

Chem 108: Lab

Week 5

Sign in: Roster @ front of lab

Remember the LETTER next to your name on the roster.

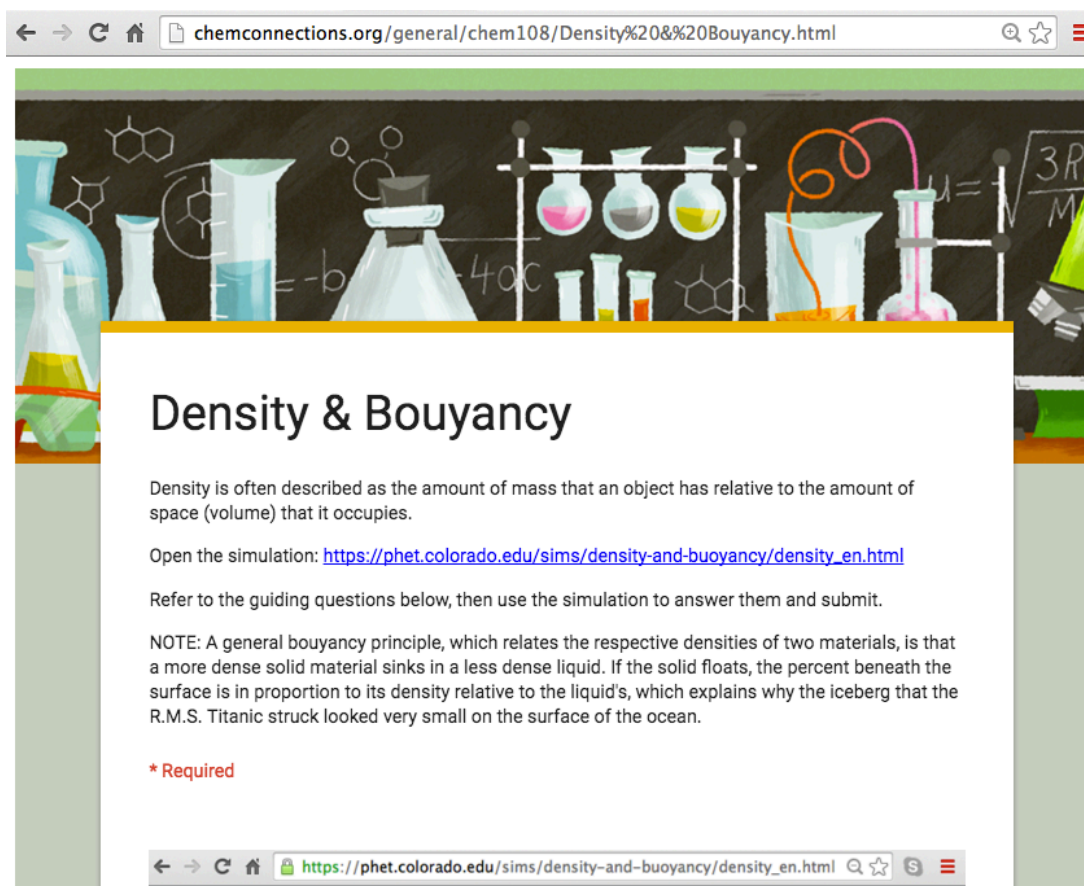
Pick up graded papers & handout

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&%20Bouyancy.html>



The screenshot shows a web browser window with the address bar displaying chemconnections.org/general/chem108/Density%20&%20Bouyancy.html. The page features a decorative header with various chemistry glassware (flasks, beakers, test tubes) and chemical structures. The main title is "Density & Bouyancy". Below the title, the text states: "Density is often described as the amount of mass that an object has relative to the amount of space (volume) that it occupies." It then provides a link to a simulation: "Open the simulation: https://phet.colorado.edu/sims/density-and-buoyancy/density_en.html". A note follows: "Refer to the guiding questions below, then use the simulation to answer them and submit." Another note explains a buoyancy principle: "NOTE: A general buoyancy principle, which relates the respective densities of two materials, is that a more dense solid material sinks in a less dense liquid. If the solid floats, the percent beneath the surface is in proportion to its density relative to the liquid's, which explains why the iceberg that the R.M.S. Titanic struck looked very small on the surface of the ocean." At the bottom, there is a red asterisk and the word "Required". The browser's address bar at the very bottom shows the URL https://phet.colorado.edu/sims/density-and-buoyancy/density_en.html.

Density & Bouyancy

Density is often described as the amount of mass that an object has relative to the amount of space (volume) that it occupies.

Open the simulation: https://phet.colorado.edu/sims/density-and-buoyancy/density_en.html

Refer to the guiding questions below, then use the simulation to answer them and submit.

