Name: _____ **Date:** _____

Physical/Earth Science **Per:** _____

Metric Measurements and Density Lab

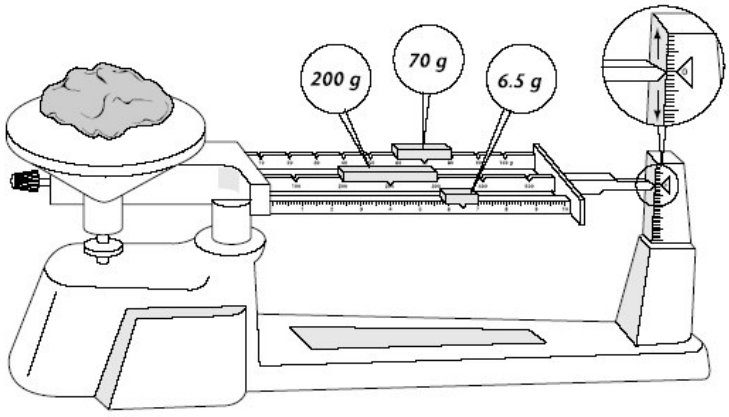
Introduction

The Metric System (SI – French for "*Systeme International d' Unites")* is the standard system of measurement in the scientific world. During this laboratory exercise you make various measurements of mass, volume, and temperature. These measurements will also be used to determine the density of an unknown liquid.

The volume of an object is the amount of space it takes up. You will often measure the volume of liquids using a graduated cylinder. ("Graduated" means that the cylinder is marked with measurement units.) Always read a graduated cylinder at eye level. Also, water in a graduated cylinder has a curved surface called the meniscus. Read the volume at the bottom of the meniscus.

Mass is the amount of matter in an object. There are different kinds of balances used to measure mass. Be sure you understand how your balance works. Some balances give a single reading. Others give two or more readings that you have to add together.

For example, look at the triple-beam balance on the right. Notice that the middle beam measures the largest amounts. To read the mass of an object, find and record the masses shown on each of the beams. Then add the readings.



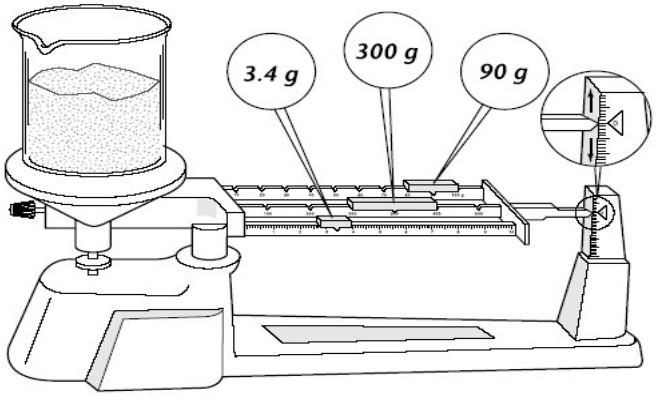
200g + 70g + 6.5g = 276.5 g

Hint: Sometimes you have to find the mass of a substance in a container. Find the mass of the container alone. Then subtract that mass from the combined mass.

Mass of substance and container	**29 g**
Mass of container	**- 13 g**
Mass of substance	**16 g**

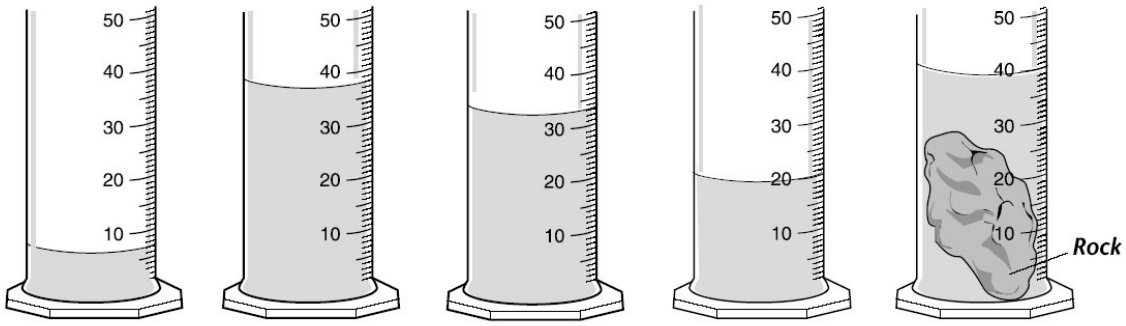
Pre-Lab Questions

1. **Using the diagram on the right, find the combined mass of the substance and its container. What is the mass of the substance if the mass of the container is 25 g?**



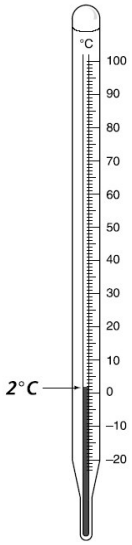
2. **What is the mass of a powder if the combined mass of the powder and its container is 12 grams and the mass of the container alone is 4 grams?**

3. **What is the volume of the liquid shown in graduated cylinders a-d below? What is the total volume in graduated cylinder e?**

