

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 π 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 π .
 ⇒ 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 $\frac{4}{3}$: $\frac{4}{3} \times 27 = \frac{108}{3} = 36$. So the volume is 36π cubic inches. Keeping π gives the exact answer.

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

PRACTICE

Find each volume. Leave answers in terms of π 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 π ? _____
22. A bowling ball is a sphere with radius 6 in. Find its volume in terms of π . _____
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 π . _____



Answer Keys

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