

**PART 3 MODULE 9**  
**PROBLEMS INVOLVING VOLUME**

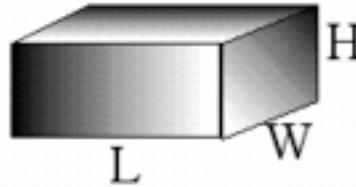
Again we will be examining a variety of “real-world” problems that can be solved by referring to familiar facts from elementary geometry. These problems will usually require that we compute the volume of one or more simple geometric figures, such as a rectangular solid, cylinder, cone, or sphere. The formulas for computing such volumes are shown below.



$$V = \pi r^2 h$$



$$V = (1/3)\pi r^2 h$$



$$V = LWH$$

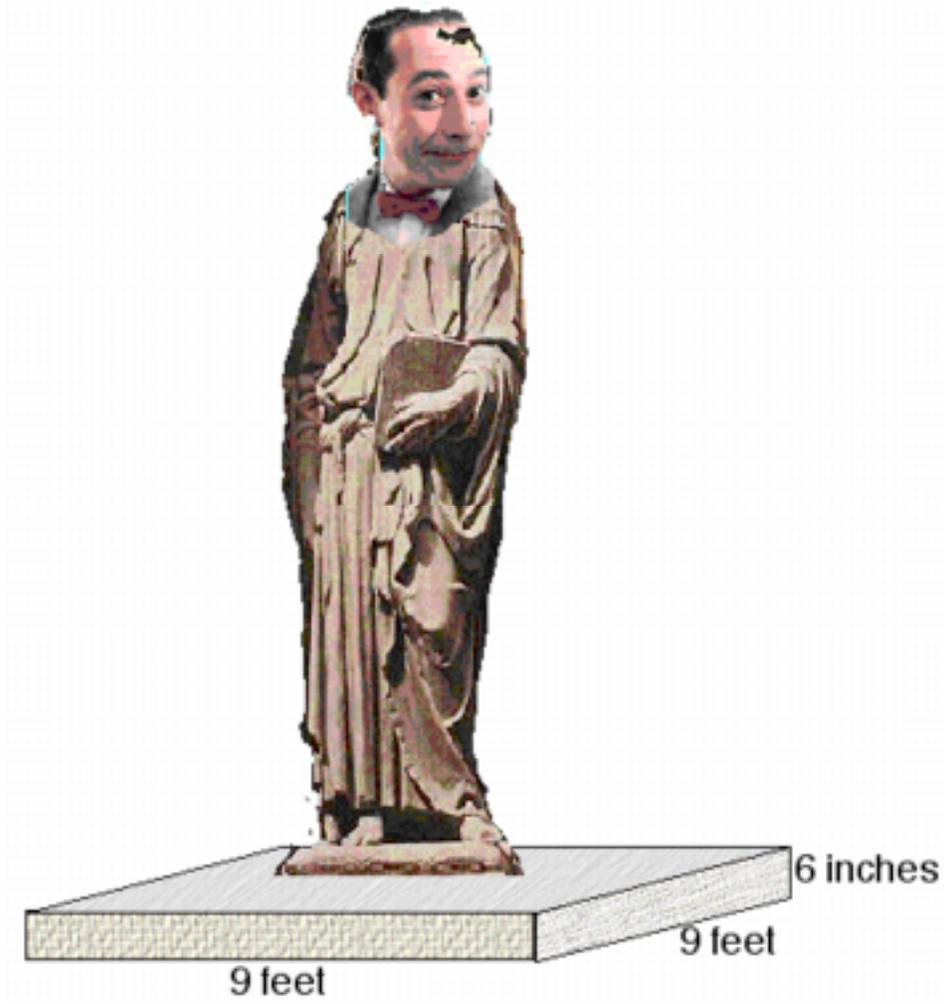


$$V = (4/3)\pi r^3$$

**EXAMPLE 3.9.1**

The pedestal on which a statue is raised is a rectangular concrete solid measuring 9 feet long, 9 feet wide and 6 inches high. How much is the cost of the concrete in the pedestal, if concrete costs \$70 per cubic yard?

