4 Math Skills

Significant Figures

The approximate volumes of the Great Lakes are as follows: 4.5×10^{11} m^3 for Lake Erie, 1.6×10^{12} m^3 for Lake Ontario, 4.5×10^{12} m^3 for Lake Huron, 5.4×10^{12} m^3 for Lake Michigan, and 1.1×10^{13} m^3 for Lake Superior. Calculate the total volume of water in the Great Lakes, and write the answer using the correct number of significant figures.

1. List the given and unknown values.

Given: volume of Lake Erie: $V_1 = 4.5 \times 10^{11}$ m^3
volume of Lake Ontario: $V_2 = 1.6 \times 10^{12}$ m^3
volume of Lake Huron: $V_3 = 4.5 \times 10^{12}$ m^3
volume of Lake Michigan: $V_4 = 5.4 \times 10^{12}$ m^3
volume of Lake Superior: $V_5 = 1.1 \times 10^{13}$ m^3

Unknown: total volume of Great Lakes: $V = ?$ m^3

2. Write the equation for the total volume.

$$V = V_1 + V_2 + V_3 + V_4 + V_5$$

3. Insert the known values into the equation, and solve.

$$V = (4.5 \times 10^{11}\ \text{m}^3) + (1.6 \times 10^{12}\ \text{m}^3) + (4.5 \times 10^{12}\ \text{m}^3) + (5.4 \times 10^{12}\ \text{m}^3) + (1.1 \times 10^{13}\ \text{m}^3)$$

$$V = (0.045 + 0.16 + 0.45 + 0.54 + 1.1) \times 10^{13}\ \text{m}^3$$

$$V = 2.314 \times 10^{13}\ \text{m}^3$$

The answer should have only one significant figure to the right of the decimal point because the number with the smallest number of significant figures has only one number to the right of the decimal point.

$$V = 2.3 \times 10^{13}\ \text{m}^3$$

Practice

1. A roadside picnic area is located at the 1453 km marker of a highway. The next picnic area is at the 1615 km marker. Calculate the distance between the two areas, and write the answer with the correct number of significant figures.
2. Venus comes closer to Earth than any other planet: 4.02×10^7 km. By contrast, the closest the outer planet Neptune ever comes to Earth is 4.35×10^9 km. Calculate the difference between these two distances, and write the answer with the correct number of significant figures.
3. Three properties with areas of 20.34 km^2, 18.0 km^2, and 25.333 km^2 are for sale. Calculate the total area of the properties, and write the answer using the correct number of significant figures.

Sample Problem

A small airtight room is filled with CO_2 gas to conduct an experiment. The room is 2.75 m high, 1.685 m wide, and 3.25 m long. Calculate the volume of the room into which the CO_2 gas is dispersed. Write the answer with the correct number of significant figures.

1. List the given and unknown values.

Given: length, $l = 3.25$ m
width, $w = 1.685$ m
height, $h = 2.75$ m

Unknown: Volume, $V = ?$

2. Write the equation for volume.

$$\text{Volume, } V = l \times w \times h$$

3. Insert the known values into the equation, and solve.

$$V = 3.25 \text{ m} \times 1.685 \text{ m} \times 2.75 \text{ m}$$
$$V = 15.059\,6875 \text{ m}^3$$

The answer should have three significant figures because the value with the smallest number of significant figures has three significant figures.

$$V = 15.1 \text{ m}^3$$

Practice

4. A small roll of double-sided tape is 6.35 m long and 1.2×10^{-2} m wide. What is the total area that could be covered by this roll of tape?

5. Calculate the volume of a rectangular swimming pool that is 20.46 m × 12.475 m × 2.25 m. Write the answer with the correct number of significant figures.

6. The dimensions of a new store's "Grand Opening" banner are 7.62 m × 3.6576 m. Calculate the area of the rectangular banner, and write the answer with the correct number of significant figures.

7. A rectangular clear-plastic container is filled with nickels at a carnival booth. The container is 45.675 cm tall, 18.75 cm wide, and 9.325 cm long. Calculate the volume of the container, and write the answer using the correct number of significant figures.

8. A high school football team practices on a field that is 73.152 m long × 30.1752 m wide. Calculate the area of the field, and write the answer with the correct number of significant figures.

Sample Problem

A satellite orbits Earth 500 km above Earth's surface. If the satellite travels 252 km in 33 s, what is its speed? Write the answer with the correct number of significant figures.

1. List the given and unknown values.

Given: distance, $d = 252$ km

time, $t = 33$ s

Unknown: speed, $v = ?$ km/s

2. Write the equation for speed.

$$\text{speed, } v = \frac{d}{t}$$

3. Insert the values into the equation, and solve.

$$v = \frac{252 \text{ km}}{33 \text{ s}}$$

$$v = 7.636 \text{ km/s}$$

The answer should have two significant figures because the value with the smallest number of significant figures has two numbers.

$$v = 7.6 \text{ km/s}$$

Practice

9. On May 5, 1979, Dr. Hans Liebold achieved one of the highest average lap speeds on any closed-circuit racetrack. Racing in a Mercedes-Benz C111-IV experimental coupe in Nardo, Italy, Liebold lapped the 12 633.35 m high-speed track in 112.67 s. Calculate his average lap speed, and write the answer with the correct number of significant figures.

10. In 1973, Secretariat was the winning horse in the Kentucky Derby, at Churchill Downs, in Louisville, Kentucky. Secretariat ran 2011.68 m in 119.4 s. Calculate the average speed of the horse, and write the answer with the correct number of significant figures.

11. On October 3–5, 1931, Major Clyde Pangborn and Hugh Herndon navigated the first nonstop trans-Pacific flight, in the Bellanca cabin monoplane *Miss Veedol.* They flew 7 335 389.952 m, from Sabishiro Beach, Japan to Wenatchee, Washington, in 148 380 s. Calculate their average speed, and write the answer with the correct number of significant figures.

12. Seppo-Juhani Savolainen cross-country skied 415 532.6 m in 24 hours (86 400 s) in Saariselka, Finland, on April 8–9, 1988. Calculate the average speed of the skier, and write the answer with the correct number of significant figures.