

Study Tip

The integer b tells you how many places to move the decimal point in the number a .

Positive exponent:

Move right

$$5.1 \times 10^8 = \underbrace{510000000.}_{\text{move 8 places right}}$$

Negative exponent:

Move left

$$2.4 \times 10^{-8} = \underbrace{0.000000024}_{\text{move 8 places left}}$$

Reading Large and Small Numbers

When numbers are too large or too small to be conveniently written in standard decimal notation, most calculators switch to *scientific* or *exponential notation*.

Exponential Notation

In **exponential notation**, numbers are written as a times a power of 10,

$$a \times 10^b$$

where a is at least 1 and less than 10, and b is an integer. Here are two examples.

Standard Decimal Notation

$$6,830,000,000$$

$$0.0000000000683$$

Exponential Notation

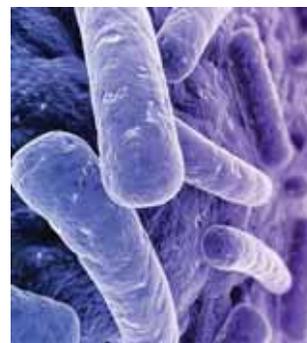
$$6.83 \times 10^9$$

$$6.83 \times 10^{-11}$$

EXAMPLE 3 Describing Large and Small Numbers

Describe the numbers in the article about bacteria.

It is estimated that 500 to 1000 species of bacteria live in the human digestive system and a roughly similar number live on the skin. Bacteria cells are much smaller than human cells (typically 3×10^{-6} meter in length), and there are at least 10 times as many bacteria as human cells in the body (approximately 10^{14} versus 10^{13}). There are approximately 5×10^{30} bacteria on Earth.

**SOLUTION**

Length of a bacteria cell:

$$3 \times 10^{-6} \text{ meter} = 0.000003 \text{ meter} \quad \text{3 millionths}$$

Number of bacteria in a human:

$$10^{14} \text{ bacteria} = 100,000,000,000,000 \text{ bacteria} \quad \text{100 trillion}$$

Number of human cells in a human:

$$10^{13} \text{ cells} = 10,000,000,000,000 \text{ cells} \quad \text{10 trillion}$$

Number of bacteria on Earth:

$$5 \times 10^{30} \text{ bacteria}$$

$$= 5,000,000,000,000,000,000,000,000,000,000 \text{ bacteria}$$

✓ Checkpoint

Help at Math.andYOU.com

The diameter of a virus is less than 3×10^{-8} meter. Write this number in standard decimal notation and describe it in words. Which is larger, a bacteria or a virus?

