CHM 1311 - PRINCIPLES OF CHEMISTRY — Sept 5, 2019

- read syllabus, slide templates will be posted on brightspace
- discussion board
- email: subject line: CHM1311
- office hours → come ask questions
- Labs → MRN 301 - enter by south stairwell
  - ↳ need: hardcover lab book, complete pre-~~lab~~ exercises
    30 min before lab (need at least 80% in order to preform lab, rough version of protocol
  - ↳ lab tutorials, after experiment: Fri, Sept 13th, 2019
    - should show up in brightspace schedule
- Textbook: 3rd editon (Olmsted)
  - ↳ Wiley PLUS (version w/out Wiley Plus is more expensive)
    - used copy is allowed
  - ↳ need SAPLING LEARNING
    - if only for 1 semester $42.75
      - www.saplinglearning.com
        - choose Fall (and prof's name)
    - work done in free account will be transferd to pay acc
    - pair uOttawa id # w/ sapling account
    - assignments due next week
    - 10% of mark
      - ↳ assignment may take an hour
      - ↳ the assignments are marked, so get 100%
      - ↳ review assigaments split up 50, 50%
      - ↳ 5% will be taken away from each wrong answer
      - ↳ difficult questions = midterms/exams

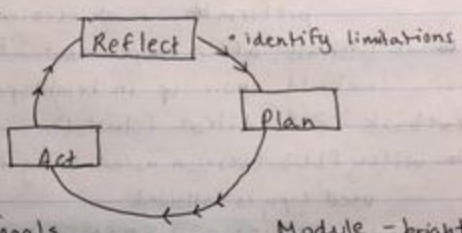
Oct 21st. if you wanna opt-out ♥

- ~~Participation Marks~~
  - ↳ ~~ANS questions~~ (even if incorrect) - ans all 4!!
    starts sept 10th
  - ↳ SMS: text 613-777-0647
  - ↳ Web Browser
- ~~Midterm~~
  - ~~1) Oct 5th~~

Kilroy ~~2) Nov 9th~~

DGD's
- Mon 17:30 – 19:00 STE TBT 333
- Wed 14:30 – 16:00 CRX C040
- mserh055@uottawa.ca : Mariam Serhan
- 1st DGD : sept 9th, 11th

Sucess
- use resources to get help - T.A's, mentor, prof
- do SAPLING
- do problems



Section 01 available ↓ use uOttawa email

- Growth & Goals — Module - brightspace
  - ↳ complete 7 sections (13 activities)
  - ↳ 1% bonus mark :)
  - ↳ 1st section due 7 Sept 12th, before class

CHAPTER 1 : FUNDAMENTAL CONCEPTS — Sept 10, 2019

$1 ps = 10^{-12}$ sec

1 min = 60 s

take $\frac{\text{desired}}{\text{given}} = \frac{1 ps}{10^{-12} s} \times \frac{60 s}{1 min}$

Quantity w/desired results = Quantity w/given units × Conversion factor

Units of Volume
- How many m^3 in 1 L
  - ↳ $(10 dm)^3 = (1 m)^3$
  - $10^3 dm^3 = 1 m^3$
  - or $1000 L = 1 m^3$

∴ conversion factor must have same exponet as unit

Converting Units of Volume

- $V = \frac{4}{3}\pi r^3$

$= \frac{4}{3}\pi (10.7\,nm)^3 = 5.13 \times 10^3\ nm^3$; given = nm, desired = dm

$1\,nm = 10^{-9}\,m$

$1\,dm = 10^{-1}\,m$

$\frac{desired}{given} = \frac{1\,dm}{10^{-1}\,m} \times \frac{10^{-9}\,m}{1\,nm} = 10^{-8}\,\frac{dm}{nm}$

$dm^3 = L$

$\left(10^{-8}\,\frac{dm}{nm}\right)^3 = 10^{-24}\,\frac{dm^3}{nm^3}$

$V = 5.13 \times 10^3\ nm^3 \times 10^{-24}\,\frac{dm^3}{nm^3}$

$= 5.13 \times 10^{-21}\ dm^3$

Uncertainty

- $32.31 \pm 0.05\,^\circ C$ → 4 sig figs
- $32.5 \pm 0.5\,^\circ C$ → 3 sig figs

Significant Figures in Calculations

- Addition + Subtraction = fewest decimal places
- Multiplication + Division = w/ the fewest sig figs

$2.06\,mL - 1.1\,mL = 0.96\,ml = 1.0$

$3.2 \times 3.7845 = 8.32590 = 8.3$

Sig Figs & Rounding

- $\frac{25.65\,mL + 37.7\,ml}{73.55\,s\left(\frac{1\,min}{60\,s}\right)} = \frac{63.0\overline{5}\,mL}{1.225\overline{8}\,Min} = 51.4\overline{36} = 51.4$

exact DOES NOT affect the # of sig figs in final answer

$(3.8621 \times 1.5630) - 5.98 = 0.036\,4623$

$= 0.06$ ✓

Chemical Problem Solving

1) know what you need to find
2) think about it realistically
3) Organize - given data, value
4) processess to solve the problem
   - equations

