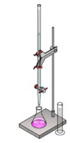
Lab 3C: Graphing as a Means of Seeking Relationships



Name:_______________________________ **Block:** ______
Group Members:_____________________ **Date:** ______/_____/_____
Due Date:__________________________ **Drop Date:**____________________

Criteria	Student Self Evaluation	Teacher Assessment
Objective: Clearly states the aim of the experiment, written in your **own words** and briefly outlines the related theory. **Procedure:** correctly references textbook or handout making notes of any changes.	/3	/3
Flow Chart: a visual representation of the procedure, to be completed <u>*before*</u> the lab! **Pre-Lab Questions:** displays a critical understanding of the background theory.	/11	/11
Data, Results & Calculations: *(hand written neatly)* Provides results/observations (and diagrams where appropriate) that are presented in correctly annotated tables and/or graphs. Scientific tables & graphs are numbered *(eg Table 1:… or Graph 1…)* and include descriptive titles. *(tables marked /2 each graph is marked /10*	/18	/18
Follow-up Questions: Correctly identifies and explains the theory relating to the experiment and supports this with accurate observations, data and/or calculations.	/6	/6
Conclusion: Identifies and defines important concepts and principles relevant to the experiment by relating back to the objective and hypothesis. ***Be sure to address the points*** listed in the lab handout when answering the conclusion.	/2	/2
Presentation: Practical report is presented in the **correct format**, is written fluently and provides **appropriate section headings** and accurate referencing. ***Tables & graphs*** have numbered headings. Data & calculations may be hand written, however the remainder of the report is to be **word-processed.**	/2	/2
Safety: *(teacher assessed during practical lab work)* Demonstrates an organized and safe approach to experimental work	/3	/3
Results Summary	/45	/45

We will be doing the lab on _______________________. In order to be ready to go, you need to complete the following sections of your lab report:

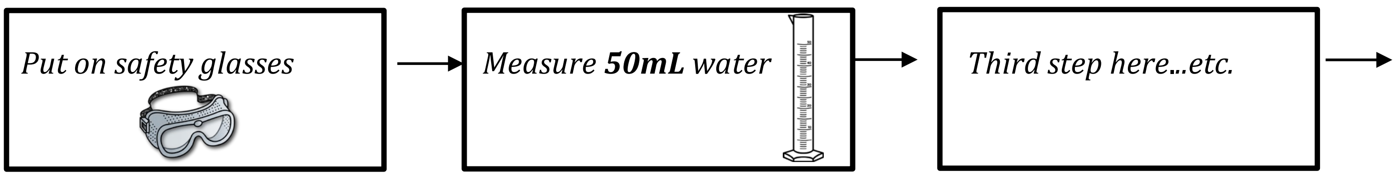
- *Objective*
- *Flow Chart*
- *Pre-Lab Questions*
- *Data & Observations: Draw & set-up Tables 1, 2 and 3 into your lab.*

Objective:

Flow Chart: Summarize the steps that you will follow in the lab. You will find this information on the attached pages, which give the "procedure" for the lab. These steps should be VERY simple, and easy to follow. You will not be permitted to carry books, and binders to your lab bench. So imagine the lab is not beside you. You will require THIS FLOW CHART to see what steps will follow.

An example flow chart is shown below.

Note: your flow chart may include diagrams/pictures; should include measurements & amounts required.



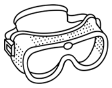
Specific to this lab, when you are creating your flow chart, **omit step 6** that is given in the procedure. You should also make a note of this when writing your *procedure* section of your lab report.

Pre-lab Questions: *(to be answered in full sentences)*
Carefully read the pre-lab discussion. Heath Chemistry page 43-44. These pages are attached for reference & include supplementary information you may find helpful..

1. How will the data be analyzed?
2. Name the three liquids used in this experiment. Which one is poisonous and flammable?
3. Why is it important to use the same flask throughout this experiment?
4. Name the two variables that will be measured in this experiment.
5. Define the following terms:
   a. Independent variable
   b. Dependent variable.
6. What variable (mass or volume) is the independent variable? How do you know?
7. When graphing, describe which variable goes on the x-axis, and which goes on the y-axis.
8. Write the equation for "slope-intercept form" and describe each part.
9. In terms of scientific experiments, how is slope calculated and what does the slop represent?
10. How do you dispose of the following:
    a) Leftover methanol
    b) Leftover salt water

Procedure: This lab is an excerpt from *Heath Chemistry*, a textbook of laboratory experiments. Information regarding the lab and detailed procedure are provided on the following pages.

