.

 **Example** Evaluate  $64^{\frac{1}{3}}$

The denominator **3** means we are finding the **cube root** of 64  $64^{\frac{1}{3}} = \sqrt[3]{64} = 4$

If the numerator is not 1, we raise the answer **to the power of** that **numerator**.

 **Example** Evaluate  $16^{\frac{3}{4}}$

The denominator **4** means we are finding the **fourth root** of 16

The numerator **3** means we then **cube our answer**.

$$\text{So } 16^{\frac{3}{4}} = (\sqrt[4]{16})^3 = 2^3 = 8$$

$$(\sqrt[4]{16})^3$$