

# Volumes of Cylinders, Cones, Pyramids and Spheres

Grade 10 – Geometry math · Worksheet Answer Key · Standards: G-GMD.A.1, G-GMD.A.3

Each solution names the formula, keeps  $\pi$  exact, and then rounds. If your answer differs, check whether you used the perpendicular height and whether you squared or cubed the radius correctly.

**Standards:** G-GMD.A.1, G-GMD.A.3 · **Level:** Grade 10 Geometry

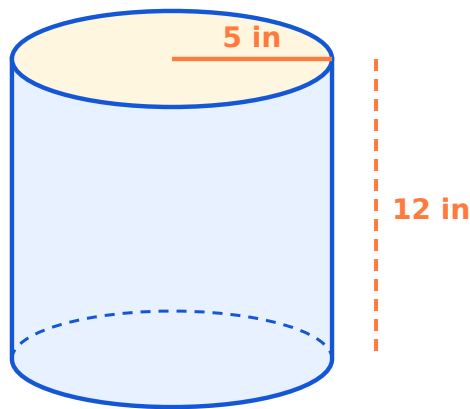
## Problem 1 Area of a Circle from Wedges

(a) The base is half the circumference:  $\frac{1}{2} \cdot 2\pi(8) = 8\pi$ . The height is the radius, 8.

(b) Area = base · height =  $8\pi \cdot 8 = 64\pi$ .

**(a) base  $8\pi$  in, height 8 in (b)  $64\pi$  in<sup>2</sup>**

## Problem 2 Volume of a Cylinder



$$V = \pi(5)^2(12).$$

$$V = \pi r^2 h = \pi(5^2)(12) = 300\pi.$$

$$300\pi \approx 942.5.$$

$$\mathbf{300\pi \text{ in}^3 \approx 942.5 \text{ in}^3}$$

### Problem 3 Cylinder from a Diameter

The radius is  $14 \div 2 = 7$ .  $V = \pi(7^2)(9) = 441\pi \approx 1385.44$ .

**$\approx 1385.4 \text{ cm}^3$**

### Problem 4 Volume of a Cone

$V = \frac{1}{3}\pi(6^2)(10) = \frac{1}{3}\pi \cdot 360 = 120\pi$ .

$120\pi \approx 376.99$ .

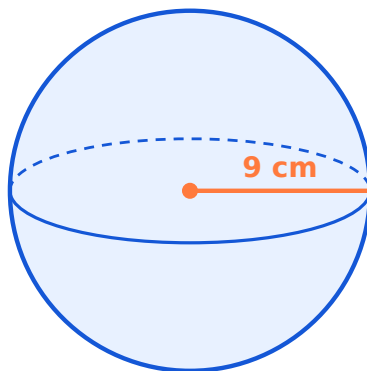
**$120\pi \text{ m}^3 \approx 377.0 \text{ m}^3$**

### Problem 5 Volume of a Square Pyramid

Base area =  $9 \cdot 9 = 81$ .  $V = \frac{1}{3} \cdot 81 \cdot 14 = 27 \cdot 14 = 378$ .

**$378 \text{ m}^3$**

### Problem 6 Volume of a Sphere



$$V = \frac{4}{3}\pi(9)^3.$$

$V = \frac{4}{3}\pi(9^3) = \frac{4}{3}\pi \cdot 729 = 972\pi$ .

$972\pi \approx 3053.63$ .

**$972\pi \text{ cm}^3 \approx 3053.6 \text{ cm}^3$**

### Problem 7 Cavalieri and an Oblique Cylinder

(a) Both have the same height, and every horizontal slice of each is a circle of radius 4, so every

pair of slices has equal area. By Cavalieri's principle the volumes are equal. The slant side does not matter.

