Notes by Aaron Hui

Chemistry Lecture 02.28.17

- Diatomic molecules:
    - Rule of 7's. Start at atomic number 7 (N), go to column 7 and down to iodine.
- Ion - charged species
    - Cation: + charge
        - Metals, **lose** e-
    - Anion: - charge
        - Nonmetals, **gain** e-
- Monatomic ion - only 1 atom **(Ex: Na^+, N^{3+})**
    - Octet rule - want 8 valence e- (be like nearest noble gas)
        - Valence e- = group # (main group elements)
            - Metals: charge = group #
            - Nonmetals: charge = group # - 8
- Polyatomic ion - more than 1 atom **(Ex: OH^-, NO_3^-)**
- How many protons and electrons are in $^{23}_{13}Al^{3+}$
    - Protons: 13 protons
    - Electrons: 10 electrons
- How many protons and electrons are in $^{78}_{34}Se^{2-}$
    - Protons: 34 protons
    - Electrons: 36 electrons
- What is the formula of the phosphorus ion (phosphide)? How many electrons are present?
    - P^{3-}, (15+3)= 18 electrons
- Ionic compounds - cation(s) + anion(s)
    - Sum of charges must equal **zero**
    - The ionic compound NaCl

- LEO the lion goes GER
  - Lose Electrons Oxidize
  - Gain Electrons Reduce
- Reducing agent is oxidized, causes the other to be reduced.
- Oxidizing agent is reduced, causes the other to be oxidized.

- Example: Zinc reacts with copper sulfate. What is the oxidizing agent in the reaction? What substance is being oxidized?
  - $Zn + CuSO_4 \rightarrow Cu + ZnSO_4$

    0 +2 same 0 +2 same
  - Cu went from +2 to 0, so $CuSO_4$ is the oxidizing agent (Cu is being reduced)
  - Zn went from 0 to +2, so Zn is the reducing agent (Zn is being oxidized)

- Example: Copper wire reacts with silver nitrate to form silver metal and copper(II) nitrate. What is the oxidizing agent in the reaction?
  - $Cu(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Cu(NO_3)_2(aq)$

    0 +1 same 0 +2 same
  - Cu went from 0 to +2, so Cu is the reducing agent (while also being oxidized)
  - Ag went from +1 to 0, so $AgNO_3$ is the oxidizing agent (and Ag is being reduced).

Lecture 03.02.17

- Average Atomic Mass - avg. mass of all naturally occurring isotopes
  - Ex: Natural Lithium is
    - 7.42% ^{6}Li (6.015 amu)
    - 92.85% ^{7}Li (7.016 amu)
      - .0742 (6.015 amu) = .446 amu

- How many Na atoms are present in 35.2 mol sample?
  - $35.2\ mol\ Na * \frac{6.022*10^{23} atoms\ Na}{mol\ Na} = 2.12 * 10^{25}\ atoms\ Na$
- How many Cu atoms are present in a 6.5 mol sample of copper?
  - $6.5\ mol\ Cu * \frac{6.022*10^{23} atoms\ Cu}{mol\ Cu} = 3.9 * 10^{24}\ atoms\ Cu$

- Practice using Chemical Formulas as Conversion Factors
  - How many moles of O are there in 18 moles of CO_2?
    - $18\ mol\ CO_2 * \frac{2\ mol\ O}{mol\ CO_2} = 36\ mol\ O$
  - How many moles of O are there in 18 moles of $CaCO_3$?
    - $18\ mol\ CaCO_3 * \frac{3\ mol\ O}{mol\ CaCO_3} = 54\ mol\ O$
- Using Both Avogadro's Number and Formulas
  - How many O_3 molecules are in 1.37 moles of ozone? How many oxygen atoms are present.
    - Part One of the problem

      $1.37\ mol\ O_3 * \frac{6.022*10^{23} molec\ O_3}{mol\ O_3} = 8.25 * 10^{23} molec.\ O_3$

    - Part Two of the problem (2 ways to do it)

      $8.25 * 10^{23}\ molec.\ O_3 * \frac{3\ atoms\ O}{molec.\ O_3} = 2.48 * 10^{24}\ atoms\ O$

