Name _____   Date_____

Estimating Quantities

Most English-speaking countries use the short-scale naming system, in which a trillion is expressed as 1,000,000,000,000. Some other countries use the long-scale naming system, in which a trillion is expressed as 1,000,000,000,000,000,000,000. Express each number as a single-digit integer times a power of ten. How many times greater is the long-scale naming system than the short-scale?

1. The Atlantic Ocean region contains approximately 2×10^{16} gallons of water. Lake Ontario has approximately 8,000,000,000 gallons of water. How many Lake Ontarios would it take to fill the Atlantic Ocean region in terms of gallons of water?

2. U.S. national forests cover approximately 300,000 square miles. Conservationists want the total square footage of forests to be $300,000^2$ square miles. When Ivanna used her phone to do the calculation, her screen showed the following:

    a. What does the answer on her screen mean? Explain how you know.

    b. Given that the U.S. has approximately 4 million square miles of land, is this a reasonable goal for conservationists? Explain. .

3. The average American is responsible for about 20,000 kilograms of carbon emission pollution each year. Express this number as a single-digit integer times a power of 10.

4. The United Kingdom is responsible for about 1×10^4 kilograms. Which country is responsible for greater carbon emission pollution each year? By how much?

Most English-speaking countries use the short-scale naming system, in which a trillion is expressed as $1,000,000,000,000$. Some other countries use the long-scale naming system, in which a trillion is expressed as $1,000,000,000,000,000,000,000$. Express each number as a single-digit integer times a power of ten. How many times greater is the long-scale naming system than the short-scale?

$1,000,000,000,000 = 10^{12}$

$1,000,000,000,000,000,000,000 = 10^{21}$

$\dfrac{10^{21}}{10^{12}} = 10^{9}$ *The long-scale is about 10^{9} times greater than the short-scale.*

Students practice estimating size of quantities and performing operations on numbers written in the form of a single-digit integer times a power of 10.

1. The Atlantic Ocean region contains approximately 2×10^{16} gallons of water. Lake Ontario has approximately $8,000,000,000,000$ gallons of water. How many Lake Ontarios would it take to fill the Atlantic Ocean region in terms of gallons of water?

$$8,000,000,000,000 = 8 \times 10^{12}$$

$$\frac{2 \times 10^{16}}{8 \times 10^{12}} = \frac{2}{8} \times \frac{10^{16}}{10^{12}}$$

$$= \frac{1}{4} \times 10^{4}$$

$$= 0.25 \times 10^{4}$$

$$= 2,500$$

   $2,500$ *Lake Ontario's would be needed to fill the Atlantic Ocean region.*

2. U.S. national forests cover approximately $300,000$ square miles. Conservationists want the total square footage of forests to be $300,000^{2}$ square miles. When Ivanna used her phone to do the calculation, her screen showed the following:

   a. What does the answer on her screen mean? Explain how you know.

   The answer means 9×10^{10}. This is because:

   $$300,000 \ ^{2} = \ 3 \times 10^{5} \ ^{2}$$
   $$= 3^{2} \times \ 10^{5} \ ^{2}$$
   $$= 9 \times 10^{10}$$

   b. Given that the U.S. has approximately 4 million square miles of land, is this a reasonable goal for conservationists? Explain.

   $4,000,000 = 4 \times 10^{6}$. It is unreasonable for conservationists to think the current square mileage of forests could increase that much because that number is greater than the number that represents the total number of square miles in the U.S, $9 \times 10^{10} > 4 \times 10^{6}$.

3. The average American is responsible for about $20,000$ kilograms of carbon emission pollution each year. Express this number as a single-digit integer times a power of 10.

$$20,000 = 2 \times 10^4$$

4. The United Kingdom is responsible for about 1×10^4 kilograms. Which country is responsible for greater carbon emission pollution each year? By how much?

$$2 \times 10^4 > 1 \times 10^4$$

America is responsible for greater carbon emission pollution each year. America produces twice the amount of the U.K. pollution.