MATHEMATICS · GRADES 10-12

# Fractional exponents

### Difficulty level: Advanced

### Mathematics: Grades 10-12

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## *Overview of the concept*

This is how scientists and engineers write roots as powers, so a formula for growth or decay stays short enough to use. Writing a root as a power lets you use all the ordinary power rules on it instead of learning a whole new set of rules for roots. You will see it in formulas for compound growth, in radioactivity and half life, and in engineering where a short formula has to be used over and over.



## *Rule*

**Fractional exponents: in $a^{(\frac{m}{n})}$, the denominator is the root and the numerator is the power.**

So $a^{(\frac{m}{n})}$ is the nth root of $a^m$.

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## Worked examples

**EXAMPLE 1**

**Q** Evaluate $16^{\frac{1}{2}}$

**SOLUTION**

Read the denominator as the root: the power $\frac{1}{2}$ means square root.

Take the square root: $\sqrt{16} = 4$

So $16^{\frac{1}{2}} = 4$

**EXAMPLE 2**

**Q** Evaluate $27^{\frac{2}{3}}$

**SOLUTION**

The denominator tells you the root and the numerator tells you the power: $(\sqrt[3]{27})^2$

$27^{\frac{1}{3}} = 3$

$3^2 = 9$

So $27^{\frac{2}{3}} = 9$

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## Practice questions

**1** What is $25\frac{1}{2}$?

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**2** Which power equals 2?

A $8\frac{1}{3}$

B $16\frac{1}{2}$

C $27\frac{1}{3}$

D $125\frac{1}{3}$

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**3** Which is greater, $16\frac{1}{2}$ or $16\frac{1}{4}$?

- **A** $16\frac{1}{2}$
- **B** $16\frac{1}{4}$
- **C** They are equal
- **D** Cannot tell

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**4** What is $16\frac{3}{4}$?

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**5** What is $81\frac{1}{4}$ plus $16\frac{1}{2}$?

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**6** **Which power means the fourth root of 81?**

- **A** $81^{\frac{1}{2}}$
- **B** $81^{\frac{1}{4}}$
- **C** $81^{\frac{3}{4}}$
- **D** $81^{\frac{1}{3}}$

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**7** **What does the denominator 3 mean in $8^{\frac{1}{3}}$?**

- **A** It asks for the cube root
- **B** It means divide 8 by 3
- **C** It means multiply 8 by 3
- **D** It means raise 8 to the power 3

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**8** **What is $64\frac{1}{2}$ times $64\frac{1}{2}$?**

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**9** **Why does $100\frac{1}{2}$ equal 10?**

A. The $\frac{1}{2}$ power asks for the number that multiplies by itself to make 100, and 10 × 10 is 100.

B. The $\frac{1}{2}$ power means 100 divided by 2, which is 50.

C. The $\frac{1}{2}$ power asks for the number that adds to itself to make 100, and 50 + 50 is 100.

D. $100\frac{1}{2}$ means 100 times $\frac{1}{2}$, which is 50.

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10 What is the square of $125\frac{1}{3}$?

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## ANSWER KEY

**1.** 5

**2.** $8\frac{1}{3}$

**3.** $16\frac{1}{2}$

**4.** 8

**5.** 7

**6.** $81\frac{1}{4}$

**7.** It asks for the cube root

**8.** 64

**9.** The $\frac{1}{2}$ power asks for the number that multiplies by itself to make 100, and 10 × 10 is 100.

**10.** 25

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