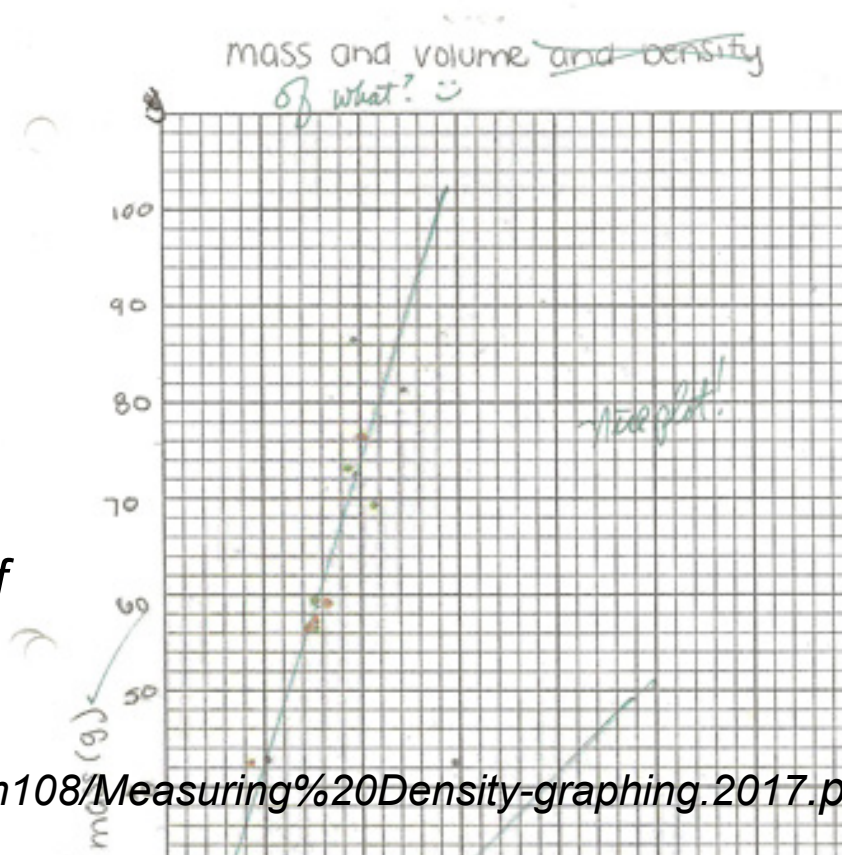
NOTE: A general buoyancy principle, which relates the respective densities of two materials, is that a more dense solid material sinks in a less dense liquid. If the solid floats, the percent beneath the surface is in proportion to its density relative to the liquid's, which explains why the iceberg that the R.M.S. Titanic struck looked very small on the surface of the ocean.

* Required

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

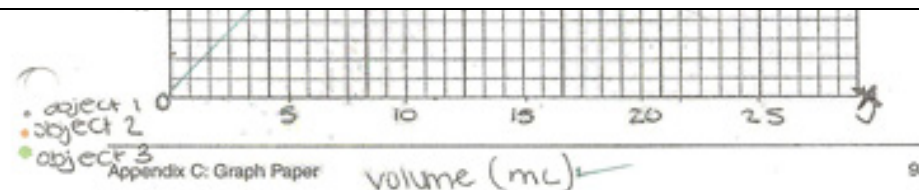
- Either (A) & (B) on the same graph paper or separate pages.
- Attach graph(s) to the combined Report Form pages
- *Complete the bottom table of handout and attach to the Report Forms to turn in.*

<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 $m = \text{slope}$ $x = x$ axis $b = y\text{-intercept}$

We're plotting: $\text{Mass} = y$ axis $\text{Volume} = x$ 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:

$$\begin{array}{ccccccc} \text{mass} & = & \text{density} & (\text{Volume}) & + & 0 \\ \Delta y & = & m & \Delta x & + & b \end{array}$$

