Understanding Volume

Understanding Volume: Apply, Compare, and Design

Name _____ **Date** _____ **Score** _____ / 6

QUICK REVIEW

Volume measures occupied space. A cube with edge 1 unit occupies 1 cubic unit. The count of cubes and their volume are different quantities, even when their numbers match. Empty space is not part of the occupied volume.

Worked example

A solid has layers of $4, 4, 3$ unit cubes. Find its cube count and volume.

1. Count all layers: $4 + 4 + 3 = 11$ cubes.
2. Each contributes 1 cubic unit, so $11 \times 1 = 11$ cubic units.
Answer: 11 cubes; 11 cubic units.

Practice Problems

Show your thinking.

1. Use all 18 one-centimeter cubes in one display tray. A has 24 cube spaces; B has 30. The display may have at most 8 cm^3 of empty space. Which tray works? Give occupied and empty volumes.

2. A storage model must occupy at most 20 cubic units. Plan A uses layers of $6, 6, 6$ unit cubes; B uses $8, 8, 6$. Which qualifies?

3. A sculpture has 27 unit cubes. Remove 5 and add 8 cubes of the same size. Find the new cube count and occupied volume.

4. A child says the model with more visible faces must have greater volume. Model A uses 16 unit cubes and B uses 15 of the same size. Which actually has greater volume, and by how much?

5. A 21-cubic-unit model is rebuilt as two pieces using all the same unit cubes. One piece uses twice as many cubes as the other. Find both occupied volumes.

6. Model A uses 9 cubes with 1 cm edges. B uses 3 cubes with 2 cm edges. Which uses fewer cubes, which occupies more space, and by how much?

Answer Key

1. A only. Each would have 18 cm^3 occupied; A has 6 cm^3 empty, B has 12 cm^3.
2. Only A: 18 cubic units.
3. 30 cubes; 30 cubic units.
4. A; 1 cubic unit greater.
5. Smaller 7 cubic units; larger 14 cubic units.
6. B uses fewer cubes but occupies 15 cm^3 more.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The same 18 cubes occupy $18 \times 1 = 18$ cm^3 in either tray.
2. Empty space: A $24 - 18 = 6$ cm^3; B $30 - 18 = 12$ cm^3.
3. Only A meets the limit because $6 \leq 8$ and $12 > 8$.

Problem 2

1. A has $6 + 6 + 6 = 18$ cubic units.
2. B has $8 + 8 + 6 = 22$ cubic units.
3. $18 \leq 20$ but $22 > 20$.

Problem 3

1. After removal there are $27 - 5 = 22$ cubes.
2. After addition there are $22 + 8 = 30$ cubes. One cubic unit per cube gives volume 30 cubic units.

Problem 4

1. Volume counts cubes: A occupies 16 and B occupies 15 cubic units.
2. $16 - 15 = 1$ cubic unit. Visible faces measure a different attribute.

Problem 5

1. There are 21 unit cubes. Give one equal group to the smaller piece and two to the larger.
2. Each group uses $21 \div 3 = 7$ cubes. The pieces use 7 and $2 \times 7 = 14$ cubes.
3. With 1 cubic unit per cube, the volumes are 7 and 14 cubic units.

Problem 6

1. A occupies $9 \times (1 \times 1 \times 1) = 9$ cm^3.
2. B occupies $3 \times (2 \times 2 \times 2) = 24$ cm^3.
3. B uses $3 < 9$ cubes, yet its volume is $24 - 9 = 15$ cm^3 greater.

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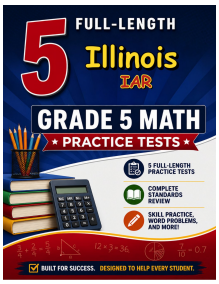

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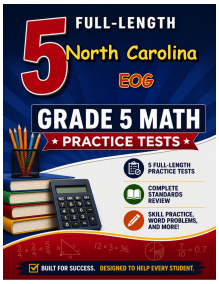

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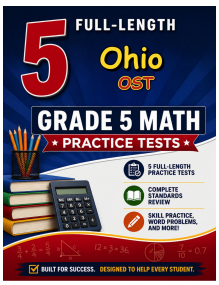

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