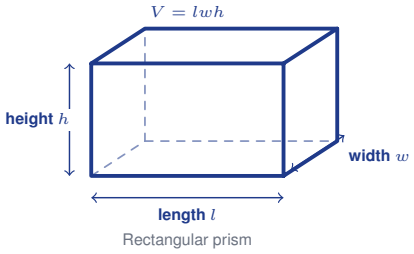
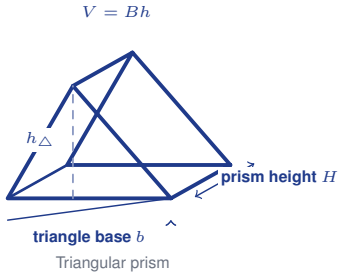
Volume of Prisms

Name: _____	Date: _____	Score: _____ / 17

Volume tells you how much space a solid takes up—or how much it can hold—and for a prism the rule is beautifully simple: find the area of the base and multiply by the height! This works no matter what shape the base is, because a prism is really just a *stack* of identical cross sections. Once you correctly identify the base, every prism volume problem follows the same satisfying pattern.



Rectangular prism



Triangular prism

Key Concepts & Quick Review

Any prism: $V = B \times h$ (B = area of one base, h = length/height of prism).

Rectangular prism: $V = l \times w \times h$. **Triangular prism:** $V = \frac{1}{2}bh_\triangle \times H$ where $h_\triangle$ = triangle height, H = prism height.

Units: if dimensions are in cm, volume is in cm^3.

Examples

① Find the volume of a rectangular prism: $l = 12\ cm$, $w = 8\ cm$, $h = 5\ cm$.

Think It Through: A rectangular prism's volume is length times width times height. Multiply the three dimensions: $12 \times 8 \times 5 = 96 \times 5 = 480$. Because volume measures space inside a solid, the units are cubic centimeters.

Answer: $480\ cm^3$

② A triangular prism has a right-triangle base with legs $6\ cm$ and $4\ cm$. The prism is $10\ cm$ long. Find the volume.

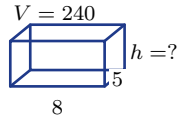
Think It Through: For any prism, volume is base area times prism length. First find the triangular base area: $B = \frac{1}{2}(6)(4) = 12\ cm^2$. Then multiply by the prism length $10\ cm$: $V = 12 \times 10 = 120\ cm^3$. Separating the work into base area first, then prism length, helps on every non-rectangular prism.

Answer: $120\ cm^3$

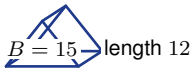
Practice Problems

Find the volume of each prism.

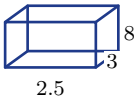
1. A rectangular prism has length 5, width 4, and height 6. Find its volume. _____
2. A rectangular prism has length 9, width 3, and height 8. Find its volume. _____
3. A cube has side length 10. Find its volume. _____
4. A rectangular prism has length 7, width 2, and height 11. Find its volume. _____
5. A triangular prism has a triangular base with base 6 and height 4. The prism length is 9. Find its volume. _____
6. A triangular prism has a right-triangle base with legs 5 and 12. The prism length is 8. Find its volume. _____
7. A triangular prism has a triangular base with base 10 and height 7. The prism length is 6. Find its volume. _____
8. A rectangular prism has length 3.5, width 4, and height 6. Find its volume. _____
9. A rectangular prism has length 15, width 6, and height 4. Find its volume. _____
10. A cube has side length 7. Find its volume. _____
11. A rectangular prism has length x, width $2x$, and height 3. If $x = 4$, find its volume. _____
12. A rectangular prism has volume 240, length 8, and width 5. Find its height. _____



13. A rectangular prism has volume 180, length 9, and height 4. Find its width. _____
14. A triangular prism has base area 15 and prism length 12. Find its volume. _____



15. A rectangular prism has length 2.5, width 3, and height 8. Find its volume. _____



Study Tips

- **Identify the base first.** The base is the cross-sectional face that stays the same throughout the prism. Then $V = B \times h$ no matter the shape.
- Volume is always in **cubic units**. If you get a flat answer (cm^2), you missed multiplying by the height.
- **Working backwards:** if $V = Bh$, then $B = V/h$ and $h = V/B$. These rearrangements appear frequently in word problems.

Word Problems

16. A fish tank is a rectangular prism $90\ cm$ long, $45\ cm$ wide, and $50\ cm$ tall. It is filled to 80% of capacity. Find the tank's total volume and the volume of water in it. If 1 liter $= 1{,}000\ cm^3$, how many liters of water does it hold?

_____

17. A Toblerone-style chocolate box is a triangular prism. The triangular cross-section is an equilateral triangle with side $4\ cm$ and height $3.46\ cm$. The box is $22\ cm$ long. Find the volume of the box. If each cm^3 of chocolate weighs $1.3\ g$, what is the total chocolate mass?

_____

Answer Keys

1) 120
2) 216
3) 1000
4) 154
5) 108
6) 240
7) 210
8) 84
9) 360
10) 343
11) 96
12) 6
13) 5
14) 180
15) 60
16) Total $202{,}500\ cm^3$; water $162{,}000\ cm^3 = 162$ liters
17) Base area $6.92\ cm^2$; volume about $152.2\ cm^3$; mass about $197.9\ g$

Step-by-Step Explanations

Strategy: For Area of Composite Figures, break the figure into familiar parts, add included areas, subtract holes or removed pieces, and trace only the outside for perimeter. Label each piece before adding or subtracting so the composite figure stays manageable.

Practice 1: Rectangle 10×8 plus rectangle 4×3 **Answer:** 92
In the first example, draw a clean boundary around each simple piece, then add only the regions that remain in the composite figure.

Practice 15: Parallelogram with base 10 and height 6 plus triangle with base 5 and height 6 **Answer:** 90
Toward the end, watch for removed pieces: subtract holes or cutouts after finding the larger surrounding area.

Word-problem notes:

16. Answer: Deck $= 20 \times 12 - 14 \times 8 = 240 - 112 = 128\ m^2$; cost $= 128 \times 18.50 = \$2{,}368$.
Picture the whole outside rectangle first: its area is $20 \times 12 = 240\ m^2$. The pool cut-out has area $14 \times 8 = 112\ m^2$. Remove the pool area from the full rectangle to get the deck area: $240 - 112 = 128\ m^2$. Then multiply by the tile cost, 128×18.50, to get a total of $\$2{,}368$.

17. Answer: $30 \times 8 + 30 \times 8 - 8 \times 8 = 240 + 240 - 64 = 416\ m^2$; cost $= 416 \times 2.40 = \$998.40$.
Add the areas of the two rectangles first: each one is $30 \times 8 = 240\ m^2$, so that gives $480\ m^2$. But the middle 8×8 square was counted twice, once in each rectangle, so subtract it once: $480 - 64 = 416\ m^2$. Finally, multiply by the seeding cost, 416×2.40, to get $\$998.40$.

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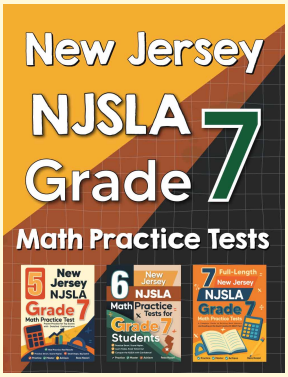

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