NOTE: all data, observations and calculations are to be completed in numbered data tables with appropriate titles.



Safety glasses are to be worn at <u>all times</u>, for <u>all experiments!</u>

Reagent Disposal: All waste from this lab is to be collected in the designated waste container All glassware used must be rinsed *<u>thoroughly</u>* in order to be used in following reactions.

Clean Up: clean up all materials, wipe lab bench with disinfectant and wash hands *well* with soap and water before you leave the lab each day.

<u>Data, Results & Calculations:</u>
Always give your table a # (example: Table 1) and a descriptive title. Underline the table # and the title.

<u>Table 1</u>: Copy the table from page 45. This table will be used for YOUR final data.

Table 1 For Lab Station ________

WATER		ALCOHOL		SALT SOLUTION	
VOLUME (mL)	MASS (g)	VOLUME (mL)	MASS (g)	VOLUME (mL)	MASS (g)

<u>Table 2</u>: Construct *<u>your own table</u>* that you will used during the lab to record the following information: **Mass of flask, Mass of flask and liquid, and Mass of liquid**

<u>Table 3</u>: Construct *<u>your own table</u>* that you will used during the lab to record the following information: **Initial volume, Final volume, Volume dispensed**

<u>Table #4:</u> Will be given at the start of the lab, and will be used to record the class data.

<u>Graph</u>: Plot a graph showing the mass vs. volume for each liquid. Graph must show **three** lines (one for each liquid), use different colours for the different liquids, and include a legend. You should also be aware of what was expected previously when you were graphing ***(ex: graph title, axes titles (with units), axes scale, line of best fit).***

After you have graphed the class data, determine the slope for each line (this is the density for each liquid). **Circle the points you have used for your calculations. Do not forget to show your calculations on side of the graph.**

<u>Follow-Up Questions :</u> Answer the following questions in full sentences, giving detailed answers.

1. Page 45 #1. Show the point you used to answer this question on your graph!
2. Page 45 #2
3. Page 45 #3
4. Using **your** data, calculate the density of your liquid. How does this compare to the actual standard? Is it accurate?
5. How does **the class data** compare to each standard?
6. Can you determine if the class data is **precise**? Why or why not? *(explain)*

Standard Densities:
H_2O: 1.0 g/mL
Ethanol: 0.79 g/mL
Salt Water: 1.1 g/mL

Graphing as a Means of Seeking Relationships

You will recall from Experiment 1B that the scientific method involves a cyclical process of making observations, seeking relationships, and making predictions. A scientist who looks for a relationship between two variables is often hoping to discover a *mathematical* relationship.

Just as people rely on language for communicating, scientists rely heavily on mathematics to better understand scientific concepts and communicate their ideas. While conducting an experiment, a scientist will typically produce a set of data as a part of the observations made, then will attempt to make sense of the data.

In this experiment, you will attempt to find a relationship between the mass and the volume of three liquids: water, methanol, and a salt solution. You will collect data on mass and volume, then analyze the data by constructing and interpreting the graphs.

OBJECTIVES

1. to make measurements of mass and volume for three different liquids
2. to analyze the data by means of graphing techniques
3. to determine a mathematical relationship between mass and volume for each liquid

MATERIALS

Apparatus

per class:
- several burets
- lab aprons
- safety goggles

per lab group:
- centigram balance
- 250 mL Erlenmeyer flask

Reagents

water
methanol
salt (sodium chloride) solution

PROCEDURE

In order to make better use of lab time, you will be sharing your data with the other members of the class. You will therefore be depending on each other for good results. You will produce two data tables: one that consists of only your own lab station's data, and one that includes the data from the entire class. Your teacher will assign you a volume of liquid that you are to measure. Use this same volume for all three solutions.

