Notes for Exam #2 (Chem)

Stoichiometry

•Molarity is an intensive property

•Molarity is a concentration unit (Mol/L)

◦Ex => A 400.ml sample of solution contains 0.20 mol of CaBr2. What is the concentration of bromide ions in this solution.

▪Solution=> (0.20mol/0.4L) (2 Bromide ions "Br2"/1 mol of CaBr2)= 1.0 M Br

•Stoichiometry in Career Situations (Preparing Solutions)

◦The solution must be 51mM NaCl and 185mM glucose, and you need to prepare 500. liters. What amour of NaCl and glucose (in Kg) should you order? (NaCl, MM= 58.4 g/mol ; Glucose= C6H12O6 MM= 180.2g/mol)

▪Solution=> NaCl = 500. L x (0.051moles NaCl / 1 L) x (58.4 g/mol NaCl) x ( 1kg/1000g) = 1.5 Kg NaCl

▪Glucose = 500L x (0.185mol C6H12O6 / 1 L)  x (180.2 g/mol of Glucose) x ( 1 kg/ 1000g) = 16.7 Kg of Glucose.

•Diluting Solutions

◦Make a stock concentrated solution and then dilute it with water in order to reach the desired concentration.

▪Moles of solute in the solution do not change

▪# mol solute = mol/L x L

▪# mole solute = Mconcentrated x Vconcentrated= Mdilu x Vdilu

▪Ex, What volume of 0.400M K2Cr04 must be diluted with water to prepare 1.00L of 0.100M solution?

▪Solution => Vconc= (Mdil x V dil)/ Mconc => (0.100M x 1.00 L)/ 0.400M = 0.250 L or 250ml.

▪#moles dont change, the concentration and volume does.

•Concentrations can be changed by mixing solutions

◦Ex, When 200. ml of 0.40M NaCl is mixed with 600. ml of 0.20 M NaCl, what is the resulting concentration of NaCl?

▪Solution => (0.200 L x 0.40 M) + (0.600 L x 0.20 M) =  0.20 mol NaCl

▪(0.20 mol NaCl)/ (0.200L + 0.600L) = 0.25 M

•Reactions in Solution

◦Ex, When 24.3 g magnesium reacts with 500. ml of 3.2 M hydrochloric acid, 0.60 mol of hydrogen gas is formed. What is the % yield?

▪Solution => Mg + 2HCL --> H2 + MgCl2

▪Mg: H2 = 1:1 mole ratio => 1 mole of H2

▪(0.50 L x 3.2 M HCl) /2 = 0.80 mole of H2

▪Thus, HCl is the limiting reagent (LR) of 0.80 mole of H2

▪Thus, the 5 yield= actual/ theo x 100% = 0.60 H2/ 0.80 H2 x 100= 75%.

Three major types of chemical reactions

◦Precipitation

◦Acid Base

◦Redox

•Lakes that have been acidified by acid rain (HNO3 and H2SO4) can be neutralized by liming, in which limestone (CaCO3) is added to the acidified water.

•Water as solvent

◦Water is an excellent solvent because it is a polar molecule. The bond are covalent, but electrons are shifted tower the oxygen atom; unequal charge distribution and bent shape cause molecular polarity.

◦I an aqueous solution, the ions are "solvated" by water.

•Covalent compounds in Water

◦Acids are covalent compounds dissociated by H20

◦Polar compounds dissolved by water (not dissociated)

◦Non-Polar compounds: Not dissolved by H20

•Electrolytes (Substance that conducts current when placed in water)

◦Strong electrolytes :complete dissociation

▪Soluble salts: NaCl, Ma(NO3)2

▪Strong acids: HCl, HBr, HNO3, H2SO4, HCl04

▪Strong bases: NaOH, Ca(OH)2

◦Weak electrolytes: small degree of dissociation

▪Weak acids: CH3COOH + H20 <--> CH3COO- + H3O+

▪Weak Bases: NH3 + H20 <--> NH4+ +OH-

•Aqueos Ionic Reactions

◦Molecular equation: Original chemical balanced equation

▪2KI + Pb(NO3)2 --> 2KNO3 + PbI2 (s)

◦Total Ionic Equation: Soluble ionic compounds as dissociated into ions

▪2K+ + 2I- +Pb2+ + 2NO3- --> PbI2 + 2K+ + 2NO3-

◦Net Ionic Equation: Eliminates spectator Ions and shows the actual chemical change (usually aq + aq to s or l or g…anything different than aq)

•Gases

◦Pressure: 760 mm Hg = 760 torr = 1 atm = 101.325 kPa= 14.7 psi

▪Si  Unit= Pa (pascals)

◦Boyle's Law ( T and n fixed)

▪V= 1/P (inversely proportional) P increases while V decreases.

