Name _____ Earth Science

Introduction to Measurement

A: Scientific Notation

Do you know this number 300,000,000 m/sec.? *It's the Speed of light!*

Do you recognize this number 0.000 000 000 753 kg.? It's the mass of a dust particle!

Scientific Notation (aka Exponential Notation) is a way for scientist to write very large and very small numbers easily and accurately. Very large numbers may have many zeroes (The Earth is 4,600,000,000 years old) and the same is true for very small numbers (The wavelength of a gamma ray is .00001 cm). It would be very easy for a zero to bemistakenly omitted when recording these numbers, so this method of writing numbers is designed to minimize this risk.

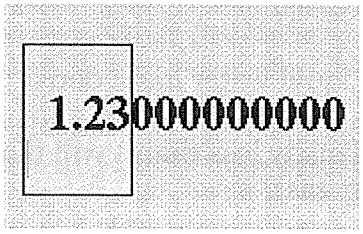
The number 123,000,000,000 in scientific notation is written as :

$$1.23 \times 10^{11}$$

The first number 1.23 is called the ***coefficient***. It must be greater than or equal to 1 and less than 10. The second number is called the ***base***. It must always be 10 in scientific notation. The base number 10 is always written in exponent form. In the number 1.23×10^{11} the number 11 is referred to as the exponent or power of ten, which simply means that you move the decimal this many times (11 for this example). The exponent can be positive or negative. **Negative exponents** would mean it is a very small number.

To write a number in scientific notation:

1st Put the decimal after the first digit and drop the zeroes.
In the number 123,000,000,000 the coefficient will be 1.23



2nd Find the exponent by counting the number of places from the decimal to the end of the number. In 123,000,000,000 there are 11 places. Therefore we write 123,000,000,000 as:

$$1.23 \times 10^{11}$$

Negative exponents are for writing very small numbers but the process is the same.
How do you write the mass of a dust particle in scientific notation?

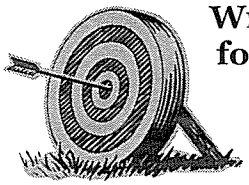
Examples:

a) $.00004522 = 4.522 \times 10^{-5}$ (the exponent is a negative five b/c we moved the decimal to the right 5 places)
b) $34{,}000 = 3.4 \times 10^{4}$
c) $.0023 = 2.3 \times 10^{-3}$
d) $6.99 \times 10^{-4} = .000699$

TRY THESE!

1) 1,521 = _____
2) 233.3 = _____
3) .003 = _____
4) .0000288 = _____
5) 12,000,000 = _____
6) 3.8×10^{6} = _____
7) 3.4×10^{-2} = _____
8) 9.7×10^{7} = _____
9) 9.7×10^{-7} = _____

In the upper left corner of the front cover of your ESRT, find the Half Life chart. **Write the half life value of Rubidium and Potassium in "standard format".**



Section B: Density

Where do you see density "at work" in nature or in our everyday experiences?

Density is defined as the quantity of material (mass) contained in a certain amount of space (volume). Density is a physical property of matter, which means it does not change for a substance, unless the sample changes phases or is exposed to temperature and/or pressure. A small piece of lead has the same density as any other sample of lead regardless of its size.

Liquid water has a density of 1.0 g/ cm^3, which is on the front cover of the ESRT. A sample which has a density greater than 1 will sink and any material that has a density less than 1 will float. This is true for all matter of all phases (solid, liquid or gas).

Formula for calculating density: $\text{density} = \frac{\text{mass}}{\text{volume}}$

Examples:

1) Calculate Density
mass = 30 g
volume = 20 cm^3

2) Calculate Density
mass = 200 g
volume = 160 cm^3

3) Calculate Density
mass = 3.5 g
volume = 4.25 cm^3

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4) Calculate Density
mass = 56 g
volume = 42 cm^3

In addition to calculating density, this formula can be used to calculate volume and mass of a sample. In short, if given any two of the three variables, the unknown can be computed. First, write the formula and then substitute the given information into the equation. Second, solve for the unknown, which is commonly called "X".

Example: Calculate mass
Density = 2.5 g/cm^3
volume = 10 cm^3

Example: Calculate volume
mass = 10 g
Density = 4 g/cm^3
4) Calculate mass
Density = 5.4 g/cm^3
volume = 22.5 cm^3

5) Calculate mass
Density = 1.8 g/cm^3
volume = 225.4 cm^3

6) Calculate mass
Density = 3.5 g/cm^3
volume = 235 cm^3

7) Calculate volume
mass = 160 g
Density = 2.8 g/cm^3

8) Calculate volume
mass = 1,575 g
Density = 3.8 g/cm^3

9) Calculate volume
mass = 2.9 g
Density = 1.8 g/cm^3

10) A boulder of granite has a density equal to 5.5 g/cm^3. What is the density of a piece that breaks off of the same boulder? (remember: density is a Physical Property)

Section C: Relationships

A relationship describes how two variables "interact" with each other. In this sense, interact describes how one thing changes another thing.

Basic Types of Relationships:

1. A **direct relationship** is where both variables increase or both decrease.

2. An **indirect or inverse relationship** is where the variables "do" the opposite of each other. One increases and the other decreases.

3. A **cyclic relationship** is where the values repeat themselves in a predictable period of time.

4. **No relationship** is when a variable does not cause a change in another variable.

List examples of each type of relationship.