- A. \$34,020      B. \$105      C. \$315      D. \$2835



**EXAMPLE 3.9.1 solution**

We need to find the volume of the pedestal, in cubic yards, and then multiply by the cost factor of \$70 per cubic yard. Recall the general formula for computing the volume of a rectangular solid:  $V = LWH$

In this case,  $L = 9$  feet,  $W = 9$  feet and  $H = 6$  inches. Since we want to compute volume in cubic yards, we should convert all three measurements to yards before using the formula for volume. To convert from feet to yards we divide by 3; to convert from inches to yards we divide by 36.

$$L = 9 \text{ feet} = (9/3) \text{ yards} = 3 \text{ yards}$$

$$W = 9 \text{ feet} = (9/3) \text{ yards} = 3 \text{ yards}$$

$$H = 6 \text{ inches} = (6/36) \text{ yards} = 1/6 \text{ yards}$$

Now we compute the volume:

$$\text{Volume} = (3 \text{ yards})(3 \text{ yards})(1/6 \text{ yards}) = 9/6 \text{ cubic yards} = 1.5 \text{ cubic yards}$$

Finally, we multiply by the cost factor:

$$\text{Cost} = (1.5 \text{ cu yd})(\$70 \text{ per cu yd}) = \$105$$

**EXAMPLE 3.9.2**

Gomer stores his iguana food in a can that is 8 inches tall and has a diameter of 6 inches. He stores his hamster food in a can that is 10 inches tall and has a diameter of 5 inches. Which can is larger?

- A. The iguana food can.
- B. The hamster food can.
- C. They are the same size.
- D. There is insufficient information to answer this question.

**EXAMPLE 3.9.3**

Gomer has a super-jumbo-sized drip coffee maker. The beverage is produced as hot water filters through a cone-shaped vessel containing coffee grounds. The cone has a height of 3 inches and diameter of one foot. Assuming that the cone is filled with water, and the water is dripping out at a rate of 10 cu. in. per minute, how long will it take for all of the water to pass through?

**EXAMPLE 3.9.4**

Gomer has been working out by lifting weights. He finds that a spherical lead-alloy weight with a radius of 3 inches weighs 20 pounds. He wishes to lift 100 pounds, so he

special-orders a spherical weight with a radius of 15 inches. Why is Gomer in intensive care?

**EXAMPLE 3.9.5**

The radius of the Earth is about 4000 miles. The radius of the Sun is about 400,000 miles. How many times bigger than the Earth is the Sun?

- A. 10            B. 100            C. 1,000            D. 1,000,000

**EXAMPLE 3.9.6**

Gomer has noticed that when a garden hose is left exposed to the summer sunshine, the water resting within the hose becomes heated. This inspires Gomer to construct a low-tech solar water heater. He reasons that if he connects a sufficient length of hose and leaves it in a sunny spot, this will provide an ample supply of hot water.

He estimates that the drum of his washing machine is a cylinder whose diameter is 17 inches and height is 10 inches. Based on that assumption, how many lineal feet of half-inch diameter water hose would be required in order to hold enough water to fill the drum of the washing machine?

**EXAMPLE 3.9.7**

Gomer delivers muffins for the Muffin-O-Matic muffin company. Each muffin is packed in its own little box. An individual muffin box has the shape of a cube, measuring 3 inches on each side. Gomer packs the individual muffin boxes into a larger box. The larger box is also in the shape of a cube, measuring 2 feet on each side. How many of the individual muffin boxes can fit into the larger box?

- A. 8            B. 16            C. 64            D. 512

**EXAMPLE 3.9.8**

To determine the number ( $N$ ) of 5-pound bags of ice required to reduce the temperature of water in a swimming pool by  $D^\circ$  Fahrenheit, use the formula  $N = 0.06125DV$ , where  $V$  is the volume of the pool (in cubic feet). Gomer has a circular pool with a diameter of 12 feet, filled to a depth of 3 feet. How many 5-pound bags of ice are required to reduce the pool's temperature from  $85^\circ$  to  $80^\circ$  Fahrenheit?

**WORLD WIDE WEB NOTE**

For more practice on problems like these, visit the companion website and try THE GEOMETRIZER.