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

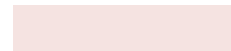
28.73

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

Density

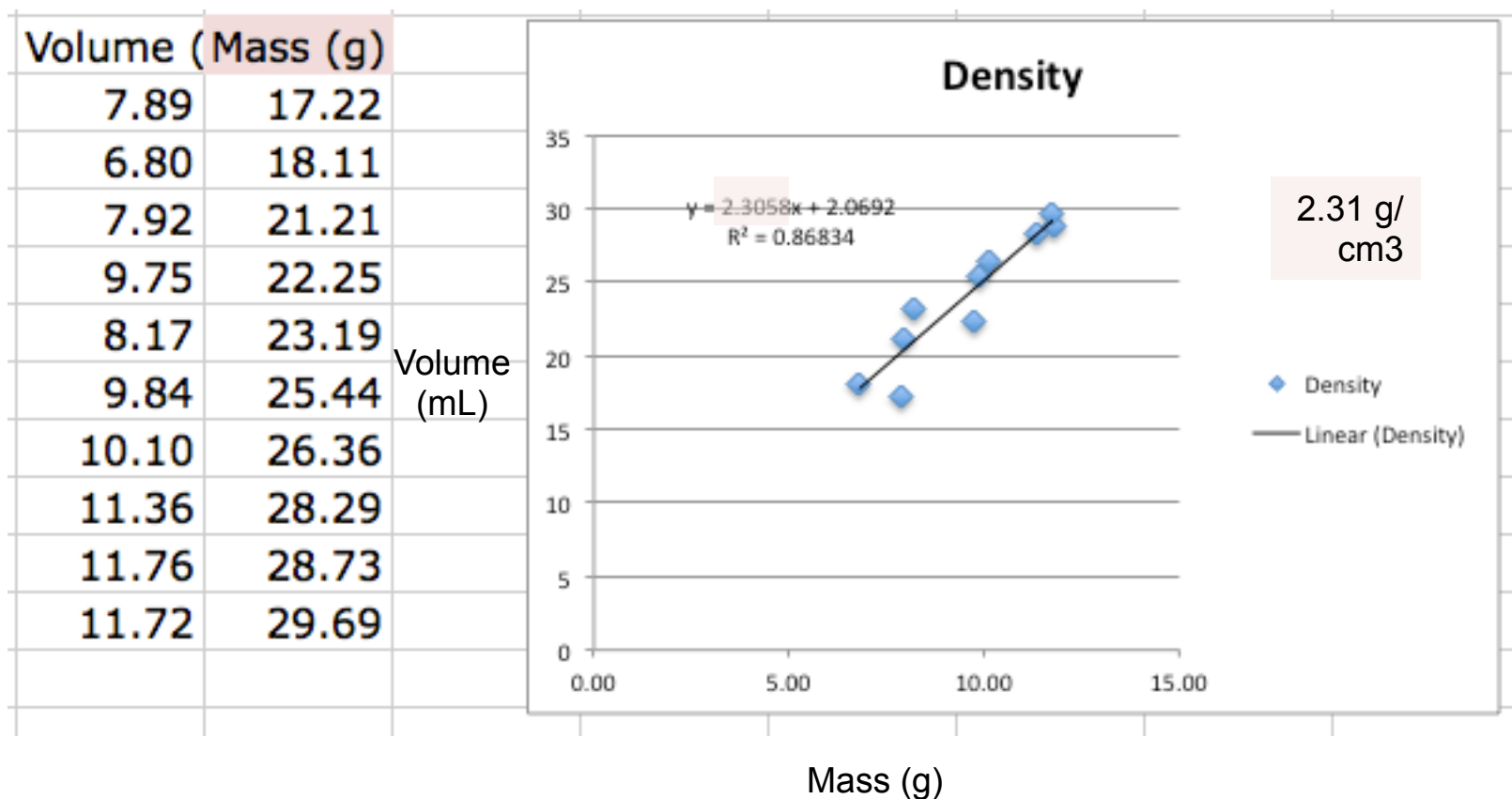
2.52

g/cm³

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 * 100= 4.5%
Density (g/cm ³) graphed	2.31 g/cm ³ +/-0.12
Error (%) graphed	(2.31-2.64)/2.64 * 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