$$(b) V = \pi(4^2)(10) = 160\pi \approx 502.7.$$

$$\mathbf{160\pi \text{ ft}^3 \approx 502.7 \text{ ft}^3}$$

### Problem 8 One Third of a Cube

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$$(a) 6^3 = 216.$$

$$(b) 216 \div 3 = 72. \text{ Formula: } \frac{1}{3} \cdot 36 \cdot 6 = 72.$$

$$\mathbf{(a) 216 \text{ in}^3 \text{ (b) } 72 \text{ in}^3}$$

### Problem 9 Height of a Cone

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$$\frac{1}{3}\pi(6^2)h = 96\pi, \text{ so } 12h = 96 \text{ and } h = 8.$$

$$\mathbf{8 \text{ in}}$$

### Problem 10 Radius of a Cylinder

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$$\pi r^2(6) = 486\pi, \text{ so } r^2 = 81 \text{ and } r = 9.$$

$$\mathbf{9 \text{ m}}$$

### Problem 11 Radius of a Sphere

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$$\frac{4}{3}\pi r^3 = 288\pi, \text{ so } r^3 = 288 \cdot \frac{3}{4} = 216 \text{ and } r = 6.$$

$$\mathbf{6 \text{ ft}}$$

### Problem 12 Hemisphere Bowl

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$$\text{Hemisphere volume} = \frac{1}{2} \cdot \frac{4}{3}\pi(10^3) = \frac{2000\pi}{3} \approx 2094.4 \text{ cm}^3.$$

$$\text{Liters: } 2094.4 \div 1,000 \approx 2.09.$$

$$\mathbf{\approx 2094.4 \text{ cm}^3 \approx 2.1 \text{ L}}$$

### Problem 13 Rectangular Pyramid

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Base area =  $8 \cdot 15 = 120$ .  $V = \frac{1}{3} \cdot 120 \cdot 11 = 40 \cdot 11 = 440$ .

**440 ft<sup>3</sup>**

#### Problem 14 Cone with a Slant Height

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The height, radius and slant height form a right triangle:  $h = \sqrt{(17^2 - 8^2)} = \sqrt{225} = 15$ .

$V = \frac{1}{3}\pi(8^2)(15) = 320\pi \approx 1005.31$ .

**$h = 15$  cm;  $V = 320\pi$  cm<sup>3</sup>  $\approx$  1005.3 cm<sup>3</sup>**

#### Problem 15 Grain Silo

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Cylinder:  $\pi(6^2)(24) = 864\pi$ . Cone:  $\frac{1}{3}\pi(6^2)(5) = 60\pi$ .

Total =  $924\pi \approx 2902.83$ .

**$924\pi$  ft<sup>3</sup>  $\approx$  2903 ft<sup>3</sup>**

#### Problem 16 Ice Cream Cone

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Cone:  $\frac{1}{3}\pi(3^2)(11) = 33\pi$ . Hemisphere:  $\frac{2}{3}\pi(3^3) = 18\pi$ .

Total =  $51\pi \approx 160.22$ .

**$51\pi$  cm<sup>3</sup>  $\approx$  160.2 cm<sup>3</sup>**

#### Problem 17 Water Tank

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Capacity =  $\pi(3^2)(4.5) = 40.5\pi \approx 127.23$  m<sup>3</sup>.

80%:  $0.8 \cdot 127.23 \approx 101.79$  m<sup>3</sup> = 101,788 L.

**$\approx$  102,000 L**

#### Problem 18 Melting a Sphere

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Sphere volume =  $\frac{4}{3}\pi(6^3) = 288\pi$ .

Cylinder:  $\pi(4^2)h = 16\pi h = 288\pi$ , so  $h = 18$ .

**18 cm**

### Problem 19 Pyramid Monument

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Monument:  $\frac{1}{3} \cdot 32^2 \cdot 21 = \frac{1}{3} \cdot 1,024 \cdot 21 = 7,168 \text{ m}^3$ .

Each dimension is divided by 8, so the volume is divided by  $8^3 = 512$ :  $7,168 \div 512 = 14$ .

**Monument 7,168 m<sup>3</sup>; model 14 m<sup>3</sup>**

### Problem 20 Sand Timer

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Cone volume =  $\frac{1}{3}\pi(3^2)(6) = 18\pi$ .

Cylinder:  $\pi(3^2)h = 9\pi h = 18\pi$ , so  $h = 2$ .

(Equal bases mean the cone fills one third of a cylinder of its own height,  $6 \div 3 = 2$ .)

**2 cm**