SOLUTIONS

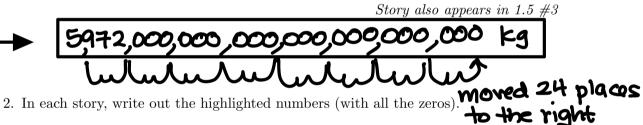## 0.8   Prelude: Scientific Notation

Practice exercises

1. In each story, write out the highlighted numbers (with all the zeros).

   (a) Melvin was looking populations based on the 2020 Census and saw the population of Saint Paul, MN listed as 3.10942×10^5 **people**. Hint: you can check the answer to this part by evaluating on your calculator.

   310,942 people

   moved 5 places to the right

   (b) The gross domestic product (GDP) measures the market value of all final goods and services produced by an economy. The United States GDP is approximately $\$2.332 \times 10^{13}$. *Story also appears in 1.5 #1*

   check: 10 zeros

   $23,320,000,000,000

   moved 13 places to the right

   (c) The Earth weighs approximately 5.972×10^{24} **kilograms**.

   Story also appears in 1.5 #3

   check: 21 zeros

   5,972,000,000,000,000,000,000,000 kg

   moved 24 places to the right

2. In each story, write out the highlighted numbers (with all the zeros).

   (a) Alpaca have very fine hairs (which can be spun into yarn to make very soft sweaters). The width of an alpaca hair is around 2.5×10^{-7} **meters**. Hint: you can check the answer to this part by evaluating on your calculator.

   check: 6 zeros

   .000 000 25 meters

   moved 7 places to the left

   (b) A dust particle weighs approximately 7.53×10^{-10} **grams**.

   Story also appears in 1.5 #2

   check: 9 zeros

   .000 000 000 753 grams

   moved 10 places to the left

   (c) A proton (part of an atom) has mass of about 1.67262×10^{-27} **kilograms**.

   Story also appears in 1.5 #7

   check: 26 zeros

   .000 000 000 000 000 000 000 000 001 672 62 kg
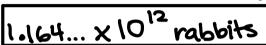
   moved 27 places to the left

3. In each story, evaluate the number and report your answer in scientific notation.

   (a) Bunnies, bunnies, everywhere. In 2007 there were 1800 and that number was predicted to increase 13% each year. I was trying to predict the number of rabbits in 2023 (after 16 years) but I accidentally typed in 166 years by mistake

   $$1800 * 1.13 \wedge 166 =$$

   Report the answer I got in scientific notation. (Yes, this is a gigantic number. The exponential model I used doesn't actually make sense for that many years.)

   Story also appears in 2.1 #2 and 5.1 #3

   If your calculator reported written out, you'll need to check these answers agree

   $$\boxed{1.164... \times 10^{12} \text{ rabbits}}$$

   (b) A signal is sent down a fiber optic cable. Its strength decreases by 2% each mile it travels. We can calculate the signal strength after 1000 miles by evaluating

   $$.98 \wedge 1000 =$$

   Report the answer you get in scientific notation. (Yes, this is a teeny number. In reality there would be signal booster installed along the route.)
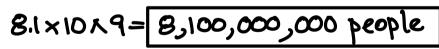
   Story also appears in 5.2 #1

   $$\boxed{1.682... \times 10^{-9}}$$

4. In each story, write out the highlighted number (with all the 0s). Note that **million** is short for $\times 10^6$, **billion** is short for $\times 10^9$, and **trillion** is short for $\times 10^{12}$.

   (a) There are approximately **1.084 million quarters** in circulation in the United States.

   Story also appears in 0.1 #4

   $$1.084 \times 10 \wedge 6 = \boxed{1,084,000 \text{ quarters}}$$

   Check 3 zeros

   (b) The population of the world is approximately **8.1 billion people**.

   Story also appears in 0.3 #1

   $$8.1 \times 10 \wedge 9 = \boxed{8,100,000,000 \text{ people}}$$

   Check 8 zeros

   (c) One way that the United States government borrow money is Treasury bonds (T-bonds). There are approximately **$24 trillion** worth of T-bonds currently.

   $$24 \times 10 \wedge 12 = \boxed{\$24,000,000,000,000}$$

   Check 12 zeros