Measurement Vocab

Measurement: a quantity that has both a number and a unit

Measuring: a description of your observation

Qualitative: description in words

Quantitative: assigns a number to an observation made with an instrument

Accuracy: a measure of how close a measurement comes to the actual or true value of whatever is measured

Precision: a measure of how close a series of measurements are to one another

length= straight-line distance between two points (measured in meters)

volume= the amount of space taken up by an object (measured in liters or cm^3)

mass= the quantity of matter in an object (measured in grams)

Density = the ratio of an object's mass to its volume

Conversion factors – used to help solve problems(action line)

-Used to convert from one unit to another

-A ratio (fraction) of two measurements that equal each other

-The fraction can be flipped if necessary

Class Notes: Conversions

Dimensional analysis: powerful problem solving technique, used to solve for the units of an unknown (forget the numbers, solve for units)

Uses conversion factors in order to multiply known units to change them into units of the unknown: **An Action Line!**

**Do not use conversion factors to determine significant figures

**small number goes with the larger unit, large number goes with the smaller unit

Ex: 1 m = 100 cm

100 cm/m = 100 cm/1 m = 1m/100cm

5 steps for dimensional analysis

1. Identify unknown unit (the answer unit)
2. Identify what's known and the equivalents and conversion factors
3. Plan: known unit → unknown unit
4. Set up an action line so that all known units cancel and the unknown unit is left on top; do the math
5. Check: scientific notation, sig figs, units, reasonableness (smaller or larger?)

Class Notes: Scientific Notation

Scientific Notation: (also known as exponential notation): a way to write a very large or very small number in a more manageable form

-a given number is written as the product of two numbers…

-**Coefficient** (number always equal to or greater than 1, and less than 10) … 1.2×10^3

-**Exponent** (10 raised to a power) …1.2×10^3

**Power = number of spaces the decimal moves

**Move decimal to the left = more positive exponent, Ex. $370{,}000 = 3.7 \times 10^5$

**Move decimal to the right = more negative exponent, Ex. $0.00054 = 5.4 \times 10^{-4}$

Class Notes: Significant Figures

Significant Figures (Sig Figs): all the digits in a number that are known, plus a last digit that is estimated

Ex. 0.534 (the 4 is estimated)

*cannot claim accuracy that was greater than what was achieved

-measurements must always be reported to the correct number of sig figs because calculated answers often depend on the number of sig figs in the values used in the calculation

Rules:

1.Non zeros count

(Ex. 24.7 , 0.743 , 714 - all have 3 sig figs)

2. Zeros in front never count as SF (but must be calculated)

(Ex. 0.0071 , 0.000099 - both have 2 sig figs)

3. Zeros in middle always count

(Ex. 7003 , 1.503 , 40.79 – all have 4 sig figs)

4. Zeros at end: Count with decimal point

(Ex. 43.00 , 1.010 - both have 4 sig figs)

5. Zeros at end: Do not count without decimal point

(Ex. 300 - 1 sig fig, 27210 - 4 sig figs)

6. All numbers in the coefficient of a number written in scientific notation are significant

(Ex. $1.030 \times 10^3 = 1030$ - has 4 sig figs)

*Measurements that have unlimited (undefined) number of sig figs:

-Conversions

-Counted items (defined #s)

Class Notes: Sig Figs in Calculations

Sig Figs in Calculations: cannot be more accurate than least accurate data point

*Answers should be rounded off

Choose the last number you want to keep:

-if next digit is 0 – 4, drop remaining numbers

-if next digit is 5 – 9, round up

Addition/Subtraction: round off to the left most estimated place in the data

*(use decimal place)

Ex. 1.1 + 1.11 = 2.2

Ex. 100.1 + 1.11 = 101.2 (1.012×10^2)

Multiply/Divide: Answer cannot have more Sig Figs than least number of Sig Figs in any data

-Decimal places are irrelevant

Ex. $2 \times 1111 = 2000$ (2×10^3)

Ex. $1.0 \times 1234 = 1200$ (1.2×10^3)

Defined quantities (values) and temperature measurements

-**not** used to determine the number of Sig Figs

Class Notes: Density, Temperature, Percent Error, and Solving Problems with Formulas

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{m}{v} = \frac{g}{cm^3} = \frac{g}{mL}$$

Density: A physical property used to compare substances

$$D_{H2O} = 1.00\ \frac{g}{cm^3} = 1.00\ \frac{g}{mL}$$

Less dense substances float, more dense substances sink

Temperature: the degree of hotness or coldness relative to water

-A measure of the KE of particles

Heat: a form of energy; can be transferred between objects

*differences in temperature indicate the direction of heat transfer

Measuring Temperature – 2 scales

1. Celsius (°C)

2. Kelvin (K, no degree °)

-Based on absolute zero (motion of particles ceases)

-water freezes at 273K and boils at 373K

$K = \ ^\circ C + 273$

$K - 273 = ^\circ C$

Percent Error

Accuracy: nearness to the true (accepted) Value

Experimental value: the one you measured

$$\text{Error} = \left| \frac{\text{accepted value} - \text{experimental value}}{\text{Accepted Value}} \right| \times 100$$

5 Steps to foolproof problem solving with formulas

1. Write the formula
2. List the variables
3. Rearrange the formula to solve for the unknown
4. Plug and chug (plug in numbers, chug out the answers)
5. Check (estimate answer, SF, sci. not., unit, box around answer)