

# Volume of Cones and Spheres

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 24

## Q Quick Review

Two more volume formulas worth knowing by heart. A **cone** has volume  $V = \frac{1}{3}\pi r^2 h$  — one third of a cylinder with the same radius and height. A **sphere** has volume  $V = \frac{4}{3}\pi r^3$ . In both,  $r$  is the *radius*, so halve the diameter if that's what you're given, and remember to *cube* the radius for a sphere but only *square* it for a cone. Leave  $\pi$  in your answer for an exact value, or use  $\pi \approx 3.14$  when asked for a decimal. Volume is always in *cubic* units.

◇ **Example:** Find the volume of a sphere with radius 3 in. Leave your answer in terms of  $\pi$ .

⇒ The sphere volume formula is  $V = \frac{4}{3}\pi r^3$ . The radius is 3, so cube it first:  $3^3 = 27$ . Now multiply by  $\frac{4}{3} \cdot \frac{4}{3} \times 27 = \frac{108}{3} = 36$ . So the volume is  $36\pi$  cubic inches. Keeping  $\pi$  gives the exact answer.

**Answer:**  $V = 36\pi \text{ in}^3$

## PRACTICE

Find each volume. Leave answers in terms of  $\pi$  unless noted.

- |                          |       |  |       |
|--------------------------|-------|--|-------|
| 1. Cone: $r = 3, h = 9$  | _____ | 11. Sphere: $r = 6$                                | _____ |
| 2. Cone: $r = 6, h = 10$ | _____ | 12. Sphere: $r = 9$                                | _____ |
| 3. Cone: $r = 5, h = 12$ | _____ | 13. Sphere: $r = 2$                                | _____ |
| 4. Cone: $r = 2, h = 6$  | _____ | 14. Sphere: $r = 12$                               | _____ |
| 5. Cone: $r = 9, h = 4$  | _____ | 15. Sphere: $r = 1$                                | _____ |
| 6. Cone: $r = 4, h = 3$  | _____ | 16. Sphere: $d = 12$                               | _____ |
| 7. Cone: $r = 3, h = 7$  | _____ | 17. Sphere: $d = 6$                                | _____ |
| 8. Cone: $r = 10, h = 9$ | _____ | 18. Cone: $r = 5, h = 6$                           | _____ |
| 9. Cone: $d = 6, h = 10$ | _____ | 19. Cone: $r = 3, h = 10$ , use $\pi \approx 3.14$ | _____ |
| 10. Sphere: $r = 3$      | _____ | 20. Sphere: $r = 3$ , use $\pi \approx 3.14$       | _____ |

## ◆ Word Problems

21. A party hat is shaped like a cone with radius 5 cm and height 12 cm. What is its volume in terms of  $\pi$ ? \_\_\_\_\_
22. A bowling ball is a sphere with radius 6 in. Find its volume in terms of  $\pi$ . \_\_\_\_\_
23. A cone-shaped paper cup has radius 3 cm and height 10 cm. Using  $\pi \approx 3.14$ , how much water does it hold, to the nearest tenth? \_\_\_\_\_
24. A cone and a sphere both have radius 6 cm, and the cone's height is also 6 cm. Which holds more, and by how much? Leave answers in terms of  $\pi$ . \_\_\_\_\_



## Answer Keys

- |              |   |
|--------------|---|
| 1. $27\pi$   | 13. $\frac{32}{3}\pi$                               |
| 2. $120\pi$  | 14. $2304\pi$                                       |
| 3. $100\pi$  | 15. $\frac{4}{3}\pi$                                |
| 4. $8\pi$    | 16. $288\pi$  |
| 5. $108\pi$  | 17. $36\pi$   |
| 6. $16\pi$   | 18. $50\pi$   |
| 7. $21\pi$   | 19. $94.2$  |
| 8. $300\pi$  | 20. $113.04$  |
| 9. $30\pi$   | 21. $100\pi \text{ cm}^3$                           |
| 10. $36\pi$  | 22. $288\pi \text{ in}^3$                           |
| 11. $288\pi$ | 23. $94.2 \text{ cm}^3$                             |
| 12. $972\pi$ | 24. The sphere; it holds $216\pi \text{ cm}^3$ more |

### Step-by-Step Explanations

- |   |  |
|---|--|
| 1. $V = \frac{1}{3}\pi(9)(9) = 27\pi$ .               | 14. $V = \frac{4}{3}\pi(1728) = 2304\pi$ .   |
| 2. $V = \frac{1}{3}\pi(36)(10) = 120\pi$ .            | 15. $V = \frac{4}{3}\pi(1) = \frac{4}{3}\pi$ .   |
| 3. $V = \frac{1}{3}\pi(25)(12) = 100\pi$ .            | 16. Radius is 6: $V = \frac{4}{3}\pi(216) = 288\pi$ .  |
| 4. $V = \frac{1}{3}\pi(4)(6) = 8\pi$ .                | 17. Radius is 3: $V = \frac{4}{3}\pi(27) = 36\pi$ .  |
| 5. $V = \frac{1}{3}\pi(81)(4) = 108\pi$ .             | 18. $V = \frac{1}{3}\pi(25)(6) = 50\pi$ .  |
| 6. $V = \frac{1}{3}\pi(16)(3) = 16\pi$ .              | 19. $V = \frac{1}{3}(3.14)(9)(10) = 94.2$ .  |
| 7. $V = \frac{1}{3}\pi(9)(7) = 21\pi$ .               | 20. $V = \frac{4}{3}(3.14)(27) = 113.04$ .   |
| 8. $V = \frac{1}{3}\pi(100)(9) = 300\pi$ .            | 21. $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(25)(12) = \frac{1}{3}\pi(300) = 100\pi$ cubic centimeters.  |
| 9. Radius is 3: $V = \frac{1}{3}\pi(9)(10) = 30\pi$ . | 22. $V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(6^3) = \frac{4}{3}\pi(216) = 288\pi$ cubic inches.  |
| 10. $V = \frac{4}{3}\pi(27) = 36\pi$ .                | 23. $V = \frac{1}{3}\pi r^2 h \approx \frac{1}{3}(3.14)(9)(10) = \frac{1}{3}(282.6) = 94.2$ cubic centimeters.   |
| 11. $V = \frac{4}{3}\pi(216) = 288\pi$ .              | 24. Cone: $V = \frac{1}{3}\pi(36)(6) = 72\pi \text{ cm}^3$ . Sphere: $V = \frac{4}{3}\pi(216) = 288\pi \text{ cm}^3$ . The sphere holds $288\pi - 72\pi = 216\pi \text{ cm}^3$ more. |
| 12. $V = \frac{4}{3}\pi(729) = 972\pi$ .              |  |
| 13. $V = \frac{4}{3}\pi(8) = \frac{32}{3}\pi$ .       |  |



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