Powers And Roots

Mana Maths

Te reo Māori terms

taupū
exponent
Open in Te Aka

pūtake
base
Open in Te Aka

tapawhā
square
Open in Te Aka

pūtoru
cube
Open in Te Aka

Notes & Steps

Key idea

A power (or exponent) tells you how many times to multiply a number by itself. A root asks: what number, multiplied by itself, gives the original?

Steps — evaluate powers

1. Identify the base (the big number) and the exponent (the small number).
2. Multiply the base by itself exponent times.
3. Example: $2^3 = 2 \times 2 \times 2 = 8$.

Steps — square roots

1. Ask: what number times itself equals the given?
2. Example: $\sqrt{25} = 5$ because $5 \times 5 = 25$.

Key facts

- $2 \times 2 \times 2 \times 2 = 2^4$
- $2^3 = 8$
- $3^2 = 9$
- $\sqrt{25} = 5$
- $4^1 = 4$ (any number to the power 1 is itself)
- $\sqrt{4} = 2$ (rational — an integer)

Common mistake

Thinking $2^3 = 6$ (multiplying base by exponent). Remember: $2^3 = 2 \times 2 \times 2 = 8$, not $2 \times 3 = 6$.

Try these

1. Write $2 \times 2 \times 2 \times 2$ using a power.
2. What is 2^3?
3. What is $\sqrt{25}$?

Notes & Steps

Example 1: square numbers

Evaluate 3^2.

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

Answer: 9. 9 is called a square number.

Example 2: cube numbers

Calculate 5^3.

$$5^3 = 5 \times 5 \times 5 = 125$$

Answer: 125. 125 is called a cube number.

Try these

1. Evaluate 3^2.
2. Find $\sqrt{36}$.
3. Name one cube number.

Notes & Steps

Example 3: powers of 10

Calculate 10^3.

$$10^3 = 10 \times 10 \times 10 = 1000$$

Pattern: the exponent tells how many zeros.

Example 4: expressing as a power

Write 81 as a power of 3.

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

Answer: 3^4.

Common mistake

Confusing -3^2 with $(-3)^2$. $-3^2 = -9$ (the square happens first). $(-3)^2 = 9$ (the whole negative is squared).

Start Tasks

1. Write $2 \times 2 \times 2 \times 2$ using a power.

2. What is 2^3?

3. Evaluate 3^2.

4. What is the square root of 25?

5. Is $\sqrt{4}$ rational or irrational?

6. Write 4^1 as a number.

7. Fill in:
$3^2 = \_\_\_\_\_$.

8. Calculate: $2 \times 2 \times 2$ and express as a power.

9. Put these in order:
$2^2, 2^3, 2^1$.

Start Tasks

1. Complete: $\_\_\_\_\_^2 = 49$.

2. Explain in one short sentence what a power represents.

3. Give an example of a cube number.

4.

5.

6.

7.

8.

9.

Build Tasks

1. Write $2 \times 2 \times 2 \times 2$ as a power and evaluate it.

2. Calculate 5^3.

3. Find $\sqrt{36}$.

4. Evaluate 3^4.

5. Explain why 4^2 and 2^4 are different.

6. Fill in:
$2^5 = \_\_\_\_\_$.

7. If $a = 3$, evaluate a^3.

8. Which is larger: 2^6 or 3^4? Show working.

9. Express 81 as a power of 3.

Build Tasks

1. Calculate 10^2 and 10^3 and explain the pattern.

2. Take square roots: $\sqrt{49}$ and $\sqrt{64}$.

3. Write 16 as 2^n and state n.

4.

5.

6.

7.

8.

9.

Push Tasks

1. Calculate 2^8 and show the prime factorisation.

2. Prove that $\sqrt{10}$ is irrational (short explanation).

3. If $4 \times 4 \times 4 = 4^3$, express 4^3 as 2^n and find n.

4. Write 32 as a power of 2 and also as a product of primes.

5. Solve: $x^2 = 144$. Give both solutions.

6. A number is 3^4. What is its square root? Express in simplest form.

7. Explain difference between -3^2 and $(-3)^2$ with examples.

8. If $a^2 = 49$ and $a > 0$, find a and explain.

9. Simplify: $(2^3)^4$.

Push Tasks

1. Show that $2^m \times 2^n = 2^{m+n}$ and give an example.

2. Write 0.0001 as a power of 10.

3. Explain why some square roots are integers and some are not, with examples.

4.

5.

6.

7.

8.

9.