▪V=constant/P or PB = constant

▪P1V1=P2V2

◦Charles' Law: (P and n fixed)

▪V= T (directly proportional), T and V increases simultaneously

▪V=constant x P or V/T= constant

▪V1/T1= V2/T2

◦Avogadro's Law: (P and T Fixed)

▪V= n (directly proportional) N increases then V increases.

▪V=constant x n or V/n = constant

▪V1/n1= V2/n2

◦At fixed P and T, equal volumes of any ideal gas contain an equal number of molecules.

•Ideal Gas Law

◦PV= nRT

◦R=0.08206 atm L/mol K or 8.314 KPa L/ mol K

◦or P1V1/n1T1 = P2V2/n2T2

◦P (molar Mass)/ RT = M/v= Density

◦Ex, what is the density of 1 atm of O2 at 300K = 1 (32)/0.08206 atm x 300K = Density…high density

◦Partial Pressure

▪ If 600torr of gas contains 4 g H2 and 4 g He, What is the partial pressure of He?

▪moles of He/ ( moles of H2 + moles of He) x P

▪2g of H2= 2 moles of H2 ; 4 g He= 1 mole of He

▪XHe= 1 mole of He/ (2 moles of H2 + 1 mole of He) x (600 torr) = 200 torr.

▪Ptotal= P barometric= Pgas + Pwater

▪Pwater= vapor pressure of water

▪22 torr at room temperature usually

•Kinetic Molecular Theory

◦Explains the physical behavior of gases at the level of individual particles

◦Three postulates:

▪Particles volume: negligible

▪Particle motion: constant, random, straight-line motion

▪Particle collissions: elastic

▪Kinetic energy (Ek) is constant.

◦Average Kinetic energy is proportional to T (at a given T, all gases have the same average kinetic energy)

▪(energy/molecule) or (energy/mol)

▪Ek is an extensive property (depends on # moles)

•Graham's Law of Effusion/Diffusion

◦Effusion: Escape of gas through a hole

◦Diffusion: movement of one gas through another

◦Rate A/Rate B = MMB^1/2 / MMA^1/2

◦A fixed time Rate A/Rate B= Distance A/Distance B (directly proportional)

◦At a fixed distance: Rate A/Rate B= Time B/Time A(inversly proportional)

Equilibrium

•The condition in which the rates of the forward and reverse reactions are equal. The amount of reactants and products become constant.

◦Equilibrium between phases

▪At equilibrium: Rate of Vaporization=Rate of Condensation

◦Equilibrium between reactants and products

▪Rate of Forward reaction= Rate of Reverse reaction

◦aA + bB <--> cC + dD

◦Reaction quotient=Qc = [C]c[D]d/[A]a[B]b

◦Equilibrium constant (Kc) based on the concentrations at equilibrium.

▪Kc= [C]ceq[D]deq/[A]aeq[B]beq

◦Kc and Qc can also be written in terms of pressure, Kp and Qp

◦Kfwd= 1/Krev

◦

◦Important Points about Q and K

▪ Q and K are always positive.

▪A ratio of concentrations, which are always positive.

▪ Q and K values are unitless numbers.

▪Quantities are referenced to standard state quantities

▪ 1 M or 1 atm

▪Q and K expressions do not include pure liquids or solids

▪ Concentrations of pure liquids and solids are constant

▪Q and K refer to a specific balanced equation

◦Relation between Kc and K

▪Kc is the k in terms of equilibrium concentrations

▪Kp is the k in terms of equilibrium pressures.

▪kp= Kc (RT)^ngas

▪ngas= # moles gas product- # moles gas reactant

◦Q=K, no net reaction occurs

◦Q<K, reaction proceeds to the right => reactants -> products (not enough product)

◦Q>K, reaction proceeds to the left => products -> reactants ( too much product)

◦I.C.E Table