

Volume of Cylinders, Cones and Spheres: practice solutions, Grade 8 – download the PDF

Written solutions to the chapter problems. Check each step, then correct yourself.

1 A cylinder



$$V = \pi r^2 h = \pi \times 4^2 \times 10 = 160\pi \text{ cm}^3.$$

With $\pi \approx 3.14$: $160 \times 3.14 = 502.4$. The volume is about **502.4 cm³**.

2 A cone



$$V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi \times 9 \times 7 = 21\pi \text{ cm}^3.$$

$21 \times 3.14 = 65.94$. The volume is about **65.94 cm³**.

3 A sphere



$$V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi \times 27 = 36\pi \text{ in}^3.$$

$36 \times 3.14 = 113.04$. The volume is about **113.04 in³**.

4 Diameter given



The radius is half of the diameter: $r = 10 \div 2 = 5$ m.

$V = \pi \times 5^2 \times 2 = 50\pi \approx 3.14 \times 50 = 157$. The volume is about **157 m³**.

5 True or false?



a. **True.** $V = \pi r^2 h$ is proportional to h . With $2h$: $\pi r^2(2h) = 2(\pi r^2 h)$.

b. **False.** The radius is squared. With $2r$: $\pi(2r)^2 h = 4\pi r^2 h$, so the volume becomes four times larger.

6 Cone and cylinder



Cylinder: $\pi \times 6^2 \times 9 = 324\pi$ cm³.

Cone: $\frac{1}{3} \times 324\pi = 108\pi$ cm³.

$324\pi \div 108\pi = 3$. The cylinder has **3 times** the volume of the cone.

7 A soup can



$V = \pi \times 4^2 \times 11 = 176\pi$. Then $176 \times 3.14 = 552.64$.

Since **1 cm³ = 1 mL**, the can holds about **552.6 mL**.

8 Finding the height



$\pi \times 5^2 \times h = 300\pi$, so $25h = 300$ after dividing by π .

$h = 300 \div 25 = 12$. The height is **12 ft**.

9 Finding the radius of a cone



$\frac{1}{3}\pi r^2 \times 9 = 75\pi$, so $3r^2 = 75$ after simplifying.

$r^2 = 25$, so $r = 5$ cm (a radius is positive).

10 Finding the radius of a sphere



$\frac{4}{3}\pi r^3 = 972\pi$, so $r^3 = 972 \times \frac{3}{4} = 729$.

Since $9^3 = 729$, $r = 9$ cm and the diameter is 18 cm.

11 Ice cream cone



Cone: $\frac{1}{3}\pi \times 3^2 \times 10 = 30\pi$.

Hemisphere: $\frac{2}{3}\pi \times 3^3 = 18\pi$.

Total: $30\pi + 18\pi = 48\pi \text{ cm}^3 \approx 150.72 \text{ cm}^3$.

12 A water tank



$V = \pi \times 1.5^2 \times 4 = 9\pi \approx 28.26 \text{ m}^3$.

$28.26 \times 1,000 = 28,260$. The tank holds about 28,260 liters.

13 A pile of sand



The radius is 3 ft. $V = \frac{1}{3}\pi \times 3^2 \times 4 = 12\pi$.

$12 \times 3.14 = 37.68$. The pile contains about 37.7 ft³ of sand.

14 A ball

$$r = 24 \div 2 = 12 \text{ cm. } V = \frac{4}{3}\pi \times 12^3 = \frac{4}{3}\pi \times 1728 = 2304\pi.$$

$2304 \times 3.14 = 7234.56$. The volume is about **7,235 cm³**.

15 Same volume, same radius

Cylinder: $\pi \times 36 \times 5 = 180\pi$.

Cone: $\frac{1}{3}\pi \times 36 \times h = 12\pi h$. Set $12\pi h = 180\pi$, so $h = 15 \text{ cm}$.

The cone must be 3 times as tall as the cylinder, which matches the one-third rule.

16 A capsule

Cylinder: $\pi \times 2^2 \times 6 = 24\pi$.

Two hemispheres make one sphere: $\frac{4}{3}\pi \times 2^3 = \frac{32}{3}\pi$.

Total: $24\pi + \frac{32}{3}\pi = \frac{72\pi + 32\pi}{3} = \frac{104}{3}\pi \text{ cm}^3$.

$\frac{104 \times 3.14}{3} \approx 108.9$. The capsule has a volume of about **108.9 cm³**.

17 A cone removed from a cylinder

Cylinder: $\pi \times 25 \times 8 = 200\pi$. Cone: $\frac{1}{3} \times 200\pi = \frac{200}{3}\pi$.

Remaining: $200\pi - \frac{200}{3}\pi = \frac{400}{3}\pi \text{ cm}^3$.

$\frac{400 \times 3.14}{3} \approx 418.7$. About **418.7 cm³** of metal remains, which is two thirds of the cylinder.

18 A sphere in a cylinder



a. Cylinder: $\pi \times 4^2 \times 8 = 128\pi \text{ cm}^3$. Sphere: $\frac{4}{3}\pi \times 4^3 = \frac{256}{3}\pi \text{ cm}^3$.

b. $\frac{256\pi/3}{128\pi} = \frac{256}{384} = \frac{2}{3}$. The sphere fills two thirds of the cylinder.

c. Empty space: $128\pi - \frac{256}{3}\pi = \frac{128}{3}\pi \approx \frac{128 \times 3.14}{3} \approx 134.0 \text{ cm}^3$.

19 Filling a tank



$$V = \pi \times 3^2 \times 5 = 45\pi \approx 141.3 \text{ ft}^3.$$

$$\text{Time} = 141.3 \div 10 = 14.13 \text{ hours.}$$

It takes about **14.1** hours to fill the tank.

20 Melting a sphere



The volume does not change when metal is melted.

$$\text{Sphere: } \frac{4}{3}\pi \times 27 = 36\pi \text{ cm}^3.$$

$$\text{Cylinder: } \pi \times 1.5^2 \times h = 2.25\pi h. \text{ Solve } 2.25\pi h = 36\pi: h = 36 \div 2.25 = 16.$$

The cylinder is **16 cm** tall.

21 Water displacement



$$\text{The water rises by a volume equal to the sphere: } \frac{4}{3}\pi \times 27 = 36\pi \text{ cm}^3.$$

$$\text{That extra water forms a thin cylinder with radius 5 cm: } \pi \times 25 \times h = 36\pi, \text{ so } h = 36 \div 25 = 1.44.$$

The water level rises by **1.44 cm**.

22 Find the error



The student used the diameter **10** in place of the radius.

Correct radius: $r = 5 \text{ in.}$ $V = \frac{1}{3}\pi \times 5^2 \times 6 = 50\pi \text{ in}^3 \approx 157 \text{ in}^3.$

The student's answer is four times too large, because the radius is squared and $2^2 = 4$.

23 Using the slant height



a. The height, the radius, and the slant height form a right triangle: $h^2 + 5^2 = 13^2$, so $h^2 = 169 - 25 = 144$ and $h = 12 \text{ cm.}$

b. $V = \frac{1}{3}\pi \times 25 \times 12 = 100\pi \text{ cm}^3 \approx 314.0 \text{ cm}^3.$



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