Volume of Cylinders, Cones, and Spheres

Models and mappings

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

Use $V = \pi r^2 h$ for a cylinder, $V = \frac{1}{3}\pi r^2 h$ for a cone, and $V = \frac{4}{3}\pi r^3$ for a sphere. Here r is radius, not diameter, and h is perpendicular height, not slant height. Equal-base, equal-height cones have one third the cylinder volume. Keep π exact until the final approximation; volume uses cubic units.

Worked example

Find the volume of a cone with radius 3 and perpendicular height 7. Give the exact volume in terms of π and an approximation to the nearest tenth.

1. The radius is $r = 3$ units; it is already a radius, so do not halve it.
2. Substitute the dimensions into the cone formula: $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(3)^2(7) = 21\pi$ cubic units.
3. The exact volume is 21π cubic units. Using calculator π gives 66.0 cubic units; round only this final result.
Answer: $21\pi \approx 66.0$ cubic units

Practice Problems

Show your thinking.

1. A cylinder has radius 2 and height 9. Find its volume. Give the exact volume in terms of π and an approximation to the nearest tenth.

2. A cone has radius 4 and perpendicular height 6. Find its volume. Give the exact volume in terms of π and an approximation to the nearest tenth.

3. A sphere has radius 3. Find its volume. Give the exact volume in terms of π and an approximation to the nearest tenth.

4. A cylinder has diameter 10 and height 4. Find its volume. Give the exact volume in terms of π and an approximation to the nearest tenth.

5. A cone has diameter 6 and perpendicular height 8. Find its volume. Give the exact volume in terms of π and an approximation to the nearest tenth.

6. A sphere has diameter 12. Find its volume. Give the exact volume in terms of π and an approximation to the nearest tenth.

7. A cylinder has radius 1.5 and height 8. Find its volume. Give the exact volume in terms of π and an approximation to the nearest tenth.

8. A cone has radius 2 and perpendicular height 5. Find its volume. Give the exact volume in terms of π and an approximation to the nearest tenth.

9. A cylinder and cone have radius 3 and height 4. Find their exact volume difference.

10. Find the exact volume of a hemisphere with radius 3.

Answer Key

1. $36\pi \approx 113.1$ cubic units
2. $32\pi \approx 100.5$ cubic units
3. $36\pi \approx 113.1$ cubic units
4. $100\pi \approx 314.2$ cubic units
5. $24\pi \approx 75.4$ cubic units
6. $288\pi \approx 904.8$ cubic units
7. $18\pi \approx 56.5$ cubic units
8. $\frac{20}{3}\pi \approx 20.9$ cubic units
9. 24π cubic units
10. 18π cubic units

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The radius is $r = 2$ units; it is already a radius, so do not halve it.
2. Substitute the dimensions into the cylinder formula: $V = \pi r^2 h = \pi(2)^2(9) = 36\pi$ cubic units.
3. The exact volume is 36π cubic units. Using calculator π gives 113.1 cubic units; round only this final result.

Problem 2

1. The radius is $r = 4$ units; it is already a radius, so do not halve it.
2. Substitute the dimensions into the cone formula: $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(4)^2(6) = 32\pi$ cubic units.
3. The exact volume is 32π cubic units. Using calculator π gives 100.5 cubic units; round only this final result.

Problem 3

1. The radius is $r = 3$ units; it is already a radius, so do not halve it.
2. Substitute the dimensions into the sphere formula: $V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(3)^3 = 36\pi$ cubic units.
3. The exact volume is 36π cubic units. Using calculator π gives 113.1 cubic units; round only this final result.

Problem 4

1. The diameter is 10 units, so $r = 10/2 = 5$ units.
2. Substitute the dimensions into the cylinder formula: $V = \pi r^2 h = \pi(5)^2(4) = 100\pi$ cubic units.
3. The exact volume is 100π cubic units. Using calculator π gives 314.2 cubic units; round only this final result.

Problem 5

1. The diameter is 6 units, so $r = 6/2 = 3$ units.
2. Substitute the dimensions into the cone formula: $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(3)^2(8) = 24\pi$ cubic units.
3. The exact volume is 24π cubic units. Using calculator π gives 75.4 cubic units; round only this final result.

Problem 6

1. The diameter is 12 units, so $r = 12/2 = 6$ units.
2. Substitute the dimensions into the sphere formula: $V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(6)^3 = 288\pi$ cubic units.
3. The exact volume is 288π cubic units. Using calculator π gives 904.8 cubic units; round only this final result.

Problem 7

1. The radius is $r = 1.5$ units; it is already a radius, so do not halve it.
2. Substitute the dimensions into the cylinder formula: $V = \pi r^2 h = \pi(1.5)^2(8) = 18\pi$ cubic units.
3. The exact volume is 18π cubic units. Using calculator π gives 56.5 cubic units; round only this final result.

Problem 8

1. The radius is $r = 2$ units; it is already a radius, so do not halve it.
2. Substitute the dimensions into the cone formula: $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(2)^2(5) = \frac{20}{3}\pi$ cubic units.
3. The exact volume is $\frac{20}{3}\pi$ cubic units. Using calculator π gives 20.9 cubic units; round only this final result.

Problem 9

1. The cylinder volume is $\pi(3)^2(4) = 36\pi$ cubic units.
2. The cone volume is $\frac{1}{3}\pi(3)^2(4) = 12\pi$, so the difference is $36\pi - 12\pi = 24\pi$.
3. The cylinder holds 24π more cubic units; the cone uses the same base and height but only one third as much volume.

Problem 10

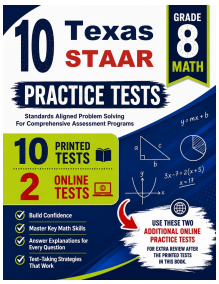
1. The corresponding full sphere has volume $\frac{4}{3}\pi(3)^3 = 36\pi$.
2. A hemisphere is half that sphere, so $V = \frac{1}{2}(36\pi) = 18\pi$ cubic units.
3. The result 18π is a volume, not the curved surface area. The hemisphere occupies exactly half of the full ball.

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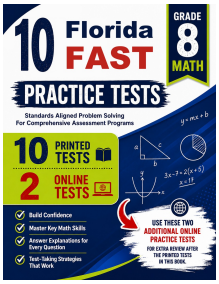
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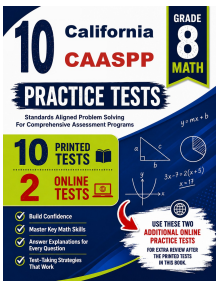
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