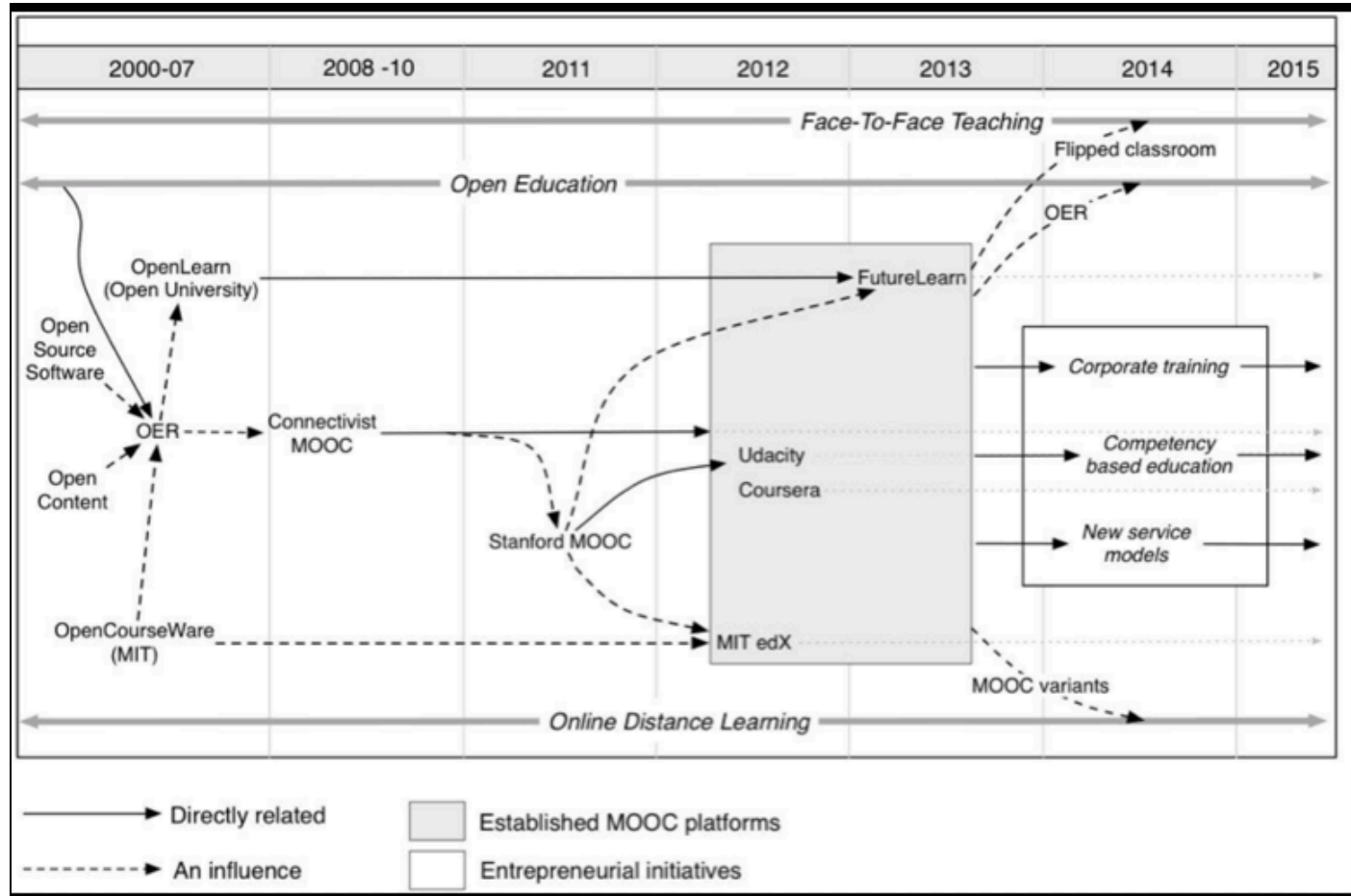
Coursera

Udacity

The screenshot shows the EdX course page for 'Analyzing and Visualizing Data with Excel'. The browser address bar displays the URL: <https://www.edx.org/course/analyzing-visualizing-data-excel-microsoft-dat206x-4>. The page header includes navigation links: Home > All Subjects > Data Analysis & Statistics > Analyzing and Visualizing Data with Excel. The main content area features a course card with a video player thumbnail, the title 'Analyzing and Visualizing Data with Excel', a description 'Develop your skills with Excel, one of the common tools that data scientists depend on to gather, transform, analyze, and visualize data.', and the Microsoft logo. To the right of the card are buttons for 'Sign In', 'Register', 'Self-Paced', and 'Enroll Now'. Below the card, there is a section for 'About this course' with 877 reviews and a 4.5/5 rating. It states that the course is part of the 'Microsoft Professional Program Certificate in Data Science' and provides a link to 'See more'. The 'What you'll learn' section lists three bullet points: 'Gather and transform data from multiple sources', 'Discover and combine data in mashups', and 'Learn about data model creation'. Below this is a link to 'View Course Syllabus'. The 'Meet the instructors' section features two profiles: Dany Hoter, Senior Program Manager at the Excel team, and Jonathan Sanito, Senior Content Developer at Microsoft. At the bottom, there is a section titled 'Pursue a Verified Certificate to highlight the knowledge and skills you gain (\$49)' with a link to 'Official and Verified' and a note to 'Receive an instructor-signed' certificate. On the right side of the page, there is a sidebar with course details: Length (6 weeks), Effort (2-4 hours per week), Price (FREE, with an option to add a Verified Certificate for \$49), Institution (Microsoft), Subject (Data Analysis & Statistics), Level (Intermediate), Languages (English), and Video content.

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/cm^3

<i>Density</i>		<i>Density</i>
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

<i>Density</i>		<i>Density</i>
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

Adapted from *Workshop Chemistry*

Name(s) _____

Precision, Accuracy & Periodicity

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

	Student 1	Deviation	Student 2	Deviation
Trial 1	22.0 g/cm ³	+0.1	23.0 g/cm ³	+1.1
Trial 2	21.8 g/cm ³	-0.1	21.0 g/cm ³	-0.9
Trial 3	22.0 g/cm ³	+0.1	21.3 g/cm ³	-0.6
Trial 4	21.8 g/cm ³	-0.1	22.3 g/cm ³	+0.4
Average	21.9 g/cm ³	+/- 0.1	21.9 g/cm ³	+/- 0.8

- The accepted value is 21.8 g/cm³.

- The error is 0.4% in both cases: $(21.9 - 21.8)/21.8 \times 100 = 0.4\%$

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



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 Guiding Questions* DUE Today
- **WORKSHEET** (HANDOUT pdf): Precision, Accuracy & Periodicity, DUE Today (Turn in before leaving lab)

2) In the early 1870's, Mendeleev predicted three "new" elements, their atomic masses and their densities: "Ekaboron", atomic mass = 44; "Ekaaluminium", atomic mass = 68, density = 5.9 g/cm³ and "Ekasilicon", atomic mass = 72, density = 5.5 g/cm³.

