Chemistry 101
DENSITY
Pre-Lab Exercises

Student:_____
Date:_____
Instructor:_____
Section:_____

1. What is the density of a gold sample that has a mass of 97.523 g and a volume of 5.1 mL?

g/mL

1. A certain metal has a mass of 84.326 g. When the sample is placed in a graduated cylinder, the water level rises from 35.4 mL to 64.3 mL. Calculate the density of the metal.

g/mL

3. When 30.0 mL of a liquid is placed in a graduated cylinder weighing 65.64 g, the resulting weight of the cylinder and liquid is 104.85 g. What is the density of the liquid?

g/mL

4. Assume you measure the density of your unknown sample to be 9.1 g/mL. The accepted (real) value for the density is 8.8 g/mL. Calculate the percent error in your measured value.

%

5. If the density of propylene glycol (antifreeze) is 1.04 g/mL, what is the volume in mL of 4.92 lbs of antifreeze? (1 lb = 454 grams)

mL

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DENSITY

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Partner:_____
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Section:_____ Date: _____

PROCEDURE AND REPORT

Density of Solids

You will determine the density of lead and an unknown metal using the displacement method described below. Make the measurements carefully, as you will be graded based upon how closely your measured densities agree with the actual densities. Record units for all measurements.

1. Use a balance to obtain the mass of a clean dry lead cylinder to the nearest 0.01 g. Record the mass in the table below. Don't forget units.

1. Place 20 to 25 mL of water in a 50 mL graduated cylinder. Measure the volume of water to the nearest 0.1 mL. Record the volume of water as the initial volume in the table below.

2. Tilt the graduated cylinder until it is almost horizontal. ***Slowly* and *carefully*** slide the lead into the graduated cylinder. **If you are not careful, the metal cylinder will break the graduated cylinder.** Read and record the new volume in the graduated cylinder as the final volume.

3. The volume of the lead can be found by subtracting the initial volume from the final volume.

4. Determine the density of lead, showing your calculations in the space provided. The accepted density of lead is 11.4 g/mL. Calculate the percent error in your measured density using the following equation:

$$percent\ error = \frac{|accepted\ value - measured\ value|}{accepted\ value} \times 100$$

6. Repeat steps 1-5 for an unknown metal. An identification number has been stamped on the unknown cylinder. Be sure to **record this number** below. You will be graded based upon how closely your measured density agrees with the actual density.

Density of Solids

Sample	Mass	Initial Volume	Final Volume	Volume of Solid	Density of Solid	Percent Error
Lead						
Unknown						

Unknown number: _____
Calculations:

Density of Liquids

In this section you will determine the density of saturated sodium chloride solution and antifreeze (propylene glycol).

1. Determine the mass of a 50 mL graduated cylinder to the nearest 0.01 g. The cylinder must be clean and dry. Record the mass in the table below.

2. Add 20 to 25 mL of saturated sodium chloride solution to the graduated cylinder and record the volume to the nearest 0.1 mL.

3. Measure the mass of the cylinder and liquid to the nearest 0.01 g. Determine the mass of the liquid by subtracting the mass of the cylinder from the mass of the cylinder and liquid.

4. Calculate the density of the solution. *Return the solution to the appropriate container*.

5. The accepted value for the density of saturated sodium chloride solution is 1.19 g/mL. Calculate the percent error in your measured density of saturated sodium chloride solution.

6. Repeat steps 1-5 for antifreeze. The accepted density of antifreeze is 1.04 g/mL.

Density of Liquids

Sample	Mass of Cylinder	Volume of Liquid	Mass of Cylinder and Liquid	Mass of Liquid	Density of Liquid	Percent Error
NaCl Sln.						
Antifreeze						

Calculations:

Specific Gravity

You will determine the specific gravities of the saturated aqueous NaCl solution and the antifreeze. Read the specific gravities by interpolating the meniscus on the floating hydrometer stems. Calculate the percent errors of your readings compared to the given specific gravities. The specific gravity for a liquid is the same numerical value as the density of that liquid if the unit of the density is in g/mL. Calculate the percent deviation between the density calculation that you obtained above and the specific gravity reading that you found, using the specific gravity reading as the accepted value.

Specific Gravity of Liquids

Liquid	Specific Gravity	Percent Error Literature	Percent Deviation Denstiy
Saturated NaCl Solution			
Antifreeze			

Calculations:

Why are there no units for specific gravity?

Effect of Concentration on Density

In this section, you will determine the densities of 100%, 80%, 60%, and 40% isopropyl alcohol solutions. You will then determine the density of rubbing alcohol, which is also an isopropyl alcohol solution. Using the density of rubbing alcohol and the densities for the isopropyl alcohol solutions of known concentration, you will be able to find the concentration of rubbing alcohol.

1. Find the isopropyl alcohol containers. Next to each container there is a color-coded 1 mL syringe. Be careful not to mix up the syringes!!
2. Place the empty syringe used for 100% isopropyl alcohol on the balance and **press tare**.
3. Remove the lid of the 100% isopropyl alcohol bottle and fill the syringe to 1.00 mL. Be sure there are no air bubbles in the syringe and remove excess liquid from the outside of the syringe with a paper towel. Place the syringe on the tared balance. Record the mass of the solution in the syringe to the nearest 0.001 g. Record the volume of the solution. Calculate the density of the solution.
4. Repeat steps 2 and 3 for the remaining solutions including rubbing alcohol (unknown).

