Volume with Fractional Edge Lengths

Volume with Fractional Edge Lengths: Find, Fix, and Work Backward

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QUICK REVIEW

A cube with edge $\frac{1}{2}$ cm occupies $\frac{1}{8}$ cm^3. Two half-centimeter edges fit along 1 cm. For a rectangular prism, count cubes along each dimension, then multiply the counts. For a missing height, find the volume of one known layer and count equal layers using a common denominator.

Worked example

A rectangular prism made of half-centimeter cubes is $1\frac{1}{2}$ cm long, 1 cm wide, and $1\frac{1}{2}$ cm tall. Count the cubes and find their volume.

1. Each $1\frac{1}{2}$ cm edge holds 3 half-centimeter edges. The 1 cm edge holds 2.

2. There are $3 \times 2 \times 3 = 18$ cubes. Each occupies $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$ cm^3.

3. All 18 cubes occupy $18 \times \frac{1}{8} = \frac{18}{8} = \frac{9}{4}$ cm^3.

Answer: 18 cubes; $\frac{9}{4}$ cm^3.

Practice Problems

Show your thinking.

1. A student says a cube with $\frac{1}{2}$ cm edges occupies $\frac{1}{2}$ cm^3. Use a 1 cm cube to explain the correct volume of one small cube.

2. A rectangular prism of wax has a $2\frac{1}{2}$ cm by 1 cm base and occupies $\frac{25}{4}$ cm^3. A label says it is two half-centimeter layers high. Find the actual height.

3. A rectangular prism is built from 30 cubes with $\frac{1}{2}$ cm edges, with no gaps. It is 5 cubes long and 3 full layers high. Recover the width in centimeters.

4. A rectangular prism has a 2 cm by $1\frac{1}{2}$ cm base and is $2\frac{1}{2}$ cm high. It is cut parallel to its base halfway up. Find the height and volume of each piece.

5. A rectangular prism has a 4 cm by 2 cm base and is $1\frac{1}{2}$ cm high. Both base dimensions are halved and the height stays fixed. Kai says the volume is halved. Correct the claim.

6. A rectangular prism with a $1\frac{1}{2}$ cm by $2\frac{1}{2}$ cm base is 1 cm high. A label lists $\frac{15}{4}$ cm^2 as the volume. Explain the number and correct the label.

Answer Key

1. $\frac{1}{8}$ cm^3.
2. $2\frac{1}{2}$ cm: five half-centimeter layers.
3. 1 cm.
4. Each piece is $1\frac{1}{4}$ cm high and occupies $\frac{15}{4}$ cm^3.
5. It becomes $\frac{1}{4}$ as large: 3 cm^3.
6. Base area $\frac{15}{4}$ cm^2; volume $\frac{15}{4}$ cm^3.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. A 1 cm cube has space for 2 small cubes along each edge, or $2 \times 2 \times 2 = 8$ altogether.

2. Each small cube is one of 8 equal parts of 1 cm^3, so it occupies $\frac{1}{8}$ cm^3.

Problem 2

1. One $\frac{1}{2}$ cm-high layer has volume $\frac{5}{2} \times 1 \times \frac{1}{2} = \frac{5}{4}$ cm^3.

2. Two layers give only $\frac{10}{4}$ cm^3. The given 25 fourths make $25 \div 5 = 5$ groups of 5 fourths.

3. Five layers give height $5 \times \frac{1}{2} = \frac{5}{2}$ cm.

Problem 3

1. One layer contains $30 \div 3 = 10$ cubes.

2. With 5 in each row, there are $10 \div 5 = 2$ rows across the width.

3. Two cube edges span $2 \times \frac{1}{2} = 1$ cm.

Problem 4

1. Each new height is half of $\frac{5}{2}$ cm: $\frac{1}{2} \times \frac{5}{2} = \frac{5}{4}$ cm.

2. The base is $2 \times \frac{3}{2} = 3$ cm^2. The volume of each is $3 \times \frac{5}{4} = \frac{15}{4}$ cm^3.

Problem 5

1. The original volume is $4 \times 2 \times \frac{3}{2} = 12$ cm^3.

2. The new base is 2 cm by 1 cm, so the new volume is $2 \times 1 \times \frac{3}{2} = 3$ cm^3.

3. $4 \times 3 = 12$, so the new volume is one fourth of the original.

Problem 6

1. The number first comes from $\frac{3}{2} \times \frac{5}{2} = \frac{15}{4}$ cm^2 for the base.

2. Multiplying by 1 cm keeps the number: $\frac{15}{4} \times 1 = \frac{15}{4}$ cm^3. Three length factors give cubic units.

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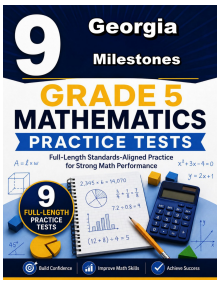

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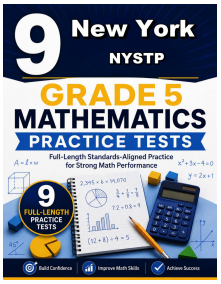

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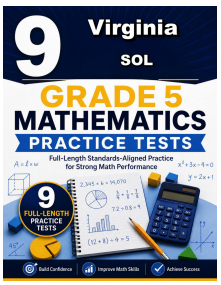

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