Gravimetric analysis

1. A 0.051 M solution of $Pb(NO_3)_2$ is reacted with excess NaCl solution to produce 0.296 grams of solid $PbCl_2$. What is the original sample volume of $Pb(NO_3)_2$ used in the reaction?

$Pb(NO_3)_2 + 2NaCl \rightarrow PbCl_2(s) + 2NaNO_3$

0.051 M 0.296 g

Pb 207.2
Cl 35.5×2 = 71
278.2 g/mol

$\frac{207.2}{278.2} = \frac{x\ g\ Pb}{0.296\ g}$ $x = 0.220\ g\ Pb$

$0.220\ g\ Pb \times \frac{1\ mol}{207.2\ g} = 0.00106\ mol\ Pb$

$0.051\ M = \frac{0.00106\ mol}{x\ L}$ $x = 0.021\ L$ or $21\ mL$

2. A 2.00 gram sample of a compound containing Ba^{+2} ion was treated with excess sulfuric acid in order to precipitate out all of the barium sulfate as $BaSO_4$. If 1.121 grams of $BaSO_4$, what is the percent mass in the original sample?

$Ba^{+2} + SO_4^{-2} \rightarrow BaSO_4$

? 1.121 g

Ba 137.3
S 32.1
O 4×16 = 64.0
233.4

$\frac{137.3}{233.4} = \frac{x\ g}{1.121\ g}$ $x = 0.659\ g\ Ba$

$\frac{0.659\ g\ Ba}{2.00\ g} \times 100 = 33.0\%$ Ba

3. A 0.654 gram sample of impure salt was dissolved in water and reacted with excess $AgNO_3$, forming 1.26 g of AgCl. What is the percent of NaCl in the impure sample?

$NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$

(impure) 0.654 g 1.26 g

Ag 107.9
Cl 35.5
143.4 g/mol

$\frac{35.5}{143.4} = \frac{x\ g\ Cl}{1.26\ g\ AgCl}$ $x = 0.312\ g\ Cl$

$0.312\ g\ Cl \times \frac{1\ mol}{35.5\ g} = 0.00879\ mol\ Cl$

$0.00879\ mol\ Cl \sim 0.00879\ mol\ NaCl$

Na 23
Cl 35.5
58.5 g/mol

$0.00879\ mol\ NaCl \times \frac{58.5\ g}{1\ mol} = 0.514\ g\ NaCl$

$\frac{0.514\ g}{0.654\ g} \times 100 = 78.6\%$ NaCl

4. Determine if the effect of the errors in the Molarity in each case in relation to the Gravimetric Analysis of Flint water lab. Explain.

a. White material is present in the filtrate (liquid below filter).

All the $PbCl_2$ is not captured in the filter and all lead is not accounted for in original sample, the Molarity will be too low.

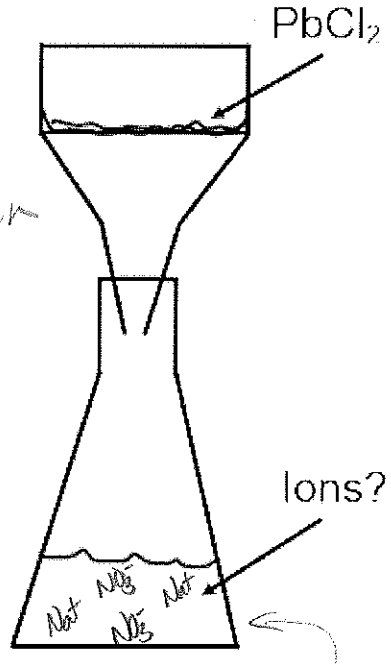
b. The filter paper with product was still wet when massed.

The final mass will include mass of H_2O and be too high. The Molarity will be higher than the actual M.

