Chem 108: Lab

Week 5

Sign in: Roster @ front of lab

Pick up graded papers & handout

Organize into a **group of 4 members**

Density: Due Today (End of Lab)

- Completed density calculations, graphs, questions in Report Form pp.20-25 (One form from each of you.)
- 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) Due Friday

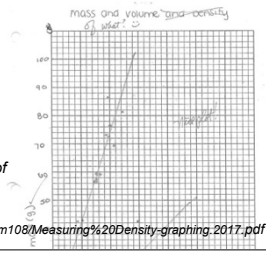
Density: Due Today (End of Lab)

- Report Forms: *One form for each lab partner are to be turned in*
  - Check each other that sig figs are correct and units included
  - Show example of each type of calculation & slope
  - Answer questions legibly in complete sentences.
  - Include graph and completed replacement page ..complete Table with % error.

- (GQ) On-line *Density & Buoyancy Guiding*
  DUE Friday

http://chemconnections.org/general/chem108/Density%20&%20Bouyancy.html

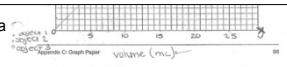
- Plot of data (A) & (B) using blank graph paper
  - Either (A) & (B) on the same graph paper or separate pages.
  - Attach graph(s) to the combined Report Form pages
  - *Complete the bottom table of handout and attach to the Report Forms to turn in.*



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

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

- 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?

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

We can rearrange this as: $mass = density(Volume)$

If we compare to equation of a line:

$$mass = density(Volume) + 0$$
$$\Delta y = m \Delta x + b$$

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

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7.89	17.22	
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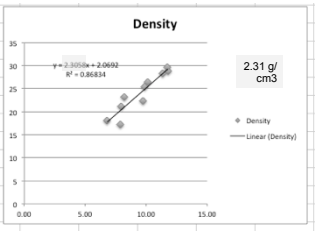
8.17	23.19	
9.84	25.44	
10.1	26.36	
11.4	28.29	
11.8	28.73	
11.7	29.69	
AVG	9.53	24.05
Density	2.52	g/cm3

Using a Spreadsheet (Excel)
Youtube

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

Volume (mL)	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
10.10	26.36
11.36	28.29
11.76	28.73
11.72	29.69



Using a Spreadsheet (Excel)
Youtube

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

A

Metal identified	Al = 2.64 g/cm3
Density (g/cm3) averaged	2.52 g/cm^3 +/-0.19 (std dev)
Error (%) averaged	(2.52-2.64)/2.64 * 100= 4.5%
Density (g/cm3) graphed	2.31 g/cm^3 +/-0.12 (std dev)
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

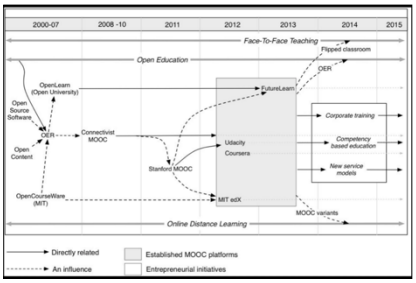
Udacity

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

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Density		*Density*
Data Averaging		Linear Regression Straight Line
2.52 g/cm3 +/-0.18		2.31 g/cm3 +/-0.12

A) Precision: Straight Line > Averaging
B) Precision: Averaging > Straight Line

QUESTION

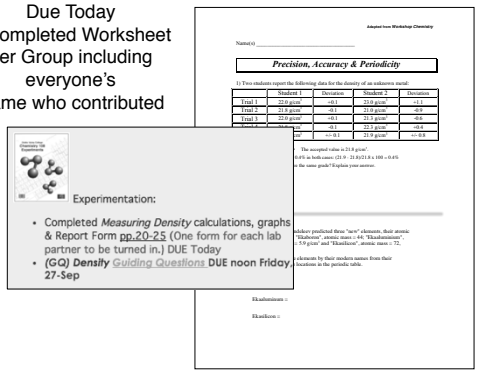
Rank the correct relative accuracy of the results from the two methods for Metal A's density's calculation. It's accepted density is 2.64 g/cm³

.

Density		*Density*
Data Averaging		Linear Regression Straight Line
2.52 g/cm3 +/-0.18		2.31 g/cm3 +/-0.12

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

Worksheet: (Handout)
Due Today
1 Completed Worksheet per Group including everyone's Name who contributed

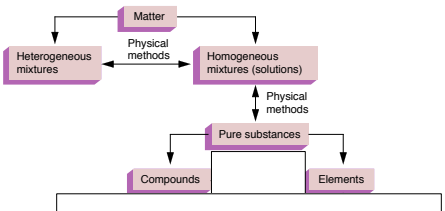


CHEM 108

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**

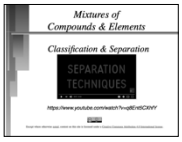


Classifying & Separating Matter
Mixtures → Pure Substances

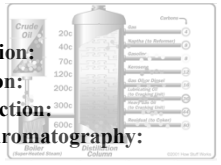
Classification of Matter
and
Chemical Change

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

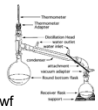
• **Filtration:** Separation of components in a mixture based upon differences in particle size. Examples: particles from air, coffee from grounds.

