

General Chemistry 200

Practice Exam 2 Stoichiometry Calculations and Aqueous Systems

Chapter 3 Stoichiometry Calc. & formulas

- 1 Chemical Equation
 - Type of Reactions
- 2 Atomic and Molc' Wt
 - AW, MW, FW
 - % Composition
- 3 The mole
- 4 Empirical Formula determination
 - Mol. Formula determination
 - From Combustion Analysis
- 5 Stoichiometry problems:
 - Molecules to moles
 - Mass to moles
 - Volume to moles
 - Using the balance equation, moles_a to moles_b
- 6 Quantitative Information
 - Calculating Limiting reagents
 - Determining the amount of excess
 - % yield calculations

- 1 Solution Composition
 - Concentrations and Molarity
 - Dilution Calculation
- 2 Properties of Solution
 - Aqueous solution (Water)
 - Ions in Water
 - Molecules in Water
 - Electrolytes: Weak electrolytes: nonelectrolytes
- 3 Acid / Base
- 4 Ionic Equations
- 5 Metathesis Reaction
 - Ppt reaction and solubility table
- 6 Oxidation – Reduction
 - Electron transfer through single displacement
 - Activity Series
- 7 Titration calculations and concepts
 - The experimental setup
 - Acid-Base Stoichiometry

Chapter 4 Aqueous Stoichiometry

1 IA		Periodic Table										13 IIIA					14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA	
1	2											3	4	5	6	7	8	9	10			
1 H 1.00794	2 He 4.0026											3 Li 6.941	4 Be 9.01218	5 B 10.811	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.179			
3 Na 22.9898	4 Mg 24.305	3 Al 26.9815	4 Si 28.086	5 P 30.9738	6 S 32.066	7 Cl 35.453	8 Ar 39.948															
4 K 39.098	5 Ca 40.078	6 Sc 44.956	7 Ti 47.88	8 V 50.9415	9 Cr 51.9961	10 Mn 54.9380	11 Fe 55.847	12 Co 58.9332	13 Ni 58.6934	14 Cu 63.546	15 Zn 65.39	16 Ga 69.723	17 Ge 72.61	18 As 74.9216	19 Se 78.96	20 Br 79.904	21 Kr 83.80					
5 Rb 85.4678	6 Sr 87.62	7 Y 88.906	8 Zr 91.224	9 Nb 92.9064	10 Mo 95.94	11 Tc 98.9063	12 Ru 101.07	13 Rh 102.906	14 Pd 106.42	15 Ag 107.868	16 Cd 112.411	17 In 114.82	18 Sn 118.710	19 Sb 121.757	20 Te 127.60	21 I 126.905	22 Xe 131.29					
6 Cs 132.905	7 Ba 137.32	8 La 138.906	9 Hf 178.49	10 Ta 180.948	11 W 183.85	12 Re 186.207	13 Os 190.2	14 Ir 192.22	15 Pt 195.08	16 Au 196.967	17 Hg 200.59	18 Tl 204.383	19 Pb 207.19	20 Bi 208.980	21 Po 208.982	22 At 209.987	23 Rn 222.017					
7 Fr 223.02	8 Ra 226.025	9 Ac 227.028	10 Ku [261]	11 [262]	12 [263]	13 [262]	14 [265]	15 [268]	16 [269]	17 [272]	18 [277]											

Conversion information:

System	LENGTH:	VOLUME	MASS	Temperature
English:	1 ft = 12 in 1 mile = 5280 ft	1 gal = 4 qt 1 qt = 2 pints 1 pt = 16 fl oz	1 lb = 16 oz 1 ton = 2000 lb	$T_{\text{°F}} = 1.8T_{\text{°C}} + 32$
SI-English:	2.54 cm = 1 in 1.609 km = 1 mi	0.946 L = 1 qt 3.785 L = 1 gal 29.57 mL = 1 fl oz.	453.6 g = 1 lb 28.35 g = 1 oz 1 kg = 2.205 lb	$T_{\text{°C}} = \frac{(T_{\text{°F}} - 32)}{1.8}$
Misc. info	1 mole = $6.02 \cdot 10^{23}$		Density H ₂ O: 1.0 g / cc	

