

Chem 108: Lab Week 5

Sign in: Roster @ front of lab
Remember the LETTER next to your name on the roster.
Pick up graded papers & handout

Due Today

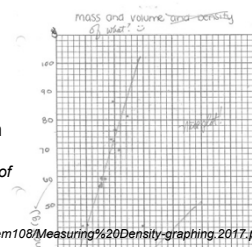
- Completed density calculations, graphs & Report Forms pp.20-25 (One form for each lab partner are to be turned in; stapled together. Neatest one on top.)
- Check significant figures and calculations carefully. Uncertainty (+/-) values are not to be included, but measurement data must be correct relative to the experimental equipment used. Review returned Measurement Reports.
- (GQ) On-line *Density & Buoyancy Guiding Questions* (individually done)

- (GQ) On-line *Density & Buoyancy Guiding*
DUE Today
<http://chemconnections.org/general/chem108/Density%20%20Buoyancy.html>



➤ Plot of data (A) & (B) using blank graph paper

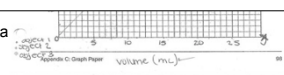
- Either (A) & (B) on the same graph paper or separate pages.
- Attach graph(s) to the combined Report Form pages
- Complete the bottom table of handout and attach to the Report Forms to turn in.



<http://chemconnections.org/general/chem108/Measuring%20Density-graphing.2017.pdf>

$$\text{Percent Error} = \frac{\text{Experimental value} - \text{True value}}{\text{True value}} \times 100$$

- Anyone plot the data using a spreadsheet?



Equation of a line: $\Delta y = m\Delta x + b$

y = y axis m = slope x = x axis b = y-intercept

We're plotting: Mass = y axis Volume = x axis

- How are mass and volume related?

$$\frac{\Delta \text{mass}}{\Delta \text{Volume}} = \text{density}$$

We can rearrange this as: $\text{mass} = \text{density}(\text{Volume})$

If we compare to equation of a line:

$$\text{mass} = \text{density}(\text{Volume}) + 0$$

$$\Delta y = m \Delta x + b$$

Now, what does the slope of our trendline represent?

(Comparing the x,y values of any 2 points on the trendline.)

Using a Spreadsheet (Excel)

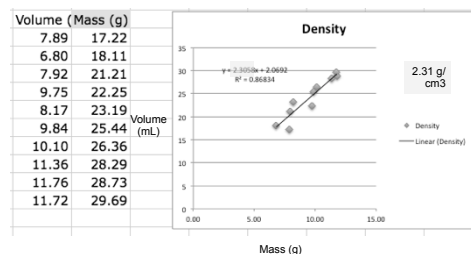
Density	Volume (cm3)	Mass (g)
	7.89	17.22
	6.80	18.11
	7.92	21.21
	9.75	22.25
	8.17	23.19
	9.84	25.44
	10.1	26.36
	11.4	28.29
	11.8	28.73
	11.7	29.69
AVG		
Density		

Using a Spreadsheet (Excel)

Density	Volume (cm ³)	Mass (g)
	7.89	17.22
	6.80	18.11
	7.92	21.21
	9.75	22.25
	8.17	23.19
	9.84	25.44
	10.1	26.36
	11.4	28.29
	11.8	28.73
	11.7	29.69
AVG	9.53	24.05
Density		2.52 g/cm ³

Using a Spreadsheet (Excel)
Youtube

<https://www.youtube.com/watch?v=3kNEv3s8TuA>

Using a Spreadsheet (Excel)
Youtube

<https://www.youtube.com/watch?v=3kNEv3s8TuA>

$$\text{Percent Error} = \frac{\text{Experimental value} - \text{True value}}{\text{True value}} \times 100$$

A	
Metal identified	Al = 2.64 g/cm ³
Density (g/cm ³) averaged	2.52 g/cm ³ +/- 0.19
Error (%) averaged	$(2.52 - 2.64) / 2.64 \times 100 = 4.5\%$
Density (g/cm ³) graphed	2.31 g/cm ³ +/- 0.12
Error (%) graphed	$(2.31 - 2.64) / 2.64 \times 100 = 12.5\%$

Linear Regression straight lines improve precision.
They do not necessarily improve accuracy.