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

Ekaboron =

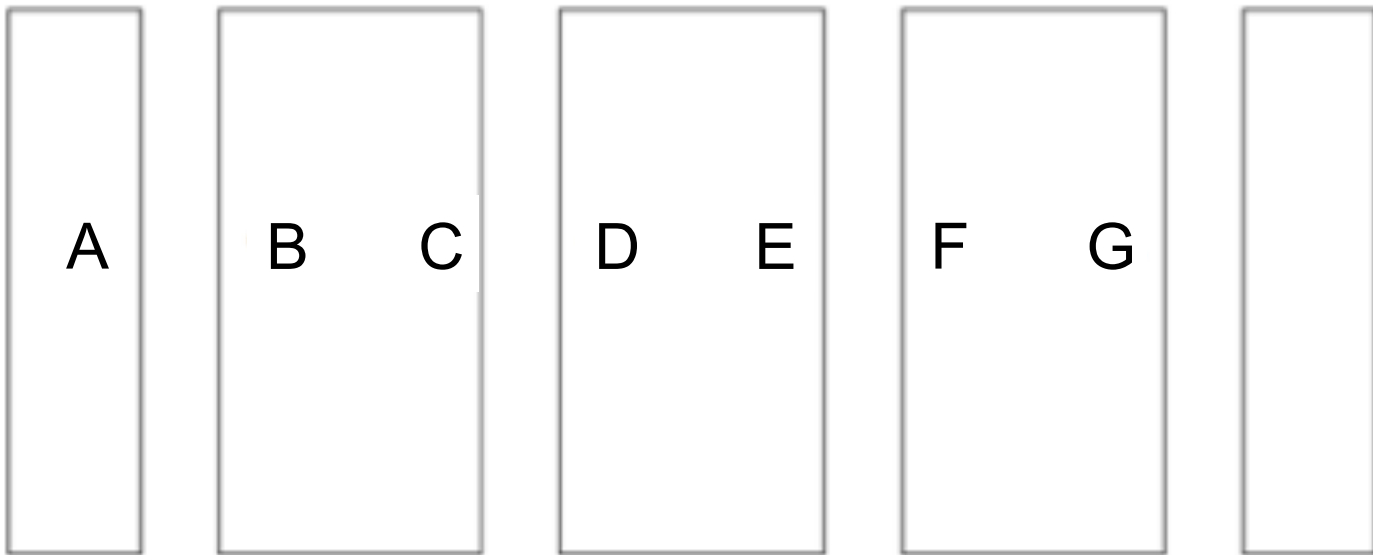
Ekaaluminium =

Ekasilicon =

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



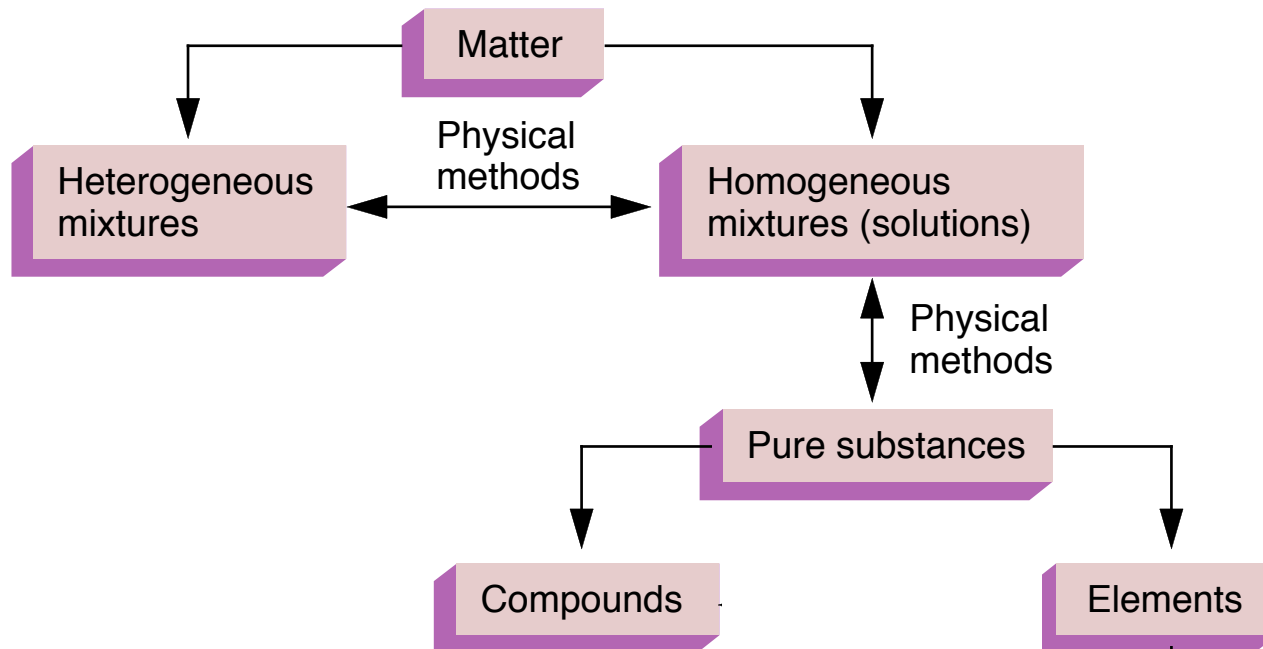
CHEM 108

Experiment 3: Classification of Matter and Chemical Change

refer to calendar link:

[http://www.chemconnections.org/general/chem108/Phys
%20Properties-Separations%202017.htm](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**



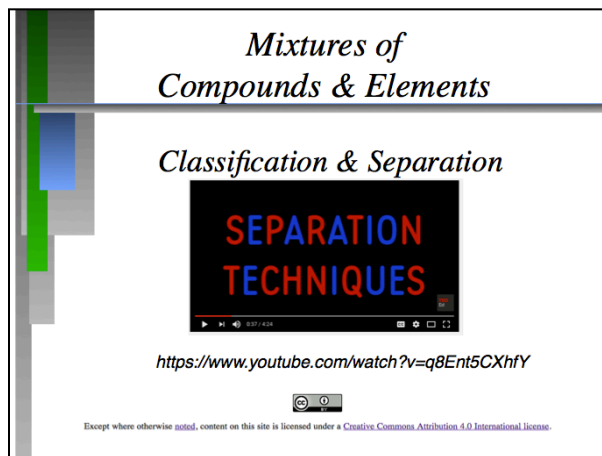
Classifying & Separating Matter

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](http://www.chemconnections.org/general/chem108/Phys%20Properties-Separations%202017.htm)



