Orders of Magnitude and Powers of 10

When you multiply something by ten, the result is one **order of magnitude** bigger. If you multiply by 100, the result is two orders of magnitude bigger, and so on. Remember these rules:

• Multiplying by 10 moves the decimal point of a number to the right by one place so that the result is one order of magnitude bigger.

Example: $10 \times 57.6 = 576$ and $45. \times 10 = 450$.

• Dividing by 10 moves the decimal point so that the result is one order of magnitude smaller.

Example:
$$\frac{130.}{10} = 13$$
. and $\frac{0.751}{10} = 0.0751$

• Powers just mean repeated multiplication. Handle powers of 10 in scientific notation by moving the decimal place to adjust to the appropriate number of orders of magnitude.

Example: $3.04 \times 10^6 = 3,040,000$ and $89 \times 10^{-3} = 0.089$

• Make sure you know these important magnitudes:

hundred = 10^2 thousand = 10^3 million = 10^6 billion = 10^9 .

Questions

1. An average elephant weighs about 3 thousand kilograms. An average mouse weighs about 2.0×10^{-2} kg. Approximately how many orders of magnitude larger is an elephant than a mouse?

2. The annual GDP (gross domestic product) of the United States is roughly \$16.8 trillion. The GDP of North Korea is estimated to be about \$15 billion. Roughly how many orders of magnitude larger is the US economy than the North Korean?

3. Approximately how many orders of magnitude is 9999 larger than 11?

Scientific notation is a convenient way to express numbers spread out over several orders of magnitude. Just write the number with the decimal place after the first (left-most) nonzero digit, multiplied by the appropriate power of 10.

Example: $6,700 = 6.7 \times 10^3$ and $0.04 = 4 \times 10^{-2}$

- 4. Convert the following numbers into scientific notation.
 - (a) The annual GDP of the United States: \$16.8 trillion
 - (b) $(2 \times 10^2)^3$
 - (c) 6% of 2 billion
 - (d) $(3 \times 10^{-4})(2 \times 10^7)$
- 5. The small figure to the left contains one hundred, or 10^2 , dots. Estimate the number of dots in the large figure as a power of 10.