15.6mm

$d = \frac{m}{v}$

10.75 g

1 cm = 10 mm

1.56 cm = 15.6 mm

$\left(\frac{1\,cm}{10\,mm}\right)\left(\frac{}{15\,cm}\right)$

Atom Accounting

- 1 mol = the # of atoms in 12 g of pure ^{12}C
- Avagadro's # = $N_A = 6.022 \times 10^{23}$ units in 1 mol
- Molar mass = the mass of 1 mol of that substance
  - ↳ calculate → consider isotopes

Atomic Isotope

$^{A}_{Z}X$ mass number; $A = Z+N$

Elemental Molar Mass (EMM)

↳ weighted average of the respective molar masses of the natural isotopes of a given element

- ex. carbon elemental molar mass:

	^{12}C	^{13}C
Mass	12 g/mol	13.00335 g/mol
Abundance	98.892 %	1.108 %

Mass from ^{12}C + mass from ^{13}C

= Mass ^{12}C × $\frac{\%\text{ abundance}}{100\%}$ + mass ^{13}C × $\frac{\text{abundance }\%}{100\%}$

= $12\ g/mol \times \frac{98.892}{100} + 13.00335\ g/mol \times \frac{1.108}{100}$

memorize → = 12.01 g/mol

EMM Calculation Ex

- $EMM_B = 10.81$ u isotopic mass $_{^{10}B} = 10.0129\ g/mol$
  // // $_{^{11}B} = 11.0093\ g/mol$

Elemental $M_B = M_{^{10}B} \times \frac{\%\ ^{10}B}{100\%} + M_{^{11}B} \times \frac{\%\ ^{11}B}{100\%}$

x $\quad$ $1-x$

↳ Solve for x $M_B - M_{^{11}B} = M_{^{10}B}\,x - M_{^{11}B}\,x$

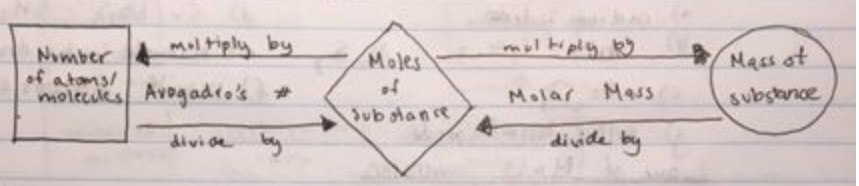
$(M_{^{10}B} - M_{^{11}B})\,x$

$$x = \frac{M_B - M_{^{11}B}}{M_{^{10}B} - M_{^{11}B}} = \frac{10.81 - 11.0093}{10.0129 - 11.0093} = 0.2000$$

$\%\ ^{10}B_A = 20.00\%$

$\%\ ^{11}B_A = 80.00\%$

Conversion Between Amount, Mass & Number



Calculation w/ Molar Mass

$m_K = 160\,g \qquad M = 39.96\,g/mol$

$M_{^{40}K} = m_K \times \frac{\%\ \text{abundance}}{100\%}$

$= 160\,g \times \frac{0.012\%}{100\%}$

$= 0.0192\,g$

$N = nN_A$

$= \frac{m}{M} N_A$

$= \frac{0.0192\,g}{39.96\,g/mol} \times 6.022 \times 10^{23} \frac{\text{atoms}}{\text{mol}}$

$= 2.9 \times 10^{20}\ \text{Atoms}$

Sept 12, 2019

Can Nomenclature Questions?

a) cadium iodide
b) $Al^{3+}.2\ S^{2-}.3$ Al_2S_3
c) Fe_2O_3
d) $Cu(NO_3)_2 \cdot 3H_2O$
e) bromide, hydrobromic acid
f) Nitrite nitrous acid
g) sulfur tetrafluoride

Law of Mass Conservation

· total Mass before rxn = total mass after rxn

Balancing Equations (B.E

$$Fe_3O_4 + 2HCl \xrightarrow{+\frac{3}{2}Cl_2} 3FeCl_3 + H_2O + \frac{3}{2}O_2$$

or

$$2Fe_3O_4 + 4HCl + 7Cl_2 \rightarrow 6FeCl_3 + 2H_2O + 3O_2$$

B.E Combustion Rxn

$$\text{Analyte} + O_2 \rightarrow CO_2 + H_2O + \text{excess } O_2$$

$$C_2H_5OH + 3O_{2(g)} \rightarrow 2CO_2 + 3H_2O_{(l)}$$

Ex. Calc Comb. Rxn

· 22.85 g of hydrocarbon w/ M = ~~the~~ 114.22 g/mol undergoes comb, 88.94 g CO_2 & 40.84 g H_2O is produced. molecular formula?