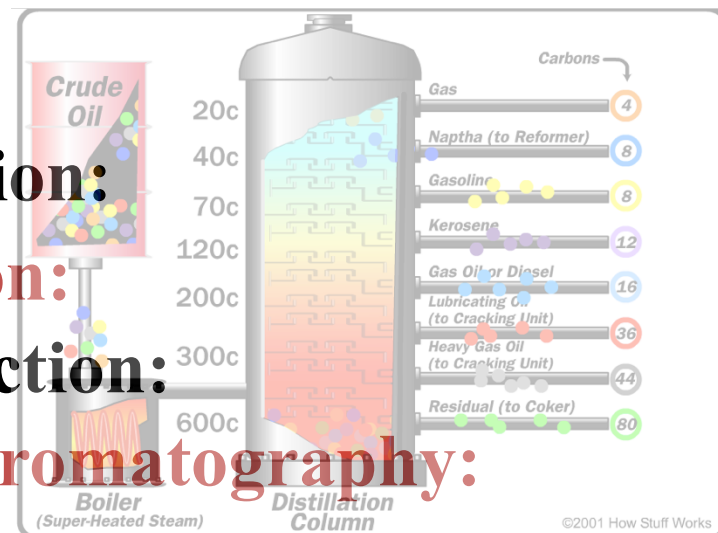
Filtration:

Crystallization:

Distillation:

Extraction:

Chromatography:



Separating Mixtures

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



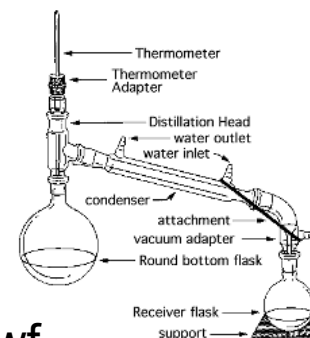
- **Crystallization:**

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



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

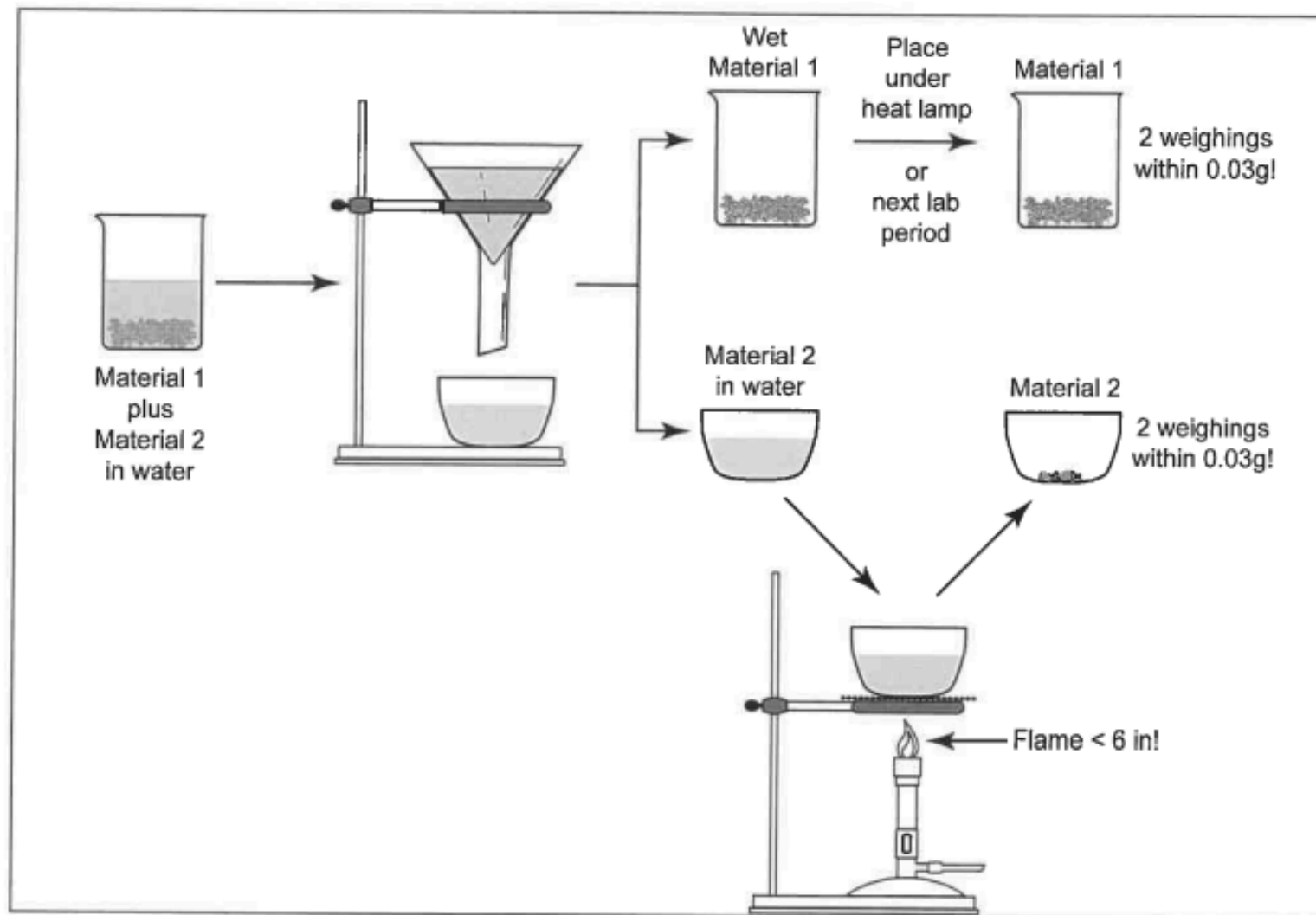


Figure 1—Overview of Part A

Classification of Matter and Chemical Change

Measuring solids (Part A):

