Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_

**Scientific Notation**

**8.EE.A.3** Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as 3 times* 108 *and the population of the world as 7 times* 109*, and determine that the world population is more than 20 times larger*.

**What is scientific notation?**

**A.** It is the method of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ very \_\_\_\_\_\_\_\_\_\_\_ and very \_\_\_\_\_\_\_\_\_ numbers as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a number greater than or equal to \_\_\_\_\_\_ and less than \_\_\_\_\_\_\_, and a power of \_\_\_\_\_\_.

**B.** When the number is \_\_\_\_\_\_\_\_\_\_\_\_ than or equal to 10 use a \_\_\_\_\_\_\_\_\_\_ exponent. When the number is \_\_\_\_\_\_\_\_\_\_ 0 and 1 use a \_\_\_\_\_\_\_\_\_\_\_ exponent.

**C.** To translate between scientific notation and standard notation, move the \_\_\_\_\_\_\_\_\_\_\_\_ point the number of places indicated by the exponent in the \_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_. When the exponent is \_\_\_\_\_\_\_\_\_\_\_, move \_\_\_\_\_\_\_\_\_\_\_ point to the right. When the exponent is \_\_\_\_\_\_\_\_\_\_\_\_\_, move the \_\_\_\_\_\_\_\_\_\_ point to the left.

 Example: 4.628 x 105  = 462,800

 4.628 x 10-5 = 0.00004628

**Applying Scientific Notation:**

|  |  |
| --- | --- |
| **Standard Form** | **Scientific Notation**Q**uestion check** √Describe how to write 3,482,000,000 in scientific notation. |
| 186,000 |  |
| 240,000 |  |
|  | 6.7 x 108 |
|  | 2.2 x 106 |
| 58,927 |  |
|  | 6.38 x 103 |
| 0.000487 |  |
| 0.0000059 |  |
|  | 4.17 x 10-4 |
|  | 2.97 x 10-3 |
| 0.000004 |  |
|  | 9.9 x 10-5**1** |

|  |
| --- |
| Find the missing exponent:Q**uestion check** √When you write a number that is less than 1 in scientific notation, how does the power of 10 differ from when you write a number greater than 1? |
| 2.345 x 10 = 2345 | 0.0783 = 7.83 x 10  |
| 2.33 x 10 = 0.00000233 | 54,000 = 5.4 x 10 |

***Draw Conclusion****:*

Which measurement would least likely to be written in scientific notation: number of grains of sand on a beach, diameter of a typical human hair, population of a country, speed of a car, or size of an atom?

***Analyze Relationships:***

a. Compare the two numbers to find which is greater. Explain how you can compare them without writing them in standard notation first.

4.5 x 106 2.1 x 108

b. Write the following diameters from least to greatest.

1.5 x 10-2 m, 1.2 x 102 m, 5.85 x 10-3 m, 2.3 x 10-2 m, 9.6 x 10-1 m

***Critique Reasoning:***

Sam’s friend Wilson had the following homework problem:

 Express 5.6 x 10-7 in standard form

Wilson wrote 56,000,000. How can Sam explain Wilson’s error and how to correct it?

**2**

**Estimating Operations with Scientific Notation**

**Example A:**

The Federal Reserve states that the average household in January of 2013 had $7,122 in credit card debt. The U.S. national debt is $16,755,133,009,522. **About** how many times greater is the U.S. national debt than an average U.S. household?

**Example B:**

There are about 3,000,000 students attending school, kindergarten through 12th grade, in New York. Express the number of students as a single-digit integer times a power of 10.

The average number of students attending a middle school in New York is 8 ×102. How many times greater is the overall number of K-12 students compared to the number of middle school students?

**Example C:**

A conservative estimate of the number of stars in the universe is 6 x 1022. The average human can see about 3,000 stars at night with his naked eye. About how many times more stars are there in the universe, compared to the stars a human can actually see?

**Example D:**

The estimated world population in 2011 was 7 x 109. Of the total population, 682 million of those people were left-handed. Approximately what percentage of the world population is left-handed according to the 2011 estimation?

**Example E:**

The average person takes about 30,000 breaths per day. Express this number as a single-digit integer times a power of 10.

If the average American lives about 80 years (or about 30,000 days), how many total breaths will a person take in her lifetime?