1) Step 1: $n_C = \frac{m_{CO_2}}{M_{CO_2}} = \frac{88.94\text{g}}{12.01 \times 2(16)} = 2.0209\ \text{mol}$

$$n_H = m_{H_2} \times \frac{2\ \text{mol H}}{1\ \text{mol } H_2O} = \frac{40.84\text{g}}{2(1.01) + 16.00} = 4.500\ \text{mol}$$

2) Step 2: $C_{\frac{2.0209}{1.0209}}\ H_{\frac{9.000}{2.0209}}$

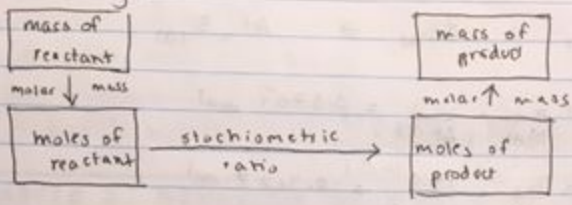
3) Step 3: $C_{M}H_{2.2268\,M} = C_4H_9$ · multiply by integers until we find that gives whole #

4) Step 4: $M_{\text{compound}} = 114.22\text{g/mol}$ $M_{C_4H_9} = (4 \times 12.01) + 9(16) = 57.112\ \text{g/mol}$

$$\frac{M_{\text{compound}}}{M_{C_4H_9}} = \frac{114.22}{57.112} = 2$$

$\therefore C_{4\times2}H_{9\times2}$

Stoichiometry



Ex

$NH_4NO_3 \longrightarrow N_2O + 2H_2O$

1) Calculate

$$n_{NH_4NO_3} = \frac{m}{M} = \frac{454\,g}{80.025\,g/mol} = 5.671\,mol$$

2) Rxn Stoich.

$$n_{H_2O} = n_{NH_4NO_3} \times \frac{2\,mol\,H_2O}{1\,mol\,NH_4NO_3} = 5.671\,mol \times \frac{2}{1} = 11.342\,mol$$

3) convert to mass

$$m_{H_2O} = n_{H_2O} M_{H_2O}$$

$$= 11.342\,mol \left(\frac{18.016\,g}{mol}\right) = 204.3\,g$$

LAW MASS of CONSERVATION

$$m_{NH_4NO_3} = m_{H_2O} + m_{N_2O}$$

$$m_{N_2O} = m_{NH_4NO_3} - m_{H_2O}$$

$$= 454\,g - 204.3\,g$$

$$= 250\,g$$

Rxn Yield Calc

% yield = $\frac{\text{actual amount of product}}{\text{theoretical amount of product}} \times 100\%$

eg: multiply the yields after divide each by 100

overall yield = $0.8 \times 0.8 \times 0.5 \times 0.1 \times 0.48 \times 0.3$

$= 4.6\%$

Limiting Reagents Problem

1) Balance Equation 2) convert to moles 3) rxn stoic

4) smallest amount of product = L.R

Ex

$2Al_{(s)} + 3S_{(s)} \rightarrow Al_2S_{3(s)}$

$n_{Al} = \frac{m_{Al}}{M_{Al}} = \frac{10.0}{26.98} = 0.3707\ mol$

$n_S = \frac{m_S}{M_S} = \frac{15.0}{32.06} = 0.4677\ mol$

$nAl_2S_3 = m_{Al} \times \frac{1\ mol\ Al_2S_3}{2\ mol\ Al}$ $\quad nAl_2S_3 = n_S \times \frac{1\ mol\ Al_2S_3}{3\ mol\ S}$

$= 0.1853\ mol$ $\quad = 0.1559\ mol$

$\therefore$ L.R is S

Echo 360 Q1 Sept 17th, 2011

$\rho = \frac{m}{V} = \frac{0.79\ g}{mL}$

$N_H = n_{EtOH} = \frac{6\ mol\ H}{1\ mol\ EtOH}$ $\quad n_{EtOH} = \frac{m_{EtOH}}{M_{EtOH}} = \frac{dv}{M_{EtOH}}$ (150.1 g)

Rxn Table

	$2\ Al_{(s)}$	$+\ 3\ S_{(s)}$	$\rightarrow Al_2S_{3(s)}$
I	0.370	0.4677	0
C	$n_S \times \frac{2\ mol\ Al}{3\ mol\ S}$	$-$ 0.4677	$+$ 0.1559
F	0.3118	0	0.1559

$n_{initial} - n_{used} = 0.059$

Limiting Reactants in Solution

Ex. $Pb(OAc)_{2(aq)} + NaCl \rightarrow PbCl_2 + 2NaOAc$

Limiting Reagent

From $Pb(OAc)_2 = n\ PbCl_2 = n\ Pb(OAc)_2 = cv$

$= 0.50\ M\ (0.268L) = 0.402\ mol$

From NaCl $= n\ PbCl_2 = n\ NaCl \times \frac{1\ PbCl_2}{2\ NaCl} = c \cdot v$

Echo 360

$Pb = 207.2\ g/mol$

$2.2 \times 10^{-3}\ mol \left(\frac{53.03\ g}{1\ mol}\right)\left(\frac{2\ mol}{5\ mol}\right)\left(\frac{1\ mol}{207.2}\right)$

% mass $Pb = \frac{m_{Pb}}{m_{soil}} \times 100\%$

25.0 g soil