5. What color is lead (II) chloride?

White

6. On the diagram to the right. Label, an ions present in the filtrate.



$Pb(NO_3)_2 + 2NaCl \rightarrow PbCl_2 + 2NaNO_3$

$PbCl_2$: solid; $NaNO_3$: aqueous (ions)

$NaNO_3 \rightarrow Na^+ + NO_3^-$

States of matter Lab practice questions

Butane Lab

1.What is the pressure of a sample of oxygen that is collected over water at 27°C if the total pressure of the sample is 778.2 mmHg? (Vapor pressure for 27°C = 23.8 mmHg)

$P_{TOT} = P_{GAS} + P_{VAP}$

$778.2\,mmHg = P_{GAS} + 23.8\,mmHg$ $\quad P_{GAS} = 754.4\,mmHg$

2.Find the molar mass of an unknown gas if 0.339 g sample of the gas has a dry pressure (vapor pressure has been accounted for already) of 743.5 mmHg, a volume of 527mL at a temperature of 23°C.

$T = 23 + 273 = 296K$

$V = 527mL \left|\frac{1L}{1000mL}\right. = 0.527L$

$P = 743.5\,mmHg \left|\frac{1atm}{760\,mmHg}\right. = 0.978\,atm$

$PV = nRT \Rightarrow n = \frac{PV}{RT}$

$n = \frac{PV}{RT} = \frac{(0.978atm)(0.527L)}{(0.0821\frac{atm\,L}{mol\,K})(296K)} = 0.0212\,mol$

$molar\ mass = \frac{g}{mol} = \frac{0.339g}{0.0212mol} = 16.0\,g/mol$

3.If the water level inside the graduated cylinder was higher than that outside the cylinder:

a. What would be the effect on the pressure of the gas in the cylinder?

$P_{GAS} + P_{Ht\ (gravity)} = P_{TOTAL}$

The total Pressure would increase.

b. What would be the effect on the resulting molar mass of the gas calculation?

Gas volume increases

$n = \frac{PV}{RT}$ n is proportional to V so n increases

$molar\ mass = \frac{g}{n}$ as n increases, molar mass decreases

4. Give an example of experimental error in the butane lab and explain the effect on the calculation.

See p. 35 in Lab Book

5. Tank A holds 1000 grams of propane C_3H_8 and tank B holds 1000 grams of methane, CH_4. Which tank holds more moles? Show the calculation for each.

C_3H_8

C $3 \times 12 = 36$

H $8 \times 1 = 8$

$44\,g/mol$

$1000g\,C_3H_8 \left|\frac{1mol}{44g}\right. = 27.7\,mol\,C_3H_8$

CH_4

$12 + 4 = 16\,g/mol$

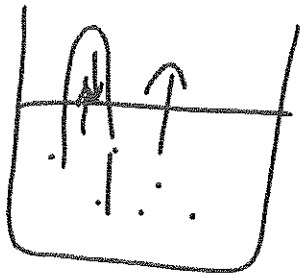
$1000g\,CH_4 \left|\frac{1mol}{16g}\right. = 62.5\,mol\,CH_4$

CH_4 tank holds more moles of gas

Butane Lab

p.35 Think it through

$P = \frac{F}{A}$



$P_{TOTAL} = P_{all\ GAS} + F_{H_2O}$

(?) ↑T, ↑ vapor P
larger V due to more H_2O molecules
↑T → take up more space
total # of particles ↑

1. V↑ due to force of gravity

molar mass = $\frac{g}{mol}$ ← (n)

$PV = nRT$ or $\frac{n}{T} = \frac{PV}{RT}$

$P_{TOT} = P_{gas} + P_{H_2O}$ (vapor)

T_{higher}

Error Analysis

a. P↑, n↑, ↓ molar mass
b. T↑, n↓, mol mass ↑
c. T↑, n↓, mol. mass ↑
d. less mass, ↓ mol mass

(2) need to correct → =0

$P_{gas} + F_{Ht} = P_{TOT}$

gravity

a. vol of gas ↑
n↑, ↓ molar mass

$n = \frac{PV}{RT}$

mol. mass = $\frac{g}{n}$