• **Crystallization:**

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

• **Distillation:**

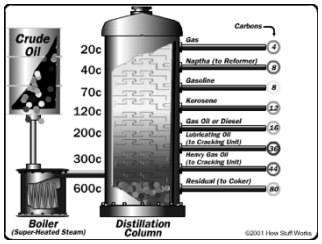
Separation based upon differences in boiling of components in a homogeneous mixture. Example: gasoline from crude oil



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

Oil Refining:

http://science.howstuffworks.com/oil-refining4.htm



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 qualitatively 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 using separation & qualitative methods
  - Part D: Determining if chemical changes occur.
- Work with your partners
  - Be sure to write partners' names ON ALL REPORT FORMS

Classification of Matter and Chemical Change

- Working with your partners
  - Bring report forms with your name and partners' names ON ALL REPORT FORMS to Dr. R.
  - Dr. R will provide each group with 2 unkown 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).
  - Evenly divide the work load among the group.

Classification of Matter

Part A: Procedural Scheme

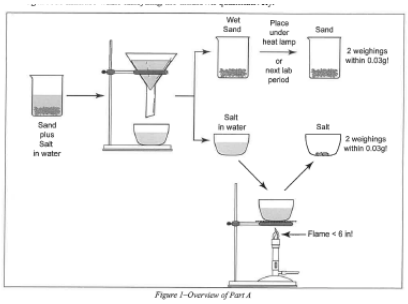


Figure 1–Overview of Part A

Classification of Matter and Chemical Change

Measuring solids (Part A):

1)Weigh empty container (beaker) & record mass

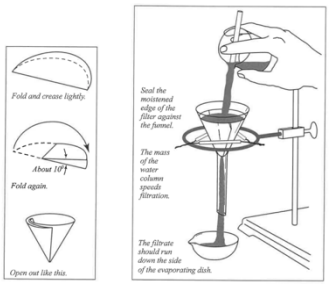
2)Remove beaker from balance and pour solid into the beaker

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

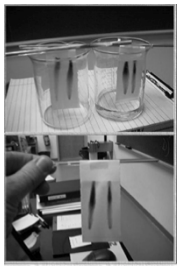
Part B: $CuSO_4 \cdot 5H_2O$

- 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, soliid: white*

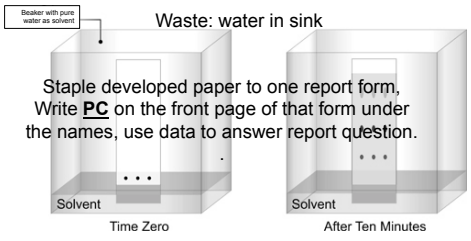
Classification of Matter

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



- 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 either of the fume hood's sink labeled **Neutralizing Bucket; ONLY use this Bucket for materials that are directed here.**

Part D.2:

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

Part D.3:

- *20 drops HCl ≈ 1mL, add "dropwise"*
- Waste for D.3:
  - Into $NaHCO_3$ in **Neutralizing Bucket**

Part D.4:

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

Exp. 3 – Classification of Matter and Chemical Change

Report DUE Next Lab Period

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

http://www.chemconnections.org/general/chem108/Physical%20Properties.html

DUE Next Lab Period; Best Done before Exam 1

Due Today

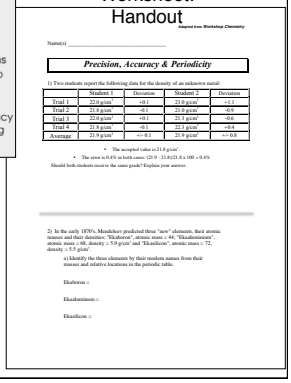
Experimentation:

- 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 1 for the Group before leaving lab today.

Worksheet: Handout



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/cm³	+0.1	21.0 g/cm³	+1.1
Trial 2	21.8 g/cm³	-0.1	21.0 g/cm³	-0.9
Trial 3	22.0 g/cm³	+0.1	21.3 g/cm³	-0.6
Trial 4	21.8 g/cm³	-0.1	22.3 g/cm³	+0.4
Average	21.9 g/cm³	+/- 0.1	21.9 g/cm³	+/- 0.8

- The accepted value is 21.8 g/cm³.
- The error is 0.4% in both cases: (21.9 - 21.8)/21.8 x 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; "Ekaaluminum", 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 =

Ekaaluminum =

Ekasilicon =