Grade 5 Unit 8 worksheet: Volume of a box (answer key)

ANSWERS AT A GLANCE

1. (a) $84\ \text{cm}^3$ (b) $90\ \text{ft}^3$ (c) $180\ \text{m}^3$ (d) $520\ \text{in}^3$
2. (a) 7 (b) 9 (c) 8 (d) 6
3. (a) $190\ \text{cm}^3$ (b) $1{,}800\ \text{cm}^3$ (c) $2{,}600\ \text{cm}^3$ (d) $2{,}100\ \text{cm}^3$
4. 9 inches
5. (a) He multiplied feet by inches; the 2 feet must first be changed to 24 inches. (b) 4,320 cubic inches
6. 12 inches
7. (a) Yes. (b) No. For example, a box 1 cm by 1 cm by 10 cm holds $10\ \text{cm}^3$, but a shorter box 5 cm by 5 cm by 2 cm holds $50\ \text{cm}^3$.

WORKED SOLUTIONS

1. Each box is given as length by width by height. Find its volume with $V = l \times w \times h$. Write the unit with your answer.

(a) 7 cm by 3 cm by 4 cm

(b) 9 ft by 5 ft by 2 ft

(c) 15 m by 4 m by 3 m

(d) 13 in by 8 in by 5 in

ANSWER

(a) $84\ \text{cm}^3$ (b) $90\ \text{ft}^3$ (c) $180\ \text{m}^3$ (d) $520\ \text{in}^3$

SOLUTION

Multiply length by width to get the cubes in one layer, then multiply by the height, the number of layers.

(a) 7 × 3 = 21, and 21 × 4 = 84. The volume is $84\ \text{cm}^3$.

(b) 9 × 5 = 45, and 45 × 2 = 90. The volume is $90\ \text{ft}^3$.

(c) 15 × 4 = 60, and 60 × 3 = 180. The volume is $180\ \text{m}^3$.

(d) 13 × 8 = 104, and 104 × 5 = 520. The volume is $520\ \text{in}^3$.

2. Each line multiplies the three edges of a box to get its volume. Find the number that goes in the box.

(a) 3 × 5 × ☐ = 105

(b) ☐ × 8 × 2 = 144

(c) ☐ × 9 × 6 = 432

(d) 12 × ☐ × 5 = 360

ANSWER

(a) 7 (b) 9 (c) 8 (d) 6

SOLUTION

Multiply the two edges you know. Then divide the volume by that product.

(a) 3 × 5 = 15, and 105 ÷ 15 = 7. Check: 15 × 7 = 105.

(b) 8 × 2 = 16, and 144 ÷ 16 = 9. Check: 16 × 9 = 144.

(c) 9 × 6 = 54, and 432 ÷ 54 = 8. Check: 54 × 8 = 432.

(d) 12 × 5 = 60, and 360 ÷ 60 = 6. Check: 60 × 6 = 360.

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3. Each list gives the three edges of a box in centimeters. Find each volume without a long multiplication: first multiply the two edges whose product is a round number. Show which two you chose.

(a) 2, 19, 5 (b) 5, 18, 20 (c) 40, 13, 5 (d) 15, 7, 20

ANSWER

(a) $190\ \text{cm}^3$ (b) $1{,}800\ \text{cm}^3$ (c) $2{,}600\ \text{cm}^3$ (d) $2{,}100\ \text{cm}^3$

SOLUTION

The order and grouping of the factors do not change the product, so any two edges may be multiplied first.

(a) 2 × 5 = 10, and 10 × 19 = 190. The volume is $190\ \text{cm}^3$.

(b) 5 × 20 = 100, and 100 × 18 = 1,800. The volume is $1{,}800\ \text{cm}^3$.

(c) 40 × 5 = 200, and 200 × 13 = 2,600. The volume is $2{,}600\ \text{cm}^3$.

(d) 15 × 20 = 300, and 300 × 7 = 2,100. The volume is $2{,}100\ \text{cm}^3$.

4. Ethan's window box for flowers is 12 inches long and 4 inches wide inside. When it is full, it holds 432 cubic inches of soil. How deep is the window box inside?

ANSWER

9 inches

SOLUTION

The base is 12 × 4 = 48 square inches. Each inch of depth is one layer of 48 inch cubes of soil, so the depth is the number of 48s in 432:

$$432 \div 48 = 9$$

The window box is 9 inches deep. Check: 12 × 4 × 9 = 48 × 9 = 432.

5. A bookshelf cubby is 2 feet wide, 15 inches tall and 12 inches deep inside. Jack says its volume is 2 × 15 × 12 = 360 cubic inches.

(a) What did Jack do wrong?

(b) Find the volume of the cubby in cubic inches.

ANSWER

(a) He multiplied feet by inches; the 2 feet must first be changed to 24 inches. (b) 4,320 cubic inches

SOLUTION

(a) All three edges must be in the same unit, because the same cube has to fit along all three. Jack used 2 for the width, but that is 2 feet, not 2 inches. One foot is 12 inches, so 2 feet is 24 inches.

(b) $V = 24 \times 15 \times 12$. First 24 × 15 = 360, the inch cubes in one layer. Then 360 × 12 = 3,600 + 720 = 4,320. The cubby holds 4,320 cubic inches.

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6. Mia has a gift box 8 inches long, 6 inches wide and 4 inches tall. She wants a flatter box that holds the same amount. The new box is also 8 inches long, but it is only 2 inches tall. How wide must the new box be?

ANSWER

12 inches

SOLUTION

The gift box holds 8 × 6 × 4 = 48 × 4 = 192 cubic inches.

The new box must also hold 192 cubic inches: 8 × ☐ × 2 = 192. Its length and height give 8 × 2 = 16, so the width is 192 ÷ 16 = 12 inches.

Check: 8 × 12 × 2 = 96 × 2 = 192.

7. (a) Omar says: "Two boxes have the same base area. The taller box holds more." Is he right? Explain using $V = B \times h$.

(b) Sarah says: "Of any two boxes, the taller box holds more." Is she right? Give an example to show your answer.

ANSWER

(a) Yes. (b) No. For example, a box 1 cm by 1 cm by 10 cm holds $10\ \text{cm}^3$, but a shorter box 5 cm by 5 cm by 2 cm holds $50\ \text{cm}^3$.

SOLUTION

(a) Yes. The volume is the base area times the height. When the base areas are the same, the box with the bigger height is the same number times a bigger number, so it has the bigger volume. Each extra unit of height adds one more layer of cubes on the same base.

(b) No. A taller box can have a much smaller base. A box 1 cm by 1 cm by 10 cm holds $1 \times 1 \times 10 = 10\ \text{cm}^3$. A box 5 cm by 5 cm by 2 cm is shorter, but it holds $5 \times 5 \times 2 = 50\ \text{cm}^3$. (Any example where the taller box holds less is correct.)

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