Surname: .....**Student Number:** .....

Partner: .....**Date of experiment:** .....**Group**: ……

Experiment 1: Density of a liquid and a solid

Introduction

In just about any lab manual you look at, you will notice that the first experiment is something like the determination of the density of various objects. The reason for this is quite simple to understand: the author wants you to learn how to use some of the basic apparatus of the lab while performing an experiment that is relatively safe. In time, you will be performing experiments that do have inherent dangers, but before you do, you want to be comfortable with your own laboratory skills through practice.

That is really what this experiment is all about. You will be performing a series of relatively simple procedures, but as you do, keep in mind that these are skills and tools you will need in future experiments so be sure to get any questions that arise answered. Be sure to take many notes and observations for yourself for future reference, especially potential problems and things to watch out for when the techniques show up again. Remember to refer to laboratory procedures for any techniques you do not know.

From time to time, a chemist must be wise enough to find an indirect method to measure some quantity. For example, how would one go about measuring the volume of an irregular solid? Archimedes faced this problem when he had to determine the density of a crown for the king to determine whether (or not) the blacksmith stole some of gold and substituted copper for it. To do so, he used water displacement to determine the volume of the crown, as you will do for this part of the experiment

In this experiment, you will measure the density of the same liquid three times to demonstrate the difference in various apparatus for measuring the volume; determine the density of an unknown solid and a regular object.

Procedure

Apparatus

50 mL Erlenmeyer flask, 20.00 mL pipette, pipette filler, graduated cylinder, 100 mL beaker, balance and bring along your metric ruler.

Part I: Density of a Liquid (Water)

1. In a clean, dry beaker of an appropriate size, get approximately 30 mL of water and bring it to your desk.
2. Get the dry weight of a second clean and dry beaker.
3. Using a pipette, put 20.00 mL of water into the second beaker.

4. Determine the mass of the second beaker with water in it.
   Return the liquid to the first beaker, and dry the second beaker.
5. Repeat steps 1 to 4 two more times. In the first repetition, replace the pipette in step 3 with a clean and dry graduated cylinder to measure out 20.0 mL of water
   Then in the second repetition replace the pipette with a clean dry Erlenmeyer flask to measure 20 mL of water
   Dispose of the liquid as down the drain.

Part II: Density of an Unknown Solid. (Density of irregular object)

1. Get a solid object from your instructor.
2. Determine its mass on an electronic balance.
3. Choose a graduated cylinder of an appropriate size. Fill it approximately half-full with water. It is not important to fill it to exactly half, but it is important to determine exactly what the initial volume is.
4. Once you have recorded the volume, *carefully lower the solid into the graduated cylinder to avoid splashing the water or breaking the graduated cylinder*.
5. Recorded the final volume, dry the solid, return it, and dispose water down the drain.

Part III: Density of regular-shaped object

1. Obtain a solid block from your instructor
2. Using your metric ruler, measure the dimensions of the block (length, width and height) and record the values to the nearest 0.5 cm. calculate the volume of the block.
3. Using the balance determine the mass of the block and record the values to the nearest 0.001g. Calculate the density of the block

Calculations

Part I:

For each of the three trials, determine the mass of the liquid by subtracting the mass of the container from the mass of the container and liquid. Divide the mass of the liquid by the volume mL to determine the density.

Part II:
To determine the volume of the object, subtract the volume of the liquid in the graduated cylinder from the volume of the liquid in the graduated cylinder with the object. To get density, divide the mass of the object by its volume. Identify the metal using the table below:

Table 1.0: densities of some common metals

metals	Density (gcm^{-3}) at 25 ^{o}C
Aluminium	2.7
Lead	11.3
Silver	10.5
Zinc	7.1

Part III

Determine volume of the block using length, width and height values, and find the density of the block.

Pre-lab questions

1. How does an *intensive* property differ from an *extensive* property? Explain and give an example for each.

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2. The volume of a fixed mass of a liquid sample increases as the temperature rises from 20 to 40 ^{o}C. Does the density increases, decreases, or stay the same? Explain your answer.

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3. A solid block of exactly 100.0 cm^3 has a mass of 153.6 g. Determine its density. Will the block sink or float on water at 25 ^{o}C?

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Objective/s :

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Part I:

Table 1: Masses and volumes obtained

	Pipette	**Graduated cylinder**	**Flask**
Mass of empty beaker /g			
Mass of beaker and liquid /g			
Mass of liquid/g			
Volume of liquid/ mL			

Part II

Table 2: Mass and volume obtained

Mass of unknown solid/g	
Initial volume of water/ mL	
Final volume of water/ mL	

Part III

Table 2: ……..

Length / cm	
Height / cm	
Width / cm	

CALCULATIONS

Part I

Sample calculation: ***Use trial 1 (pipette) data***

a) Mass of the liquid

b) Density of the liquid

Table 3: …….

	DENSITY g/ mL		
	pipette	Cylinder	flask
Liquid			

Part II

a) Volume of the unknown solid

b) Density of the unknown solid

c) Identity of the unknown metal ……..

Part III

Density of the block

Post-lab questions

1. In the density determination of a liquid, it was necessary to use the volumetric pipet properly. A student needed to delivery 50.00 ml of a liquid. How will the quantity of a liquid be affected by the situations described below, and how will the density determination be affected?
   a) The student did not allow sufficient time for all the liquid to empty from the pipet.

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   b) The student allowed all the liquid to drain and then blew out the small amount from the tip

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   c) Air bubbles were not removed from the pipet before delivering the liquid.

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2. For each of the following, what apparatus (pipette, graduated cylinder or Erlenmeyer flask) would you choose for measuring the volume?

(a) You want to take 50 mL of a reagent from the area that it is stored to your desk.

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(b) A titration requires 10.00 mL of a reagent measured as accurately as possible.

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(c) A synthesis requires 35 mL of acid.

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Conclusion

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