Mr. Dehne AMSAT Chem 1H

Name: _____

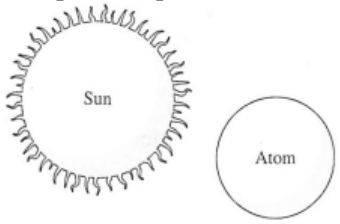
Date: _____

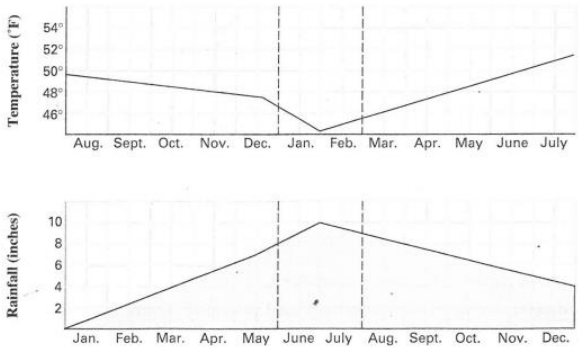
Per#:___

MeasCalc Topic #2

WS#1: Scientific Method

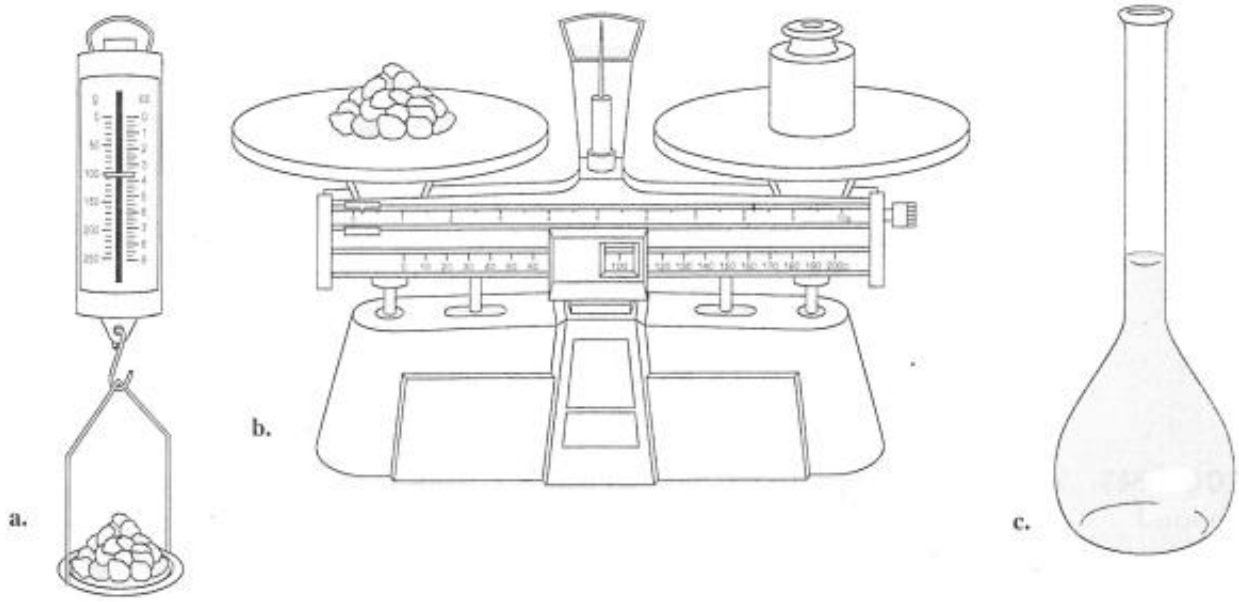
1. Determine whether each of the following is an example of an *observation and data*, a *theory*, a *hypothesis*, a *control*, or a *model*.
   a. A research team records the rainfall in inches per day in a prescribed area of the rain forest. The square footage of vegetation and relative plant density per square foot are also measured.
   b. The intensity, duration, and time of day of the precipitation are noted for each precipitation episode.
   c. The information gathered is compared with the data on the average precipitation and the plant population collected over the last 10 years.
   d. The information gathered by the research team indicates that rainfall has decreased significantly. They propose that deforestation is the primary cause of this phenomenon.
2. "When 10.0g of a white, crystalline sugar are dissolved in 100.mL of water, the solution is observed to freeze at -0.54ºC, not 0.0ºC. The system is denser than pure water." Which parts of these statements represent quantitative information, and which parts represent qualitative information?
3. Compare and contrast a model with a theory.
4. Evaluate the models shown to the right. Describe how the models resemble the objects they represent and how they differ from the objects they represent.
5. How many different variables are represented in the two graphs shown?





