2 Math Skills

Writing Scientific Notation

A single railroad engine pulled 250 freight cars on the Erie Railroad from May 1914 until 1929. The mass pulled by the engine was 15 545 000 kg. Express this value for mass in scientific notation.

1. List the given and unknown values.

> *Given:* mass = 15 545 000 kg
>
> *Unknown:* mass = $? \times 10^?$ kg

2. Write the form for scientific notation.

$$\text{mass} = ? \times 10^? \text{ kg}$$

3. Convert the known values into the form for scientific notation. Move the decimal point to the left until only one digit remains to the left of the decimal point. Count the number of places the decimal point was moved. To change 15 545 000 to 1.554 5000, the decimal point is moved seven places to the left. The number of places the decimal point is moved is the correct power of 10. The zeros at the end of the number can be dropped from the answer.

$$\text{mass} = 1.5545 \times 10^7 \text{ kg}$$

Practice

1. Scientists have estimated that the area of Earth covered by water is 70.98 percent, or 362 031 100 km^2. Express this value in scientific notation.

2. The brightest comet on record, the Great Comet of 1843, had a tail that trailed for 205 000 000 mi. Express this distance in scientific notation.

3. Mount Everest, an eastern Himalayan peak on the Tibet-Nepal border, was discovered to be the world's highest mountain in March 1856. The Survey Department of the Government of India computed its height to be 29 002 ft. Express this height in scientific notation.

4. The Great Barrier Reef, off Queensland, northeastern Australia, is actually not a single reef but consists of thousands of separate reefs. Together, they stretch for a length of 2 027 773 m. Express this distance in scientific notation.

5. The material cost of World War II has been estimated at $1.5 trillion. In May 1959, the total cost to the Soviet Union was estimated at 2 500 000 000 000 rubles. Express this monetary value in scientific notation.

6. The speed of light in outer space is about 300 000 000 m/s. Express this speed in scientific notation.

Sample Problem

The diameter of the hydrogen atom has been measured to be about 0.000 000 01 m. Express this diameter in scientific notation.

1. List the given and unknown values.

Given: diameter = 0.000 000 01 m

Unknown: diameter = $? \times 10^?$ m

2. Write the form for scientific notation.

$$\text{diameter} = ? \times 10^? \text{ m}$$

3. Convert the known values into the form for scientific notation. Move the decimal point to the right until the first nonzero digit is to the left of the decimal point. Count the number of places the decimal point was moved. To change 0.000 000 01 to 1.0, the decimal point is moved eight places to the right. The number of places the decimal point is moved is the correct power of 10.

$$\text{diameter} = 1.0 \times 10^{-8} \text{ m}$$

Practice

7. In 1981 the IBM Zurich research laboratory invented the scanning tunneling microscope (STM). It has a magnifying ability of 100 million with resolution capability down to 0.000 000 0002 m, about the diameter of a sulfur atom. Express the value 0.000 000 0002 m in scientific notation.

8. One of the smallest of all free-living organisms, *Mycoplasma laidlawii,* was first discovered in sewage in 1936. During its early existence, its diameter can be as small as only 0.000 0001 m. Express this diameter in scientific notation.

9. The mass of the smallest bacterium is about 0.000 000 000 000 002 g. Express this value in scientific notation.

10. The speed with which the shutter of a camera opens and shuts can be changed on certain models of cameras. On most 35 mm cameras, the fastest shutter speed is 0.001 s. Express this time in scientific notation.

11. Although you cannot see it, the lights in a room flicker on and off several times a second. The flickering results from the electricity changing direction rapidly, causing the lights to brighten and dim repeatedly. This cycle occurs once every 0.0166 s. Express this time interval in scientific notation.