Calculations:

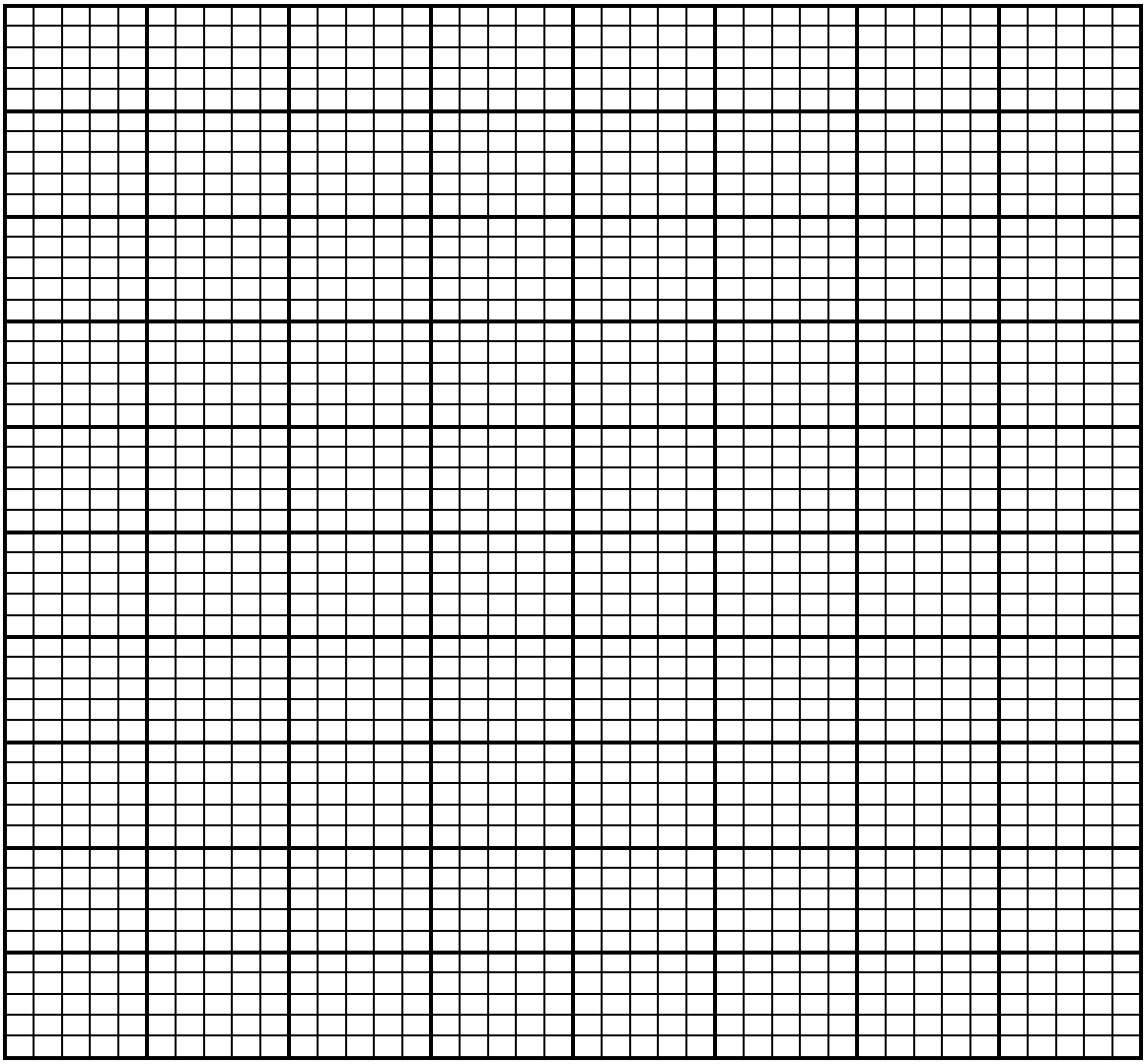
Density of Isopropyl Alcohol Solutions

% alcohol	Mass Alcohol	Volume Alcohol	Density
100.0			
80.0			
60.0			
40.0			
unknown			

5. Plot the density and % alcohol data on the graph below by placing the density on the y-axis and the % alcohol on the x-axis. Adjust the scales so that the data is spread out and occupies as much of the graph as possible. The scale on the y-axis should range from about 0.7 g/mL at the bottom to 1.0 g/mL at the top and the x-axis should range from 40% at the left to 100% at the right of the graph.

6. When the points have been plotted, draw a best-fit straight line through them. Do not “connect the dots”. Use the graph to determine the concentration of isopropyl alcohol in rubbing alcohol.

Rubbing Alcohol Concentrations: _____


Density (g/mL)
Percent Alcohol

Density of Pennies

In this section you will determine the density of two sets of pennies. Using the density data you will be able to distinguish which pennies are mainly composed of copper and which pennies are mainly composed of zinc. Before conducting the experiment, look up the density of copper and the density of zinc in the Handbook of Chemistry and Physics and record these values below

Density of Copper: _____

Density of Zinc: _____

1. Obtain 20 pennies that have mint dates before 1982. Be sure that the pennies are thoroughly dry and then determine their mass.

2. Place 20 to 30 mL of water in a 50 mL graduated cylinder and record the volume to the nearest 0.1 mL.

3. Tilt the cylinder slightly and carefully slide the pennies into the cylinder. Be careful not to splash any of the water out of the cylinder. Again measure and record the volume to the nearest 0.1 mL.

4. Determine the volume of the pennies by taking the difference of the initial and final volumes.

5. Calculate the density of the pennies.

6. Repeat steps 1-5 for a 20 penny sample with mint dates after 1982.

Density of Pennies

Year	Mass	Initial Volume	Final Volume	Volume of Sample	Density
Before 1982					
After 1982					

Which mint year is made mostly of zinc?: _____