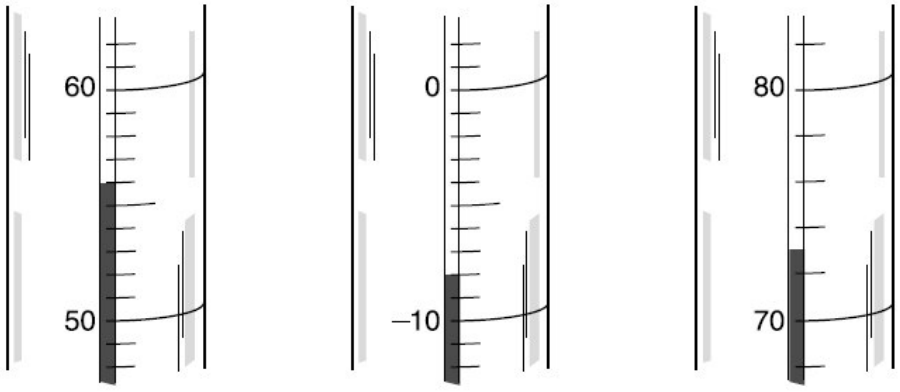


a. _____ **b.** _____ **c.** _____ **d.** _____ **e.** _____

Temperature is a measure of how hot or cold something is. In science, you will measure temperature with a Celsius thermometer like the one at the right. The correct unit for readings on this thermometer is °C. As you read the temperature in the diagram to the right, notice which thermometer marks are labeled and unlabeled, and determine what the unlabeled marks represent. Also, always check whether you are reading temperatures above or below zero. Temperatures below zero should be shown with a minus sign.



4. **What temperature is shown in the diagrams below?**



a. _____ **b.** _____ **c.** _____

Problem – **What is the proper way to use graduated cylinders, triple-beam balances, and thermometers to measure volume, mass and temperature of different objects and liquids?**

Materials

100 mL Graduated Cylinders	**300 mL Beakers**
Celsius Thermometers	**Triple-Beam Balances**
Hot Plates	**Water**
Unknown Substance	**Safety Goggles**

Safety – **Review safety procedures for working with and heating liquids.**

Procedures

Before you measure the mass of any object, make sure the riders are moved all the way to the left and the pointer rests on zero.

1. **Measure the mass of the 300 mL beaker using the triple-beam balance. Place the beaker on the balance. The beams will rise and the pointer will point above zero.**

2. **Move the rider on the middle beam one notch at a time until the pointer drops and stays below zero. Move the rider back one notch.**

3. **Move the rider on the back beam one notch at a time until the pointer drops and stays below zero. Move the rider back one notch.**

4. **Move the rider on the front beam until the pointer drops and stays at zero. The mass of the beaker is the sum of the readings from the three beams.**

5. **Record the mass to the nearest tenth of a gram in the data table.**

6. **Using a graduated cylinder, measure 50 mL of water.**

7. **Pour the 50 mL of water into the 300 mL beaker and find the mass of the beaker and the water. Record the mass to the nearest tenth of a gram in the data table**

8. **Repeat step 7 for 100 mL, 150 mL, 200 mL, and 250 mL of water. Record the mass to the nearest tenth of a gram in the data table.**

9. **Using a graduated cylinder, measure 100 mL of the "Unknown" liquid.**

10. **Pour the 100 mL of the "Unknown" liquid into the 300 mL beaker and find the total mass. Record the mass to the nearest tenth of a gram in the data table.**

11. **Calculate the mass of each volume of water and the "unknown" liquid in the data table by subtracting the mass of the 300 mL beaker from the total mass. Record the each mass in the data table.**

12. **Calculate the density of each fluid. Record the density in the data table.**

13. **Each team will be responsible to measure the boiling point of a specific volume of water or the "unknown" liquid.**

14. **Measure the specific volume of liquid using a graduated cylinder and pour the liquid into the 300 mL beaker.**

15. **Place the beaker on a hot plate and place a Celsius thermometer in the beaker.**

16. **When the liquid reaches its boiling point, read the thermometer and record the temperature in the data table.**

17. **Create a bar graph that represents each volume of water and the "unknown" liquid, and their densities. Density is the dependent variable.**

18. **Create a bar graph that represents each volume of water and the "unknown" liquid, and their boiling points. Temperature is the dependent variable.**

Data Table

Liquid	Volume (mL)	Total Mass (g)	Mass of Beaker (g)	Mass of Liquid (g)	Density (g/mL)	Boiling Point (°C)
Water	50 mL					
Water	100 mL					
Water	150 mL					
Water	200 mL					
Water	250 mL					
"Unknown"	100 mL					

Questions

1. **Describe how you use a graduated cylinder to measure the volume of 87 mL of water.**

2. **Describe how you use a triple-beam balance.**

3. **You are performing an experiment and you need 350 grams of salt. Describe how you would measure the correct mass of salt without pouring it directly on the pan of the triple-beam balance.**

4. **Compare the densities of each volume of water. What is your explanation for the comparison?**

5. **What is the density of the "unknown" liquid? How does it compare to the densities of water?**

6. **What do you think the "unknown" liquid is? Explain your answer.**

7. **Explain why density and boiling point are characteristic properties of matter.**