Solving Real-World Volume Problems

Solving Real-World Volume Problems: Apply, Compare, and Design

Name _____ **Date** _____ **Score** _____ / 8

QUICK REVIEW

Use inside dimensions for capacity and the filled height for contents. A base area uses square units; multiplying it by a height gives cubic units. To recover a height, divide the known volume by its base area.

Worked example

Two cartons share a 5 cm by 3 cm inside base. Their heights are 3 cm and 4 cm. Together can they hold 110 cm^3 of grain?

1. The base area is $5 \times 3 = 15$ cm^2. Capacities are $15 \times 3 = 45$ and $15 \times 4 = 60$ cm^3.

2. Together they hold $45 + 60 = 105$ cm^3, short by $110 - 105 = 5$ cm^3.

Answer: No; short by 5 cm^3.

Practice Problems

Show your thinking.

1. Store 155 cm^3 of sand in the box that leaves less unused space. A is 8 by 5 by 4 cm; B is 7 by 6 by 4 cm inside. Which should you use, and what space remains?

2. A planter is 10 cm by 6 cm by 5 cm inside. Leave the top 1 cm empty. It already contains 140 cm^3 of soil. How much more can you add?

3. Two full grain bins measure 4 by 3 by 2 cm and 5 by 3 by 4 cm inside. Empty them and share all the grain equally into 3 cups. Find the volume per cup.

4. Design a box with an 8 cm by 4 cm base and at least 150 cm^3 of capacity. Choose the smallest whole-number height and give the extra capacity.

5. A 14 by 8 by 6 cm case takes 4 by 2 by 3 cm cartons. Keep the edges aligned in that order. How many cartons fit in full rows and layers, and how much volume is unoccupied?

6. Tank A has base area 18 m^2 and water depth 2 m. B has base area 9 m^2 and depth 1 m. Transfer 18 m^3 from A to B, which has room. Find both new depths.

7. Design two boxes of capacity 96 cm^3 and height 4 cm. Each base edge must be a whole number of centimeters no greater than 8. The bases must not be rotations of one another.

8. A 10 by 5 by 6 cm tank contains 180 cm^3 of water. A solid 5 by 4 by 2 cm block goes entirely below the surface. Will the water spill? Find the space left above it.

Answer Key

1. A; 5 cm^3 unused.
2. 100 cm^3.
3. 28 cm^3 per cup.
4. Height 5 cm; 10 cm^3 extra.
5. 24 cartons; 96 cm^3 unoccupied.
6. A: 1 m; B: 3 m.
7. For example, bases 6 by 4 cm and 8 by 3 cm.
8. No; 80 cm^3 remains above the water.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. A holds $8 \times 5 \times 4 = 160$ cm^3. B holds $7 \times 6 \times 4 = 168$ cm^3.

2. Both fit. Unused space is $160 - 155 = 5$ cm^3 in A and $168 - 155 = 13$ cm^3 in B.

Problem 2

1. The allowed depth is $5 - 1 = 4$ cm. Allowed volume: $10 \times 6 \times 4 = 240$ cm^3.

2. Add at most $240 - 140 = 100$ cm^3.

Problem 3

1. The bins hold $4 \times 3 \times 2 = 24$ cm^3 and $5 \times 3 \times 4 = 60$ cm^3.

2. Total: $24 + 60 = 84$ cm^3. Each cup receives $84 \div 3 = 28$ cm^3.

Problem 4

1. The base is $8 \times 4 = 32$ cm^2. At 4 cm the volume is $32 \times 4 = 128$ cm^3, too little.

2. At 5 cm it is $32 \times 5 = 160$ cm^3, so 5 cm is the least height. Extra: $160 - 150 = 10$ cm^3.

Problem 5

1. Length fits 3 since $3 \times 4 = 12 \le 14$ but $4 \times 4 = 16 > 14$. Width fits $8 \div 2 = 4$; height fits $6 \div 3 = 2$.

2. Total cartons: $3 \times 4 \times 2 = 24$. They occupy $24 \times (4 \times 2 \times 3) = 576$ cm^3.

3. The case holds $14 \times 8 \times 6 = 672$ cm^3, leaving $672 - 576 = 96$ cm^3.

Problem 6

1. A has $18 \times 2 = 36$ m^3. After transfer it has $36 - 18 = 18$ m^3.

2. B has $9 \times 1 = 9$ m^3. After transfer it has $9 + 18 = 27$ m^3.

3. Depths: A $18 \div 18 = 1$ m; B $27 \div 9 = 3$ m.

Problem 7

1. The base area must be $96 \div 4 = 24$ cm^2.

2. Both $6 \times 4 = 24$ and $8 \times 3 = 24$ fit the edge limit. Their edge pairs differ.

3. Each capacity is $24 \times 4 = 96$ cm^3.

Problem 8

1. Tank capacity: $10 \times 5 \times 6 = 300$ cm^3. Block volume: $5 \times 4 \times 2 = 40$ cm^3.

2. Water and block occupy $180 + 40 = 220$ cm^3. The tank does not overflow.

3. Space left: $300 - 220 = 80$ cm^3.

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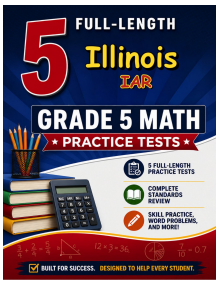

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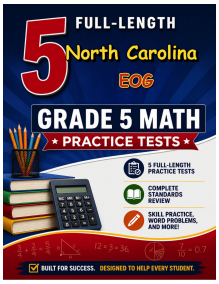

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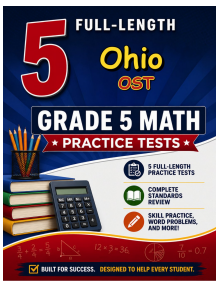

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