1) Weigh empty container (beaker) & record mass

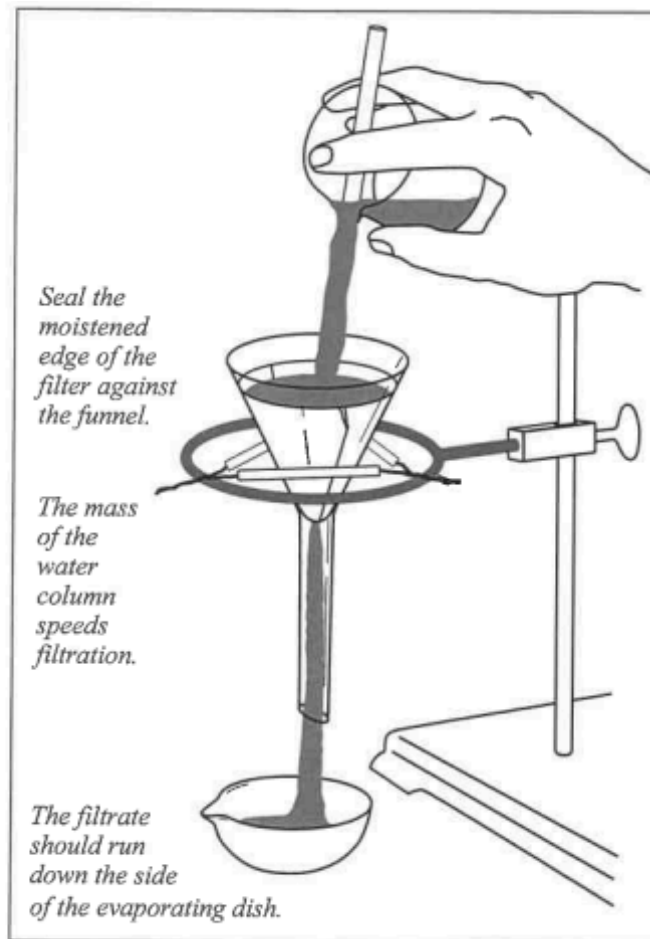
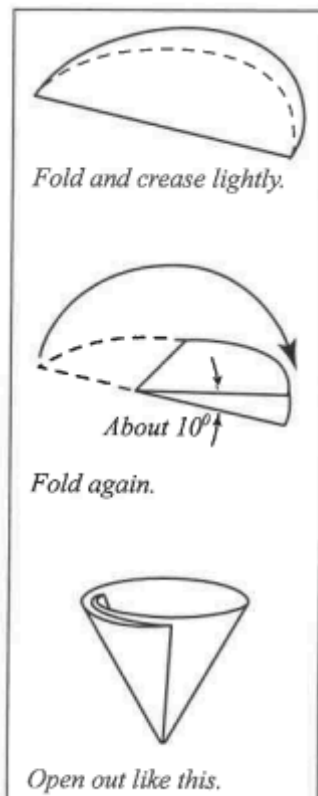
2) Remove beaker from balance and pour solid into the beaker

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: $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

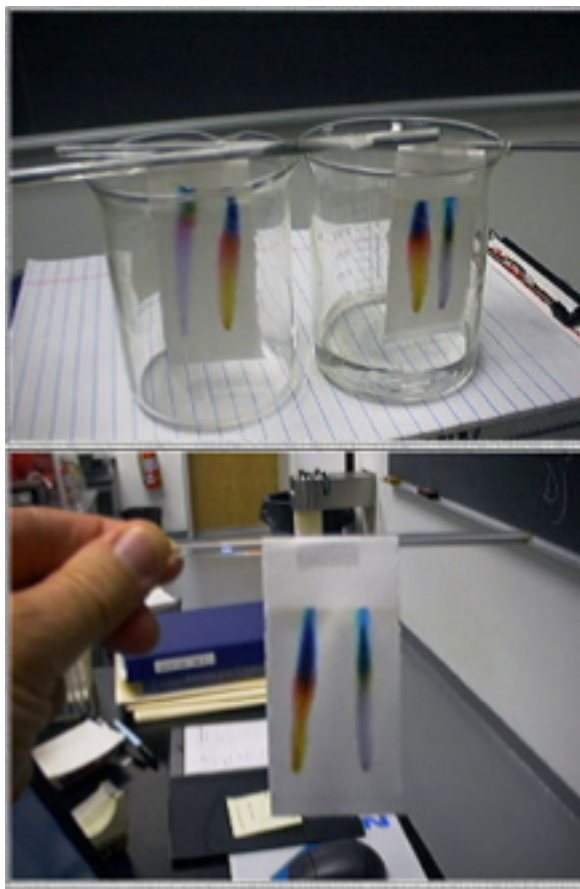


- Copper(II) sulfate pentahydrate
 - *May be labeled cupric sulfate pentahydrate*
- Heat the hydrate *gently* in a test tube
- Waste:
 - Add in minimum amount of H_2O and stir to dissolve all solid
- Pour solution into red “Aqueous Metal Waste” container in hood
- Be sure to record “color” and/or “clarity” BEFORE discarding any solutions or chemicals