MOOCs: “Free” Courses

<https://www.edx.org/course/analyzing-visualizing-data-excel-microsoft-dat206x-4>

Learning to Use a Spreadsheet (Excel)

EdX

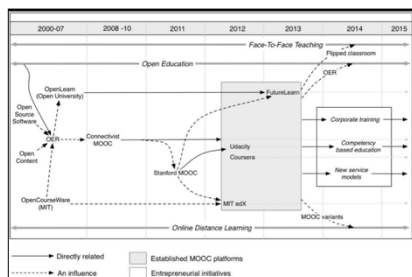
Coursera

Udacity



MOOCs: “Free” Courses

EdX
Coursera
Udacity



QUESTION

Rank the correct relative precision of the results from the two methods for Metal A's density's calculation. It's accepted density is 2.64 g/cm³

Density		Density
Data Averaging		Linear Regression Straight Line
2.52 g/cm ³ +/- 0.19		2.31 g/cm ³ +/- 0.12

A) Precision: Straight Line > Averaging

B) Precision: Averaging > Straight Line

QUESTION

Rank the correct relative accuracy of the results from the two methods for Metal A's density's calculation. It's accepted density is 2.64 g/cm^3

Density		Density
Data Averaging		Linear Regression Straight Line
2.52 g/cm^3 ± 0.19		2.31 g/cm^3 ± 0.12

- A) Accuracy: Straight Line > Averaging
B) Accuracy: Averaging > Straight Line

Worksheet: Handout



Experimentation:

- Complete Measuring Density calculations, graphs & Report Form pp.20-25 (One form for each lab partner to be turned in.) DUE Today
- (GQ) Density *Writing Questions* DUE Today
- WORKSHEET (HANDOUT) pp.1: Precision, Accuracy & Periodicity, DUE Today (Turn in before leaving lab)

Number:

Adapted from: Worksheet Chemistry

Precision, Accuracy & Periodicity

	Student 1	Student 2	Student 3	Student 4
Trial 1	22.4 g/cm ³	22.5	22.4 g/cm ³	22.5
Trial 2	22.4 g/cm ³	22.5	22.4 g/cm ³	22.5
Trial 3	22.4 g/cm ³	22.5	22.4 g/cm ³	22.5
Trial 4	22.4 g/cm ³	22.5	22.4 g/cm ³	22.5
Average	22.4 g/cm ³	22.5	22.4 g/cm ³	22.5

- The average is 22.45 g/cm³ for each student (22.4 + 22.5)/2 = 22.45

Should both students receive the same grade? Explain your answer.

2. In the early 1970s, Mendeleev predicted that "new" elements, their atomic masses and their densities, lay "between" adjacent ones: e.g., "Ekaaluminum" (atomic mass = 68 g/mol, density = 5.0 g/cm³, atomic number = 31).

a) Sketch the three elements by their modern names from their names and relative locations in the periodic table.

Element 1:

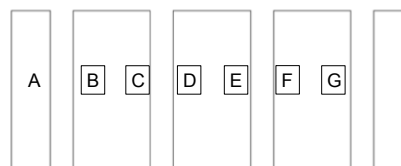
Element 2:

Element 3:

Experiment 3: Classification of Matter and Chemical Change

Move to the lab location that matches your roster letter with the map letter

Front of Lab



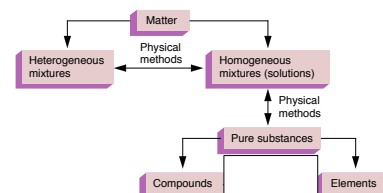
CHEM 108

Experiment 3: Classification of Matter and Chemical Change

refer to calendar link:

<http://www.chemconnections.org/general/chem108/Phys%20Properties-Separations%202017.htm>

- Write yours and all partners' names **ON all REPORT FORMS**, pp. 5-8, **DUE Next Week**



Classifying & Separating Matter Mixtures → Pure Substances

Classification of Matter and Chemical Change

Refer to the calendar link:

<http://www.chemconnections.org/general/chem108/Phys%20Properties-Separations%202017.htm>



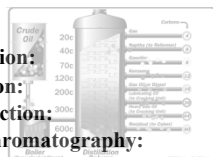
Filtration:

Crystallization:

Distillation:

Extraction:

Chromatography:



<https://www.youtube.com/watch?v=q8Ent5CXhfY&t=17s>

Separating Mixtures

• **Filtration:** Separation of components in a mixture based upon differences in particle size. Examples: particles from air, coffee from grounds.