WS#2: Units of Measurement

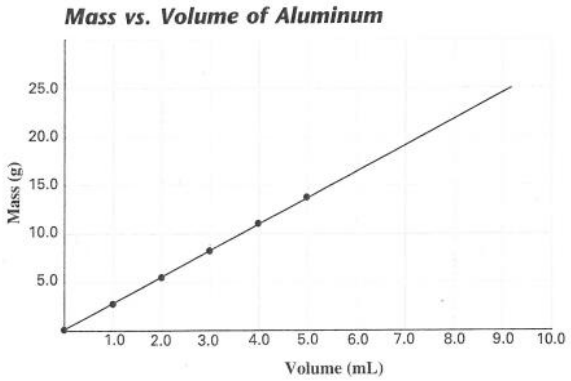
1. Compete the following conversions:
   a. 100mL = __L b. 0.25g = __cg c. $400cm^3$ = __L d. $400cm^3$ = __m^3
2. For each of the devices shown, identify the quantity measured and tell when it would remain constant and when it would vary.



3. Use the data found in the table to answer the following questions:
   a. If ice were denser than liquid water at 0°C, would it float or sink?
   b. Water and kerosene do not dissolve readily in one another. If the two are mixed, they quickly separate into layers. Which liquid floats on top?
   c. The other liquids in the table that do not dissolve in water are gasoline, turpentine, and mercury. Which of these liquids would settle to the bottom when mixed with water?

Solids	Density (g/cm^3)	Liquids	Density (g/mL)
cork	0.24	gasoline	0.67
butter	0.86	ethyl alcohol	0.791
ice	0.92	kerosene	0.82
sucrose	1.59	turpentine	0.87
bone	1.85	water	0.998
diamond	3.26	sea water	1.025
copper	8.92	milk	1.031
lead	11.35	mercury	13.6

4. Use the graph of the density of aluminum to determine the approximate mass of aluminum samples with the following volumes.
   a. 8.0mL
   b. 1.50mL
   c. 7.25mL
   d. 3.50mL

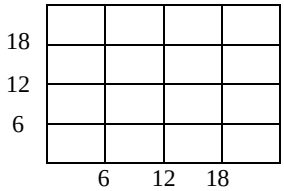


5. Aluminum has a density of $2.70 g/cm^3$. What would be the mass of a sample whose volume is $10.0 cm^3$? (Ans: 27.0g)
6. A certain piece of copper wire is determined to have a mass of 2.00g per meter. How many centimeters of wire would be needed to provide 0.28g of copper? (Ans: 14cm)

WS#3: Using Scientific Measurements

1. Report the number of significant figures in each of the following values
   a. 0.002 37g
   b. 0.002 037g
   c. 350.J
   d. 64mL
   e. $1.3 \times 10^2 cm$
   f. $1.30 \times 10^2 cm$
2. Write the value of the following operations using scientific notation.
   a. $\frac{10^3 \times 10^{-6}}{10^{-2}}$
   b. $\frac{8 \times 10^3}{2 \times 10^5}$
   c. $3 \times 10^3 + 4.0 \times 10^4$
3. The following data are given for two variables, A and B:

A	B
18	2
9	4
6	6
3	12



   a. In the graph, plot the data.
   b. Are A and B directly or inversely proportional?
   c. Do the data points from a straight line?
   d. Which equation best fits the relationship shown by the data? A/B = *k* (a constant) or A x B = *k* (a constant).
   e. What is the value of *K*?
4. Carry out the following calculations. Express each answer to the correct significant figures and use the proper units.
   a. 37.26m + 2.7m + 0.0015m
   b. $\frac{300.kPa \times 274.57mL}{547kPa}$
   c. 256.3mL + 2L + 137mL =
   d. $\frac{346mL \times 200K}{546.4K}$

5. Round the following measurements to three significant figures.
   a. 22.77g b. 14.62m c. 9.3052L d. 87.55cm e. 30.25g
6. A pure solid at a fixed temperature has a constant density. We know that d = m/V.
   a. Are mass and volume directly proportional or inversely proportional for a fixed density?
   b. If a solid has a density of 4.0g/cm^3, what volume of the solid has a mass of 24g?
7. A crime scene tape has a width of 13.8cm. A long strip of it is torn off and measured to be 56m long.
   a. Convert 56m into centimeters.
   b. What is the area of this rectangular strip of tape, in cm^2?