**3**

**Operations with Scientific Notation**

**8.EE.A.4** Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

***Adding and Subtracting with Scientific Notation***

Method 1:

**4**

 Step 1 First, write each number with the same \_\_\_\_\_\_ of \_\_\_\_

 Step 2 Add or subtract the \_\_\_\_\_\_\_\_\_\_ for each number

 Step 3 Write the final answer in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Method 2:

 Step 1 First, write each number in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Step 2 Find the sum or difference of the numbers in standard notation

 Step 3 Write the answer in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Example:

The table below shows the population of the three largest countries in North America in 2011. Find the total population of these countries.

|  |  |  |  |
| --- | --- | --- | --- |
| Country | United States | Canada | Mexico |
| Population | 3.1 x 108 | 3.38 x 107 | 1.1 x 108 |

Method 1

Step 1: United States 3.1 x 108

Step 2: Add the multipliers 3.100

 0.338

 1.100

 Canada 0.338 x 108

 Mexico 1.1 x 108

Step 3: Write the final answer in scientific notation: \_\_\_\_\_\_\_\_\_\_\_ x 108

Method 2:

Step 2: Find the sum of the numbers in standard notation.

 310,000,000

 33,800,000

+ 110,000,000

Step 1: United States: 310,000,000

 Canada: 33,800,000

 Mexico: 110,000,000

Step 3: Write the answer in scientific notation: \_\_\_\_\_\_\_\_\_\_ x 108

Add or Subtract. Write your answer in scientific notation.

|  |  |
| --- | --- |
| Method 1 | Method 2 |
| A. 4.2 x 106 + 2.25 x 105 + 2.8 x 106 | B. 1.25 x 103 + 0.50 x 102 + 2.8 x 103 |
| C. 8.5 x 103 – 5.3 x 103 – 1.0 x 102 | D. 6.2 x 105 - 2.6 x 104 + 1.9 x 102 |

 ***Multiplying and Dividing with Scientific Notation***

When **multiplying** in Scientific Notation you must use the \_\_\_\_\_\_\_\_\_\_\_ property to move the numbers around and use the \_\_\_\_\_\_\_\_\_\_\_ property to regroup the numbers. You want to get your \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ together and your \_\_\_\_\_\_\_\_ together.

Example: (1.8 x 109) (6.7 x 1012) = (1.8 • 6.7) (109 • 1012)

Do the math: (1.8 • 6.7) (109 + 12) = x 10

*Your turn:*

(5 x 1012) (3.38 x 106) = ( x ) ( x ) =

When **dividing** in Scientific Notation, like multiplying you want to get your \_\_\_\_\_\_\_\_ together and your \_\_\_\_\_\_\_\_\_\_\_ together.

Example:

$\frac{3.46 x 10^{17}}{2 x 10^{9}}$ = $\frac{3.46}{2}$ • $\frac{10^{17}}{10^{9}}$ = \_\_\_\_\_\_ x 10 Do the math:

**5**

*Your turn:*

$\frac{8.4 x 10^{21}}{4.2 x 10^{14}}$ =

Practice:

A. When the Sun makes an orbit around the center of the Milky Way, it travels 2.025 x 1014 km. The orbit takes 225 million years. At want rate does the Sun travel? Write your answer in scientific notation.

B. Light travels at a speed of 1.86 x 105 miles per second. It takes light from the Sun about 4.8 x 103 seconds to reach Saturn. Find the approximate distance form the Sun to Saturn. Write your answer in scientific notation.

C. An adult blue whale can eat 4.0 x 107 krill in a day. At that rate, how many krill can an adult blue what eat in 3.65 x 102 days?

D. Jala takes 2.4 x 104 steps during a long distance run. Each step covers an average of 810 mm. What total distance (in mm) did Jala cover during her run? Write your answer in scientific notation.

E. Here are the masses of the so-called inner planets of the Solar System.

|  |  |  |  |
| --- | --- | --- | --- |
| Mercury | Earth | Venus | Mars |
| 3.3022 x 1023 kg | 5.9722 x 1024 kg | 4.8685 x 1024 kg | 6.4185 x 1023 kg |

What is the average mass of all four inner planets? Write your answer in scientific notation?

**6**