Square Roots and Cube Roots

Square and Cube Designs

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QUICK REVIEW

Area of a square is s^2, so its physical side is $s = \sqrt{A} > 0$. Cube volume is e^3, so its edge is $e = \sqrt[3]{V} > 0$. Recover lengths before finding perimeter, face area, or edge totals. For integer designs, compare neighboring squares or cubes and verify the complete dimensions. Track length, square units, and cubic units separately.

Worked example

A cube has volume 729 cm^3. Find the perimeter of one face.

1. The edge is $e = \sqrt[3]{729} = 9$ centimeters, because $9^3 = 729$. A face is a square whose side equals this edge.

2. Its perimeter is $4e = 4(9) = 36$ centimeters. Taking the cube root first turns volume into a length before the four sides are added.

Answer: 36 cm.

Practice Problems

Show your thinking.

1. A square garden has area 225 m^2. Find its side length in meters.

2. A cube-shaped box has volume 512 cm^3. Find its edge length in centimeters.

3. A square rug has area 2.25 m^2. Find its perimeter.

4. A cube container holds 1000 cm^3. Find the total length of its 12 edges.

5. Design a cube with whole-number edge length and volume strictly between 200 and 400 cm^3. List all possible edge lengths.

6. A square board has area 196 cm^2. Can it fit inside a square opening of side 13.5 cm? Compare side lengths.

7. A cube of modeling clay has volume 64 cm^3. It is remade into a cube of volume 216 cm^3 by adding clay. How much longer is each edge?

8. A square tile has side $\frac{3}{4}$ m. Specify its exact area and recover the side with a root.

9. A toy cube has volume 0.125 m^3. Find its edge length and the area of one face.

10. A square display has area 121 cm^2. A stand requires its side length to equal the edge of a cube. Design the cube volume.

Answer Key

1. 15 m
2. 8 cm
3. 6 m.
4. 120 cm.
5. 6 or 7 cm.
6. No; its side is 14 cm.
7. 2 cm.
8. Area $\frac{9}{16}$ m^2; side $\frac{3}{4}$ m.
9. Edge 0.5 m; face area 0.25 m^2.
10. 1331 cm^3.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Test the candidate 15 by multiplying 2 identical factors: $(15) \cdot (15) = 225$. This reproduces the given radicand exactly.

2. The square-root symbol selects the nonnegative candidate. Since $15 \geq 0$ and $(15)^2 = 225$, $\sqrt{225} = 15$; no negative root is included. The garden side is 15 meters.

Problem 2

1. Test the candidate 8 by multiplying 3 identical factors: $(8) \cdot (8) \cdot (8) = 512$. This reproduces the given radicand exactly.

2. Cubing preserves the sign, so the real cube root of 512 is 8. Thus $\sqrt[3]{512} = 8$, the unique real number with the verified cube. The box edge is 8 centimeters.

Problem 3

1. Find the positive side from area: $s = \sqrt{2.25} = 1.5$ meters because $1.5^2 = 2.25$. Length cannot use the negative equation solution.

2. The perimeter is $4s = 4(1.5) = 6$ meters. This converts the given square-meter area into side length before adding the four equal sides.

Problem 4

1. Each edge has length $e = \sqrt[3]{1000} = 10$ centimeters, since $10 \cdot 10 \cdot 10 = 1000$. Volume determines a cube root, not a square root.

2. All 12 edges have that length. Their combined length is $12(10) = 120$ centimeters, with length units rather than cubic units.

Problem 5

1. Test nearby integer cubes: $5^3 = 125$, $6^3 = 216$, $7^3 = 343$, and $8^3 = 512$. Only the middle two volumes meet both strict limits.

2. Choose edge 6 or 7 centimeters. Cubes increase with positive edge length, so no smaller or larger whole-number edge can fall in the required volume interval.

Problem 6

1. The board side is $\sqrt{196} = 14$ centimeters because $14^2 = 196$. This is its positive side length, not its perimeter.

2. Compare $14 > 13.5$. The board is $14 - 13.5 = 0.5$ centimeter too wide in each aligned dimension, so it cannot fit inside that square opening.

Problem 7

1. The old edge is $\sqrt[3]{64} = 4$ centimeters, and the new edge is $\sqrt[3]{216} = 6$ centimeters, verified by $4^3 = 64$ and $6^3 = 216$.

2. The edge increase is $6 - 4 = 2$ centimeters. Subtracting the volumes would instead measure added clay, not the requested change in length.

Problem 8

1. Square the proposed side: $A = (\frac{3}{4})^2 = \frac{9}{16}$ square meter. Both numerator and denominator are squared.

2. Take the principal root to verify the design: $\sqrt{\frac{9}{16}} = \frac{3}{4}$ meter. The positive root recovers the original physical side length exactly.

Problem 9

1. Take a cube root: $e = \sqrt[3]{0.125} = 0.5$ meter because $0.5^3 = 0.125$. This gives the linear dimension of the cube.

2. One face is a square, so its area is $e^2 = (0.5)^2 = 0.25$ square meter. The volume, edge, and face area use different units.

Problem 10

1. The display side is $\sqrt{121} = 11$ centimeters, since $11^2 = 121$. Use this positive length as the edge of the proposed cube.

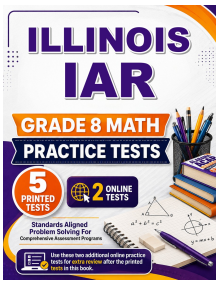
2. The cube volume is $11^3 = 11 \cdot 11 \cdot 11 = 1331$ cubic centimeters. Its cube root is 11, confirming the required equality of lengths.

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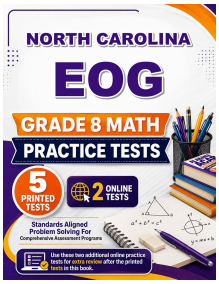
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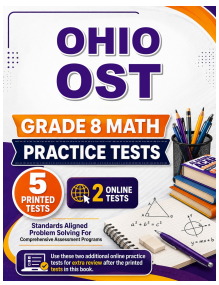
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