General Solubility Table:

Soluble substances containing -	Exceptions	Insoluble substances containing -	Exceptions
nitrate (NO ₃ ⁻) chlorate (ClO ₃ ⁻) perchlorate (ClO ₄ ⁻) Acetate (CH ₃ COO ⁻)	None	carbonate (CO ₃ ²⁻) Phosphate (PO ₄ ³⁻) chromate (CrO ₄ ²⁻) Sulfides (S ²⁻)	slightly soluble
Halogens (X ⁻) X ⁻ = Cl ⁻ , Br ⁻ , I ⁻	Ag, Hg, Pb	Hydroxides (OH ⁻)	Ca*, Sr, Ba, Alkali, NH ₄ ⁺ * marginally soluble
Sulfates (SO ₄ ²⁻)	Ca, Ba, Hg, Pb		
Alkali & NH ₄ ⁺	None		

Soluble - dissolve, no precipitate (aq -phase)

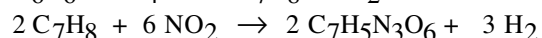
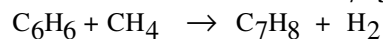
insoluble (or slightly soluble) - does not dissolve, precipitate forms. (s-phase)

- 1 Combustion of a sulfide of bismuth compound, Bi_xS_y (50.00g) in O₂ produced 45.30 g of dibismuth trioxide (Bi₂O₃).
- What is the IUPAC compound name, empirical formula and the formula weight of the bismuth sulfide (Bi_xS_y) compound?
 - What is the oxidation state of the sulfur and the bismuth in this compound?
 - Suppose in your combustion experiment, the Bi_xS_y compound also contained some bismuth oxide impurities, how would this affect the x-value in the empirical formula of Bi_xS_y (higher or lower and state your reason)?
 - Suppose instead of producing 45.30 g dibismuth trioxide in the final product of the combustion, 45.30 g of dibismuth pentaoxide is produced instead, how would this affect the y-value in the empirical formula of Bi_xS_y ?
- 2 Balance the following equations.
- $\text{___KOH(aq)} + \text{___H}_2\text{SO}_4\text{(aq)} \rightarrow \text{___K}_2\text{SO}_4\text{(aq)} + \text{___H}_2\text{O (aq)}$
 - $\text{___C}_4\text{H}_{14}\text{(l)} + \text{___O}_2\text{(g)} \rightarrow \text{___CO}_2\text{(g)} + \text{___H}_2\text{O(l)}$
 - $\text{N}_2\text{H}_4\text{(l)} + \text{___O}_2\text{(g)} \rightarrow \text{___NO}_2\text{(g)} + \text{___H}_2\text{O (g)}$
 - $\text{___K}_2\text{CO}_3\text{(aq)} + \text{___H}_3\text{PO}_4\text{(aq)} \rightarrow \text{___K}_3\text{PO}_4\text{(aq)} + \text{___CO}_2\text{(g)} + \text{___H}_2\text{O(l)}$
 - Arsenic(III) oxide + Hydrochloric acid → Arsenic(III) chloride + Dihydrogen monoxide
 - Phosphorus + Bromine → Phosphorus tribromide
 - Calcium carbonate decomposes to calcium oxide and carbon dioxide
 - Copper(II) sulfate pentahydrate is dehydrated to _____ + _____

Identify the type of reaction above.

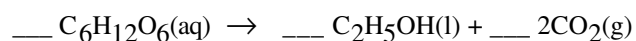
3 A compound of Ca, C, N, and S was subjected to quantitative analysis and formula mass determination, and the following data were obtained. A 0.250 g sample was mixed with Na_2CO_3 to convert all of the Ca to 0.160 g of CaCO_3 . A 0.0268 g sample of the compound was carried through a series of reactions until all of the S was changed to 0.0802 g of BaSO_4 . A 0.712g sample was processed to liberate all of its N as NH_3 , and 0.155 g NH_3 was obtained. The formula mass was found to be 156 g/mol. Determine the empirical and molecular formulas of this compound.