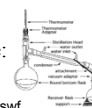
• **Crystallization:**

Separation based upon differences in solubility of components in a mixture. Example: rock candy



• **Distillation:**

Separation based upon differences in boiling of components in a homogeneous mixture. Example: gasoline from crude oil



<http://chemconnections.org/general/movies/html-swf/oil-refining.swf>

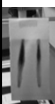
<https://www.youtube.com/watch?v=q8Ent5CXhfY&t=17s>

Separating Mixtures



• **Extraction:** Separation based upon differences in a compound's solubility between two different solvents, typically immiscible liquids. Examples: gasoline (hydrocarbons) and water.

• **(Chemical Separation) Chromatography:**



Separation based upon differences a compound's solubility in a solvent versus a stationary phase. Examples: paper chromatography, thin layer (TLC), column, gas-liquid (GC); liquid-liquid: (HPLC), reverse phase.

Classification of Matter and Chemical Change

➤ Goals:

- Part A: To classify a pure substance as a homogeneous or heterogeneous mixture and quantify the mixture's components
- Part B: To classify a material as a pure substance or mixture based on observation
- Part C: Using Paper Chromatography to classify inks as pure substances or homogeneous mixtures
- Part D: Determining if chemical changes occur.
- Work with your partners
- Be sure to write partner's name ON ALL REPORT FORMS

Classification of Matter and Chemical Change

➤ Working with your partners

- Bring completed report forms with your name and partners' name ON ALL REPORT FORMS to Dr. R.
- Dr. R will provide each group with 2 unknown mixtures of sand and salt to be quantitatively analyzed.
- Decide who will do which unknown. Record unknown numbers on the respective individual Report Form(s).

Classification of Matter

Part A: Procedural Scheme

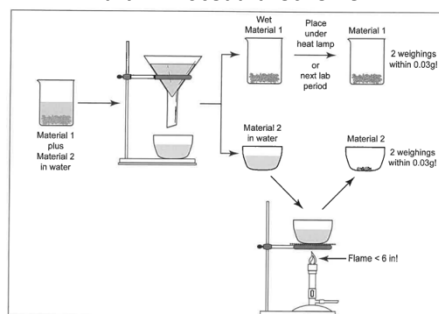


Figure 1- Overview of Part A

Classification of Matter and Chemical Change

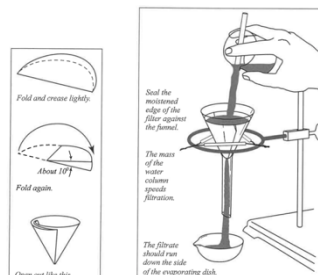
Measuring solids (Part A):

- 1) Weigh empty container (beaker) & record mass
- 2) Remove beaker from balance and pour solid into the beaker
- 3) Place the beaker with the solid back on the balance & record mass

DO NOT pour any materials/ chemical into containers while on balance pan; clean area and balance of any loose /spilled materials/ chemicals before leaving, close all bottles

Classification of Matter

Filtration



Part A

➤ Use a minimal amount of H_2O when transferring solids from beaker into filter; too much causes evaporation time to be VERY long

➤ PROCEDURE to note & follow:

• Boil filtrate *gently* until no drops are observed on watch glass

- If boiled too rapidly, crystals collect on watch glass
- **SAFETY TIP:** Hot evaporating dish will shatter if placed on cold lab bench – Allow to cool on grating before placing on bench

• DO NOT dry Material 1 and filter paper under heat lamp. Store in your lab drawer covered by paper towel . . . by the next lab session, they will be very dry

➤ WASTE: (to be handled next lab session)

- Filter paper and Material 1 in trash
- Material 2 in sink with H_2O running

Part B: $CuSO_4 \cdot 5H_2O$

➤ Copper(II) sulfate pentahydrate

➤ May be labeled cupric sulfate pentahydrate

➤ Heat the hydrate *gently* in a test tube

➤ Waste:

