Name _____ Date_____

Efficacy of the Scientific Notation

1. The two largest mammals on earth are the blue whale and the African elephant. An adult male blue whale weighs about 170 tonnes or long tons. (1 tonne $= 1000$ kg)

   Show that the weight of an adult blue whale is 1.7×10^5 kg.

2. An adult male African elephant weighs about 9.07×10^3 kg.

   Compute how many times heavier an adult male blue whale is than an adult male African elephant (that is, find the value of the ratio). Round your final answer to the nearest one.

1. There are approximately 7.5×10^{18} grains of sand on Earth. There are approximately 7×10^{27} atoms in an average human body. Are there more grains of sand on Earth or atoms in an average human body? How do you know?

2. About how many times more atoms are in a human body compared to grains of sand on Earth?

3. Suppose the geographic areas of California and the US are 1.637×10^5 and 3.794×10^6 sq. mi., respectively. California's population (as of 2012) is approximately 3.804×10^7 people. If population were proportional to area, what would be the U.S. population?

4. The actual population of the U.S. (as of 2012) is approximately 3.14×10^8. How does the population density of California (i.e., the number of people per sq. mi.) compare with the population density of the U.S.?

1. **The two largest mammals on earth are the blue whale and the elephant. An adult male blue whale weighs about 170 tonnes or long tons. (1 tonne $= 1000$ kg)**

   Show that the weight of an adult blue whale is 1.7×10^5kg.

   Let x (or any other symbol) represent the number of kilograms an adult blue whale weighs.

   $$170 \times 1000 = x$$
   $$1.7 \times 10^5 = x$$

2. **An adult male elephant weighs about 9.07×10^3 kg.**

   Compute how many times heavier an adult male blue whale is than an adult male elephant (that is, find the value of the ratio). Round your final answer to the nearest one.

   Let $r =$ the ratio

   $$r = \frac{1.7 \times 10^5}{9.07 \times 10^3}$$
   $$= \frac{1.7}{9.07} \times 10^2$$
   $$= 0.18743 \times 10^2$$
   $$= 18.743$$
   $$\approx 19$$

   The blue whale is 19 times heavier than the elephant.

1. **There are approximately 7.5×10^{18} grains of sand on Earth. There are approximately 7×10^{27} atoms in an average human body. Are there more grains of sand on Earth or atoms in an average human body? How do you know?**

   There are more atoms in the average human body. When comparing the order of magnitude of each number, $27 > 18$; therefore, $7 \times 10^{27} > 7.5 \times 10^{18}$.

2. **About how many times more atoms are in a human body compared to grains of sand on Earth?**

   $$\frac{7 \times 10^{27}}{7.5 \times 10^{18}} = \frac{7}{7.5} \times \frac{10^{27}}{10^{18}}$$
   $$\approx 1 \times 10^{27-18}$$
   $$\approx 1 \times 10^9$$
   $$\approx 10^9$$

   There are about $1,000,000,000$ times more atoms in the human body compared to grains of sand on Earth.

3. **Suppose the geographic areas of California and the U.S. are 1.637×10^5 and 3.794×10^6 sq. mi., respectively. California's population (as of 2012) is approximately 3.804×10^7 people. If population were proportional to area, what would be the U.S. population?**

We already know from the Exercise 5 that it would take about 23 Californias to make up one U.S. Then the population of the U.S. would be 23 times the population of California, which is

$$\begin{aligned} 23 \times 3.804 \times 10^7 &= 87.492 \times 10^7 \\ &= 8.7492 \times 10^8 \\ &= 874,920,000. \end{aligned}$$

4. **The actual population of the U.S. (as of 2012) is approximately 3.14×10^8. How does the population density of California (i.e., the number of people per sq. mi.) compare with the population density of the U.S?**

Population density of California per sq. mi.:

$$\begin{aligned} \frac{3.804 \times 10^7}{1.637 \times 10^5} &= \frac{3.804}{1.637} \times \frac{10^7}{10^5} \\ &= 2.32376\ldots \times 10^2 \\ &\approx 2.32 \times 10^2 \\ &= 232. \end{aligned}$$

Population density of the U.S. per sq. mi.:

$$\begin{aligned} \frac{3.14 \times 10^8}{3.794 \times 10^6} &= \frac{3.14}{3.794} \times \frac{10^8}{10^6} \\ &= 0.8276\ldots \times 10^2 \\ &\approx 0.83 \times 10^2 \\ &= 83. \end{aligned}$$

Population density of California compared to the population density of the U.S.:

$$\begin{aligned} \frac{232}{83} &= 2.7951\ldots \\ &\approx 2.8. \end{aligned}$$

California is about 3 times as dense as the U.S. in terms of population.