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

Classification of Matter

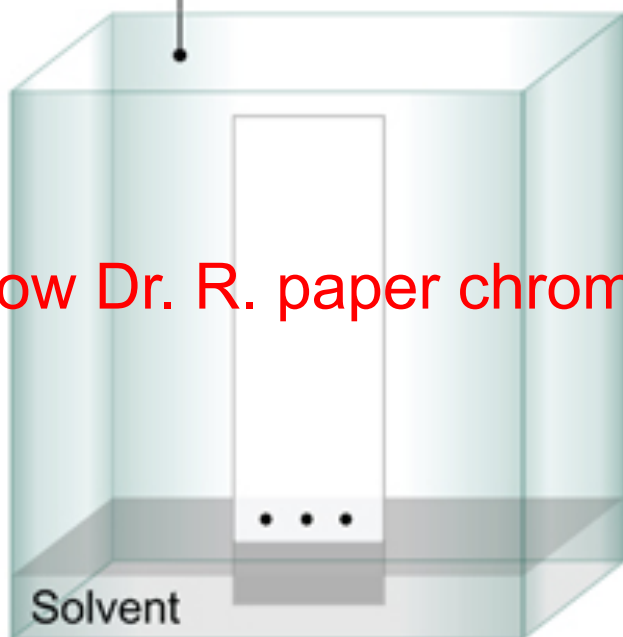
Part C – Paper Chromatography)



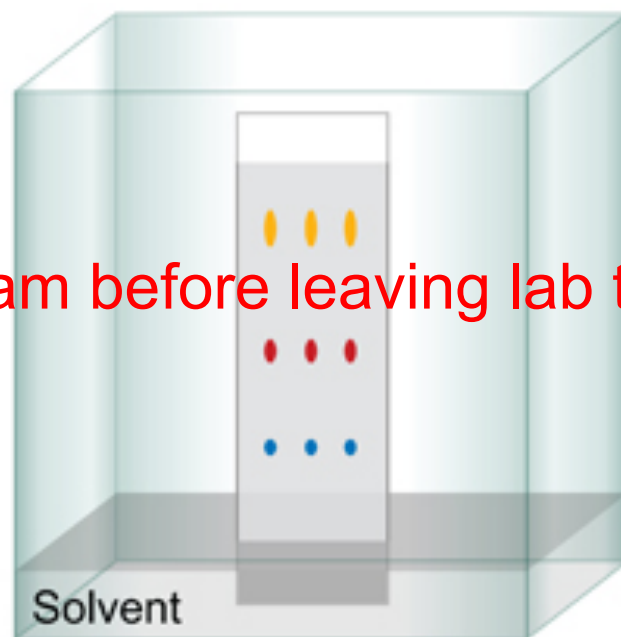
Part C – Paper Chromatography

- Use water-soluble pens that are provided, DO NOT use your own pen
 - DO NOT use permanent pens/markers

Beaker with pure water as solvent



Time Zero



After Ten Minutes

Show Dr. R. paper chromatogram before leaving lab today.

- 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 NaHCO₃ in hood sink with H₂O 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://chemconnections.org/general/chem106/Investigating%20Physical%20Properties.1.pdf>
Provide answers to the following questions.

*** Required**

Name: Last, First *

Your answer

DVC id *

Your answer


Lab Section *

☐ Monday

☐ Wednesday

e-mail address *

Your answer

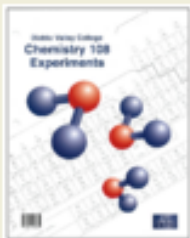


1. A mixture of sand and sawdust contains 124 g of sand and 305 g of sawdust. Find the mass percent of each component in this mixture. *

Provide % sand and % sawdust.

Your answer

DUE Next Lab Period



Due Today

Experimentation:

- Complete *Measuring Density* calculations, graphs & Report Form pp.20-25 (One form for each lab partner to be turned in.) **DUE Today**
- (GQ) *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

Adapted from *Workshop Chemistry*

Name(s) _____

Precision, Accuracy & Periodicity

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

	Student 1	Deviation	Student 2	Deviation
Trial 1	22.0 g/cm ³	+0.1	23.0 g/cm ³	+1.1
Trial 2	21.8 g/cm ³	-0.1	21.0 g/cm ³	-0.9
Trial 3	22.0 g/cm ³	+0.1	21.3 g/cm ³	-0.6
Trial 4	21.8 g/cm ³	-0.1	22.3 g/cm ³	+0.4
Average	21.9 g/cm ³	+/- 0.1	21.9 g/cm ³	+/- 0.8

- The accepted value is 21.8 g/cm³.

- The error is 0.4% in both cases: $(21.9 - 21.8)/21.8 \times 100 = 0.4\%$

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

2) In the early 1870's, Mendeleev predicted three "new" elements, their atomic masses and their densities: "Ekaboron", atomic mass = 44; "Ekaaluminium", atomic mass = 68, density = 5.9 g/cm³ and "Ekasilicon", atomic mass = 72, density = 5.5 g/cm³.

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

Ekaboron =

Ekaaluminium =

Ekasilicon =