      ——

      $1.37\ mol\ O_3 * \frac{3\ mol\ O}{mol\ O_3} * \frac{6.022*10^{23} atoms}{mol\ O} = 2.48 * 10^{24}\ atoms\ O$
  - How many $C_6H_{12}O_6$ molecules are present in a 0.225 mol sample? How many C atoms are present?
    - Part One of the problem

$.225\ mol\ C_6H_{12}O_6 * \frac{6.022*10^{23}\ molec\ C_6H_{12}O_6}{mol\ C_6H_{12}O_6} = 1.35 * 10^{23} molec\ C_6H_{12}O_6$

Part Two of the problem

$1.35 * 10^{23} molec\ C_6H_{12}O_6 * \frac{6\ atoms\ C}{molec.\ C_6H_{12}O_6} = 8.13 * 10^{23} atoms\ C$

- $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$

  50.0g 75.0g

$$50.0\ g\ Al * \frac{mol\ Al}{26.98\ g\ Al} * \frac{3\ mol\ H_2}{2\ mol\ Al} * \frac{2.016\ g\ H_2}{mol\ H_2} = 5.60\ g\ H_2$$

$$75.0\ g\ HCl * \frac{mol\ HCl}{36.46\ g\ HCl} * \frac{3\ mol\ H_2}{6\ mol\ HCl} * \frac{2.016\ g\ H_2}{mol\ H_2} = 2.07\ g\ H_2$$

2.07 g H_2 is the theoretical yield and HCl is the limiting reagent.

Start with L.R. (0 g HCl left since its L.R.)

$$75.0\ g\ HCl * \frac{mol\ HCl}{36.46\ g\ HCl} * \frac{2\ mol\ Al}{6\ mol\ HCl} * \frac{26.98\ g\ Al}{mol\ Al} = 18.5\ g\ Al\ used\ up$$

$$Al:\ 50.0\ g - 18.5\ g = 31.5\ g\ Al\ left$$

$$\%\ Yield = \frac{1.92\ g}{2.07\ g} * 100\% = 92.6\%$$

OTHER METHOD FOR DETERMINING L.R.

1. Take one reactant and convert into other
2. Compare to what was given

$$50.0\ g\ Al * \frac{mol\ Al}{26.98\ g\ Al} * \frac{6\ mol\ HCl}{2\ mol\ Al} * \frac{36.46\ g\ HCl}{mol\ HCl} = 203\ g\ HCl$$

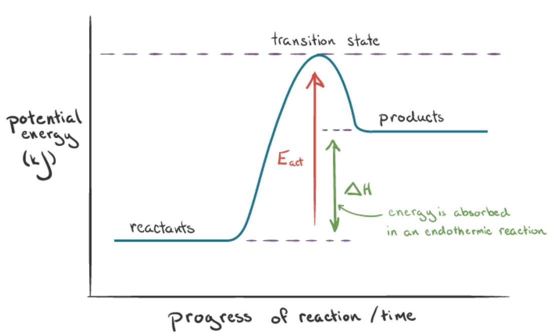
Need 203 g HCl. Don't have 203 g, only have 75 g, thus HCl is L.R.

QUIZ 1 TOPICS:

Sig fig
Measurements
Dim Analy
Atomic Theory

- Pressure-Volume (PV) Work:
  - Work done by an expanding gas (w is -)
  - Work done on a gas compressing it (w is +)

- Heat
  - Exothermic process - <u>releases</u> heat
    - $2H_2$ (g) + O_2 (g) → $2H_2O$ (l) + energy
    - H_2O (g) → H_2O (l) + heat
    - FEELS HOT
  - Endothermic process - <u>absorbs</u> heat
    - Energy + 2HgO (s) → 2Hg (l) + O_2
    - Energy + H_2O (s) → H_2O (l)
    - FEELS COLD
  - Solid →(endo)→ Liquid →(endo)→ Gas
  - Solid ←(exo)← Liquid ←(exo)← Gas

- Enthalpy (H)
  - ΔH = heat given off or absorbed during a reaction **at constant pressure**.
    - $\Delta H = H_{products} - H_{reactants}$
    - $\Delta H < 0$ exothermic
    - $\Delta H > 0$ endothermic
    - $H_{products} < H_{reactants}$
    - 

exothermic