4 2,4,6-Trinitrotoluene (TNT), $\text{C}_7\text{H}_5\text{N}_3\text{O}_6$, can be prepared by the following two step synthesis:



If **each** step in this synthesis gives a 50% yield, how much $\text{C}_7\text{H}_5\text{N}_3\text{O}_6$ (TNT) in grams can be produced starting with 780 g of benzene (C_6H_6) ?

5 Ethyl alcohol (booze), $\text{C}_2\text{H}_5\text{OH}$, also called grain alcohol, can be made by the fermentation of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, which often comes from starch in grain:



Determine the maximum mass (theoretical yield) of ethyl alcohol which could be produced from 750 g of glucose. If 150 L of CO_2 is collected after the fermentation, what is the % yield. Density of CO_2 (g) is 1.96 g/ L.

6 Determine which of the following will dissolve in water, then classify these as

(s) strong electrolyte, (w) weak electrolyte or (n) non-electrolyte.

i) NH_3 ii) PbSO_4 iii) KHSO_4 iv) Hg_2Cl_2 v) HNO_3 vi) NH_4OH vii) $\text{C}_2\text{H}_5\text{OH}$

Explain your answer

7 Write the net ionic equation for any reaction that occurs upon mixing each pair of solution:

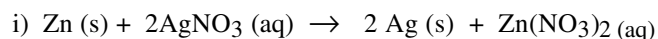
i) silver nitrate and barium chloride

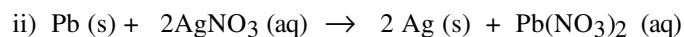
ii) Magnesium sulfate and barium hydroxide

iii) Hydrochloric acid and strontium hydroxide.

iv) Iron(III) sulfide and nitric acid

8 In each of the following reaction, indicate which metal ion is the stronger oxidizing agent, that is rank each metal Zn, Ag and Pb in order of ease of oxidation . (i.e., Most easily oxidized > next easily oxidize > most difficult to oxidize)





9 Some sulfuric acid is spilled on a lab bench. It can be neutralized by sprinkling some sodium bicarbonate on to the sulfuric acid. The reaction produces sodium sulfate, carbon dioxide and water.

i) Write the molecular, ionic and net ionic equation and balance the equation (include the phases).

ii) What is the limiting reagent and how much remains if 35 ml of 6.0 M sulfuric acid is spilled and 50 grams of sodium bicarbonate is added ?

iii) What is the mass of carbon dioxide gas (g) that is produced ?

iv) How many molecules of carbon dioxide is produced ?

v) If 5.00 ml of water is actually produce, what is the % yield of water ?

vi) How many oxygen atoms are involved in this reaction ?

vii) If all the liquid is evaporated, what is the mass of sodium sulfate that is produced ?

viii) What is the concentration of sodium sulfate if 20.0 g sodium sulfate is dissolved in the 5.00 ml water?

ix) Suppose potassium hydroxide is substituted for sodium bicarbonate in the above reaction. What mass of potassium hydroxide is required to neutralize 35 ml of 6.0 M sulfuric acid.

10 Balance the following equations and then answer the questions below.

Potassium permanganate is added to hydrochloric acid to produce

chlorine gas, potassium chloride, manganese(II) chloride and water.

i) How many moles of hydrochloric acid are required to react with 45 grams of potassium permanganate ?

ii) How many chlorine molecules will be produced using 5.0 moles of potassium permanganate ?

iii) To produce 55.0 grams of manganese(II) chloride, what mass of hydrochloric acid is required?

iv) How many moles of water will be produce when 7.00 moles of potassium permanganate is consumed ?

v) What is the maximum weight of chlorine that can be produced by reacting 35.0 g of potassium permanganate with 45.0 g of hydrochloric acid ?

vi) In v (above), if the %yield of chlorine in the reaction is 76%, how much (g) chlorine was actually recovered ?

11 Consider **100** formula units (or molecules) of each:

a) Tin(IV) hypoiodite

b) carbon tetraiodide

c) cadmium iodite

i) Which compound contains the largest mass of iodine? How much is this mass in grams?

ii) Which contains the greatest mass of metal atoms? For a 100 unit sample, what is the total of these metal atoms ?

iii) If all three of these substances were mixed and added to water, calculate the total number of ions in solution.