## PRACTICE EXERCISES

1. A spherical container with a radius of 4 feet is filled with a gas that costs \$12 per cubic yard. What is the total value of the gas in the container?  
A. \$3216.99      B. \$119.15      C. \$1072.33      D. \$357.45
2. Euclid's beer mug is shaped basically like a cylinder that is 8 inches tall with a radius of 3 inches. Aristotle's beer glass is shaped basically like a cone that is 18 inches tall with a diameter of 4 inches. Which vessel holds the most beer?  
A. Euclid's      B. Aristotle's      C. they have the same capacity
3. Suppose that a rectangular aquarium that is 12 inches long, 8 inches wide and 8 inches high provides enough room to safely house 6 guppies. Assuming that the number of guppies that can be safely housed depends upon the size of the aquarium, how many guppies can be safely housed in an aquarium that is 24 inches long, 16 inches wide and 16 inches high?  
A. 8      B. 24      C. 32      D. 48
4. Plato stores his Pokeman cards in a shoe box measuring 8 inches by 14 inches by 6 inches. Socrates stores his Magic cards in a cake box measuring 1 foot by 1 foot by 5 inches. Whose container has the greater capacity?  
A. Plato's      B. Socrates'      C. they have the same capacity
5. A marble with a radius of 1 cm. has a mass of 10 grams. What would be the mass of a similar marble whose radius is 2 cm?  
A. 5 grams      B. 80 grams      C. 20 grams      D. 40 grams
6. A cone-shaped container with a height of 6 inches and radius of 2 inches is filled with a substance that is worth \$5 per cubic foot. Find the total value of the substance in the container.  
A. \$125.66      B. \$376.99      C. \$0.07      D. \$0.22
7. People living in Florida sometimes find that the water in their swimming pools becomes uncomfortably warm during the summer months. This situation can be rectified by adding ice cubes to the pool. The following authentic formula can be used to determine the approximate number (N) of 5-pound bags of ice required to reduce the temperature of a pool by D degrees Fahrenheit if the volume of the pool is V cubic feet:  $N = 0.06125DV$ . Gomer's pool is roughly rectangular in shape, with a length of 50 feet, width of 20 feet and average depth of 5 feet. How many bags of ice will be required to reduce the temperature of the pool by  $10^\circ$ ?  
A. 306      B. 3063      C. 9      D. 92

**8.** Homer's pool is circular with a diameter of 24 feet and height of 4 feet. Using the formula from the previous problem, how many bags of ice are required to reduce the temperature from  $85^{\circ}$  to  $70^{\circ}$ ?

- A. 10,857                      B. 6,650                      C. 2,714                      D. 1,663

**9.** A cylindrical can that is four inches tall and has a radius of 1.5 inches can hold 10¢ worth of soda. Assuming that the value of the contents is proportional to the size (volume) of the can, what would be the value of the soda contained in a can that is 8 inches tall with a radius of 3 inches?

- A. 40¢                      B. 90¢                      C. 20¢                      D. 80¢                      E. None of these

**10.** Concrete costs \$105 per cubic yard. Plato is making a rectangular concrete garage floor measuring 33 feet long by 15 feet wide by 6 inches thick. How much will the concrete cost?

- A. \$311850                      B. \$9.17                      C. \$962.50                      D. \$247.50

**11.** Aristotle stores his Kool-Aid in a cylindrical container with a diameter of 5.5 feet and a height of 8.25 feet. If the filled container springs a leak and the Kool-Aid is escaping at a rate of 8 cubic feet per hour, how long will it take before the container is empty?

- A. 98 hours                      B. 15 hours  
C. 24.5 hours                      D. 196 hours

**12.** Gomer is digging a hole for a rectangular swimming pool measuring 38 feet long by 22 feet wide by 8 feet deep. How much water will the swimming pool hold, assuming that 1 cubic foot = 7.5 gallons.

- A. 50160 gallons                      B. 891.73 gallons  
C. 75240 gallons                      D. 37620 gallons

**ANSWERS TO LINKED EXAMPLES**

**EXAMPLE 3.9.2** A

**EXAMPLE 3.9.3** 11.31 minutes

**EXAMPLE 3.9.4** Because he was trying to lift 2,500, but he thought he was lifting 100 pounds.

**EXAMPLE 3.9.5** D

**EXAMPLE 3.9.6** 963 feet of hose

**EXAMPLE 3.9.7** D

**EXAMPLE 3.9.8** 104 bags of ice

**ANSWERS TO PRACTICE EXERCISES**

**1. B**

**2. A**

**3. D**

**4. B**

**5. B**

**6. C**

**7. B**

**8. D**

**9. D**

**10. C**

**11. C**

**12. A**