WS#4: Problem Solving WS

Part A – Density **Density = mass ÷ volume (d = m/V)**.

Note: Volume unit for solids, liquids, and gases differ slightly; liquids are **mL**, solids are **cm^3**, and gases are **L**.

So, d_{sol} = g/cm^3; d_{liq} = g/mL; d_{gas} = g/L

1. A block of aluminum occupies a volume of 15.0cm^3 and has a mass of 40.5g. What is its density? (Ans: 2.70g/cm^3)
2. What is the mass of ethyl alcohol that fills a 200.0mL container? The density of ethyl alcohol is 0.789g/mL. (Ans: 158g)
3. The helium gas stored inside a large weather balloon has a mass of 13.558g. What is the volume of the balloon if the density of helium is 0.1786g/L? (Ans: 75.91L)
4. A flask with a mass of 345.8g is filled with 225mL of carbon tetrachloride. The mass of the flask and carbon tetrachloride is found to be 703.55. From this information, calculate the density of carbon tetrachloride. (Ans: 1.59g/mL)
5. A rubber balloon with a mass of 144.85g is filled with carbon dioxide gas and re-massed. The mass of the balloon plus gas is 153.77g. The volume of the balloon filled with carbon dioxide is 4.55L. What is the resulting density for the carbon dioxide? (Ans: 1.96g/L)
6. A block of lead has the dimensions of 4.5cm by 5.2cm by 6.0cm. The block has a mass of 1587g. Calculate the density of lead. (Ans: 11g/cm^3)
7. 28.5g of iron shot is added to a graduated cylinder containing 45.5mL of water. The water level rises to the 49.1mL mark. Calculate the density of iron. (Ans: 7.9g/mL)
8. A cylindrical glass tube of length 27.75cm and a radius 2.00cm is filled with argon gas. The empty tube has a mass of 188.25g and the tube filled with argon gas has a mass of 188.87g. Use the data to calculate the density of argon gas. (Ans: 1.8g/L)
9. What volume of silver metal will have a mass of exactly 2500.0g? The density of silver is 10.5g/cm^3. (Ans: 238cm^3)
10. What is the mass of 215L of hydrogen sulfide gas if the density of hydrogen sulfide is 1.54g/L? (Ans: 331g)

Part B – Dimensional Analysis

1. Convert the following measurements
   a. 5.2cm of magnesium ribbon in millimeters. (Ans: 52mm)
   b. 0.0025g of vitamin A in micrograms. (Ans: 2500μg)
   c. 0.020kg of tin in milligrams. (Ans: 20,000mg)
   d. 452.9ns into milliseconds. (Ans:0.0004529ms)
   e. 87.2μm into nanometers (Ans: 87,200nm)
   f. 1.009mm into decimeters (Ans: 0.01009dm)
   g. 6900cg into kilograms (Ans: 0.069kg)
   h. 631L into nanoliters (Ans: 631,000,000,000nL)
   i. 0.78410ms into centiseconds (Ans: 0.07841cs)
   j. 323,190ds into seconds (Ans: 32,319s)
2. A piece of copper wire is 150cm long. How long is the wire in millimeters? How many 50mm segments can be cut from the length? (Ans: 1500mm; 30 piece)
3. A baker uses 1.5tsp of vanilla extract in each cake. How much vanilla extract in liters should the baker order to make 800 cakes? (1tsp = 5mL). (Ans: 6L)
4. Convert 4128g/dm^2 to kilograms per square centimeters. (Ans: 0.041 28kg/cm^2)
5. A gas has a density of 5.56g/L.
   a. What volume in milliliters would 4.17g of this gas occupy? (Ans: 750.mL)
   b. What would be the mass in kilograms of 1m^3 of this gas? (Ans: 5.56kg)
6. A heater gives off energy as heat at a rate of 330kJ/min. What is the rate of energy output in kilocalories per hour? (1cal = 4.184J) (Ans: 4700kcal/hr)
7. Convert the following using derived conversion factors.
   a. 893m^3 to cm^3(Ans: 8.92x10^{8}cm^3)
   b. 0.00923mm^3 to m^3(Ans:9.23x10^{-12}m^3)
   c. 6.781mm^3 to dm^3(Ans: 6.781x10^{-6}dm^3)