1. Put on your lab apron and safety goggles.
2. Determine and record the mass of a clean, dry 250 mL Erlenmeyer flask. Since different flasks, although they appear to be identical, can have different masses, it is important that you use this same flask throughout this experiment.
3. Go to one of the burets that contains water, methanol, or salt solution (the order of the liquids is not important) and dispense your assigned volume into your Erlenmeyer flask as accurately as possible. If you do not obtain precisely your assigned volume, do not be concerned. What is important is that you accurately record in Table 1 the volume you do obtain.

HAZARD

CAUTION: Methanol is highly flammable and toxic. Extinguish all flames in the area. Do not get methanol in your mouth, do not swallow any.

4. Measure the total mass of the liquid and the flask. Subtract the previous mass of the flask in order to determine the mass of the liquid. Record this figure in Table 1.
5. Now repeat Procedure Steps 2 and 3 for the other two liquids. Do not empty the flask each time you add a different liquid—just keep determining the mass of each volume by subtracting the previous balance reading.
6. A data table similar to Table 2 will be on the chalkboard. Record your results from Table 1 in the table on the board.
7. When all lab stations have recorded their data on the board, copy the completed Table 2 in your notebook.
8. Before you leave the laboratory, wash your hands thoroughly with soap and water; use a fingernail brush to clean under your fingernails.

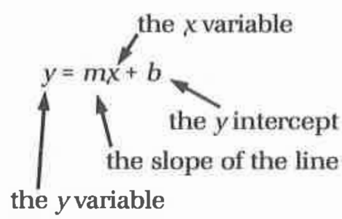
REAGENT DISPOSAL

Pour any leftover methanol into the designated waste container. Sodium chloride solution can be rinsed down the drain with plenty of water.

POST LAB DISCUSSION

A mathematical relationship can be expressed in the form of an equation. Graphs are extremely useful tools for scientists, since certain characteristic shapes of lines on graphs can lead to mathematical equations. For instance, any straight-line graph can be represented by a mathematical equation of the form $y = mx + b$. You may recall from mathematics courses that this equation is sometimes called the *slope-intercept form.*

A brief mathematics review might be helpful here.



How is this equation related to the lab you just did? First, the y and x variables are defined by the terms "mass" and "volume" respectively. Second, the y intercept will be zero because mass = 0 when volume = 0. Finally, the slope, m, must be calculated along with its appropriate units:

$$m = \frac{\Delta y}{\Delta x}$$

When reporting your mathematical relationship, you must ensure that it is meaningful. In other words, your final equation in the slope-intercept form would include the terms "mass" and "volume" rather than "y" and "x".

DATA AND OBSERVATIONS

Table 1 For Lab Station ________

WATER		ALCOHOL		SALT SOLUTION	
VOLUME (mL)	**MASS (g)**	**VOLUME (mL)**	**MASS (g)**	**VOLUME (mL)**	**MASS (g)**

Table 2 Class Results

	WATER		ALCOHOL		SALT SOLUTION	
LAB STATION	**VOLUME (mL)**	**MASS (g)**	**VOLUME (mL)**	**MASS (g)**	**VOLUME (mL)**	**MASS (g)**
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

COMPLETE IN YOUR NOTEBOOK

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ANALYSIS OF DATA (GRAPHING)

1. Whenever a graph is constructed, the first question that arises is, "Which variable goes on the y-axis and which goes on the x-axis?" The answer is that the dependent variable goes on the y-axis and the independent variable goes on the x-axis. The *independent* variable is the one over which you have control; it is the variable that you decided to measure. (Did you decide to obtain a certain volume or a certain mass of each liquid?)
2. Following the rules of good graphing, plot a graph showing mass vs. volume for each liquid. You should plot the results for all liquids on the same graph, but be careful to differentiate the results. For example, use circles for the data points of water, squares for those of methanol, and triangles for those of the salt solution.
3. If the lines on your graph illustrate straight-line relationships, determine the mathematical relationship between mass and volume for each liquid.

QUESTIONS AND CALCULATIONS

1. Use your graph to predict the mass of 6.5 mL of methanol.
2. Use your mathematical relationship to calculate the mass of 6.5 mL of methanol.
3. Compare your answers to Questions 1 and 2, and explain why they might not be identical.