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*.

Study Tip

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

Positive exponent:
Move right
$5.1 \times 10^8 = 510000000.$

Negative exponent:
Move left
$2.4 \times 10^{-8} = 0.000000024$

Exponential Notation

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

$$a \times 10^b$$

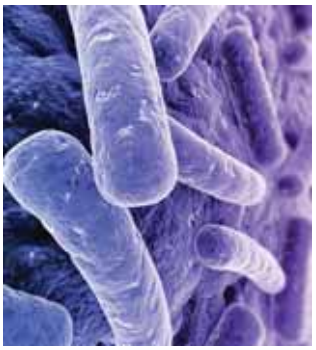
where a is at least 1 and less than 10, and b is an integer. Here are two examples.

Standard Decimal Notation	Exponential Notation
6,830,000,000	6.83×10^9
0.0000000000683	6.83×10^{-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:

3×10^{-6} meter $= 0.000003$ meter — 3 millionths

Number of bacteria in a human:

10^{14} bacteria $= 100{,}000{,}000{,}000{,}000$ bacteria — 100 trillion

Number of human cells in a human:

10^{13} cells $= 10{,}000{,}000{,}000{,}000$ cells — 10 trillion

Number of bacteria on Earth:

5×10^{30} bacteria

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

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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?