Part C – Significant Figures, Percentage Error, and Temperature Conversions

1. Determine the number of significant figures in the following measurements.
   a. 30 040g b. 0.663kg c. 20.05mL d. 1500.mg e. 0.0008m
2. Experimental value = 1.24g, accepted value = 1.30g
3. Experimental value = 1.24×10^{-2}g, accepted value = 9.98×10^{-3}g

	ºC	K	ºF
4.	0º		
5.			212ºF

	ºC	K	ºF
6.		450 K	
7.			98.6ºF

	ºC	K	ºF
8.	-40ºC		
9.		225 K	

Part D – Scientific Notation

1. Express the following quantities in scientific notation.
   a. 158 000km b. 837 100 000cm^3 c. 0.00593g d. 0.000009782L
2. Convert the following scientific numbers into decimal form.
   a. $2.45 \times 10^3 cm^2$ b. 3.871×10^{-3}g c. 1.42×10^{-6}sec d. 6.11×10^8L
3. Perform the following operations, and express the result in scientific notation.
   a. 2.48×10^2 kg + 9.17×10^3kg + 7.2×10^1 kg
   b. 4.07×10^{-5}mg + 3.966×10^{-4} mg + 7.1×10^{-2} mg
   c. 1.39×10^4 m^3 + 6.52×10^2 m^3 – 4.8×10^3 m^3
   d. 9.81×10^{27} molecules + 3.18×10^{25} molecules – 2.09×10^{26} molecules
4. Perform the following computations, and express the result in scientific notation.
   a. 1.54×10^{-1} L/2.36×10^{-4} s
   b. 3.890×10^4 mm X 4.71×10^2 mm^2
   c. 9.571×10^3 kg / 3.82×10^{-1} m^2
   d. 9.36×10^2 m X 3.82×10^3 m X 9.01×10^{-1}m

WS#5: Mixed Review

1. Match the description on the right to the most appropriate quantity on the left.
   a. $2m^3$ i. mass of a small paper clip
   b. 0.5g ii. length of a small paper clip
   c. 0.5kg iv. volume of a refrigerator compartment
   d. $600cm^2$ v. surface of the cover of a book
   e. 20mm vi. mass of a jar of peanut butter
2. A measured quantity is said to have good accuracy if
   a. it agrees closely with the accepted value.
   b. repeated measurements agree closely.
   c. it has a small number of significant figures.
   d. all digits in the value are significant.
3. A certain sample with a mass of 4.00g is found to have a volume of 7.0mL. To calculate the density of the sample, a student entered 4.00÷7.0 on a calculator. The calculator display shows the answer as 0.571429.
   a. Is the setup for calculating density correct?
   b. How many significant figures should the answer contain?
4. It was shown in the text that in a value such as 4000g, the precision of the number is uncertain. The zeros may or may not be significant.
   a. Suppose that the mass was determined to be 4000g. How many significant figures are present in this measurement?
   b. Suppose you are told that the mass lies somewhere between 3950 and 4050g. Use scientific notation to report the value, showing appropriate number of significant figures.
5. If you divide a sample's mass by its density, what are the resulting units?
6. Three students were asked to determine the volume of a liquid by a method of their choosing. Each performed three trials. The table below shows the results. The actual volume of the liquid is 24.8mL.

	Trial 1 (mL)	Trial 2 (mL)	Trial 3 (mL)
Student A	24.8	24.8	24.4
Student B	24.2	24.3	24.3
Student C	24.6	24.8	25.0

   a. Considering the average for all three trials, which student's measurements show the greatest accuracy?
   b. Which student's measurements show the greatest precision?
7. A single atom of platinum has a mass of 3.25×10^{-22}g. What is the mass of 6.0×10^{23} platinum atoms?
8. A sample thought to be pure lead occupies a volume of 15.0mL and has a mass of 160.0g.
   a. Determine its density.
   b. Is the sample pure lead? (Google density of lead)
   c. Determine percentage error, based on the accepted value for the density of lead.