➤ Add in minimum amount of H_2O and stir to dissolve all solid

➤ Pour solution into red “Aqueous Metal Waste” container in hood

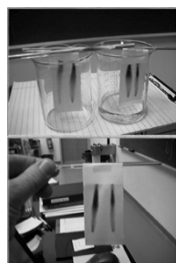
➤ Be sure to record “color” and/or “clarity” BEFORE discarding any solutions or chemicals

e.g.) solution: blue and cloudy, solution: colorless and clear, solid: white



Classification of Matter

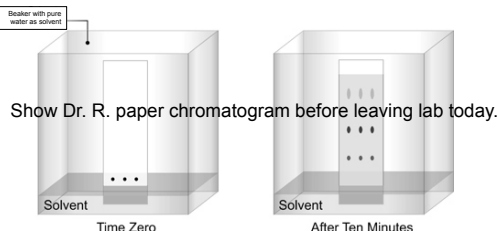
Part C – Paper Chromatography)



Part C – Paper Chromatography

➤ Use water-soluble pens that are provided, DO NOT use your own pen

➤ DO NOT use permanent pens/markers



➤ Waste: water in sink

- **PROCEDURE:** Before starting Part D, dispense 3-4mL of 6M NaOH and 3-4mL of 6M HCl into separate test tubes: *6M means 6 Molar = 6 mol/L; Molarity is an important unit of concentration*
- Take to YOUR LAB BENCH for Parts D.1 and D.3
- Avoid spilling NaOH or HCl
- If spilled, neutralize with solid NaHCO_3 (sodium bicarbonate) from bucket, then wipe with paper towel
- An acid + base react to produce a salt and water
- Waste for D.1:
- Pour all solutions into NaHCO_3 in hood sink with H_2O running

Part D.2:

- Waste for D.2:
- Into red "Aqueous Metal Waste" container in hood

Part D.3:

- 20 drops HCl \approx 1mL, add "dropwise"
- Waste for D.3:
- Into NaHCO_3 in hood sink with H_2O running

Part D.4:

- Waste for D.4:
- Into red "Aqueous Metal Waste" container in hood

Exp. 3 – Classification of Matter and Chemical Change

DUE Next Lab Period

- **Report Forms:** *One form for each lab partner are to be turned in; stapled together. Neatest one on top.*
- Staple Paper Chromatogram to Report Form.
- Check sig figs are correct and units included
- Show example of each type of calculation
- Answer questions legibly in complete sentences.

Individually complete
on-line post-lab
questions and
submit on-line:

[http://www.chemconnections.org/
general/chem108/Physical
%20Properties.html](http://www.chemconnections.org/general/chem108/Physical%20Properties.html)

Physical Properties

Refer to the reading:
<http://www.chemconnections.org/general/chem108/Physical%20Properties.html>
and
answer the following questions.

* Required

Name: Last, First *

Your answer

EWG # *

Your answer

Lab Section *

☐ Monday
☐ Wednesday

e-mail address *

Your answer



1. A mixture of sand and sawdust contains 100 g of sand and 200 g of sawdust. Find the mass percent of each component in this mixture.

Provide % sand and % sawdust.

Your answer

DUE Next Lab Period

Due Today

Experimentation:

- Complete *Measuring Density* calculations, graphs & Report Form pp. 20-21. (One form for each lab partner to be turned in.) DUE Today
- (GO) *Density Guiding Questions* DUE Today
- **WORKSHEET [HANDOUT pdf]:** Precision, Accuracy & Periodicity, DUE Today (Turn in before leaving lab)

Complete Worksheet in collaboration with your assigned group partners.

Turn in before leaving lab today.

Worksheet: Handout

Report Your Worksheet Chemistry

Name: _____

Precision, Accuracy & Periodicity

1) Five students report the following data for the density of an unknown metal:

Student	Student 1	Student 2	Student 3	Student 4	Student 5
Density	2.1 g/cm ³	2.2 g/cm ³	2.3 g/cm ³	2.4 g/cm ³	2.5 g/cm ³

• The accepted value is 2.8 g/cm³.

• The error is 0.4 g/cm³ in both cases (2.4 - 2.8) and (2.5 - 2.8).

Based on the data, which student is the most precise? Explain your answer.

2) In the early 1900s, Mendeleev predicted three "new" elements, their atomic masses and their densities: "Eka-boron", atomic mass = 44, "Eka-aluminum", atomic mass = 68, density = 1.3 g/cm³, and "Eka-silicon", atomic mass = 72, density = 1.5 g/cm³.

a) Identify the three elements by their modern names from their names and relative location in the periodic table.

Eka-boron: _____

Eka-aluminum: _____

Eka-silicon: _____