

AQUEOUS SOLUTIONS

1. (10 points) Names, formulas, and solubility of compounds.

Name	Formula	Soluble in Water?
Ammonium chloride	NH_4Cl	Yes
	BaSO_4	
	Li_2CO_3	
Barium phosphate		
Manganese(IV) oxide		
	$\text{Cu}(\text{OH})_2$	

2. (9 points) Names, formulas, and ions formed by the compounds in water. (*Each of the compounds listed here is soluble in water.*)

Name	Formula	Cation	Anion
Ammonium chloride	NH_4Cl	NH_4^+	Cl^-
	Na_2SO_4		
	H_3PO_4		
Nitric acid			

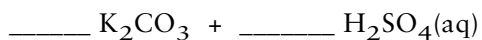
3. (3 points) Write the net ionic equation for the following reaction:

*Net ionic equation:*

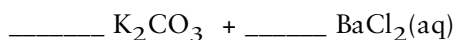
WRITING EQUATIONS

1. (12 points) Complete and balance the equations a-c. Describe each of the equations as an *acid-base reaction*, a *precipitation*, or a *gas-forming reaction*:

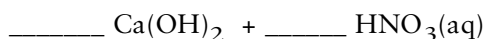
(a) Reaction type: _____



(b) Reaction type: _____



(c) Reaction type: _____

**MAKING SOLUTIONS/CONCENTRATION UNITS**

1. (7 points) What mass of sodium carbonate, Na_2CO_3 (molar mass = 106 g/mol) is required to make exactly 100 mL of a 0.115 M solution of the compound?

- (a) 0.100 g
(b) 0.115 g
(c) 1.06 g
(d) 1.22 g

If the Na_2CO_3 solution has a concentration of 0.115 M, what are the concentrations of the individual ions?

Cation = _____ Concentration of cation = _____

Anion = _____ Concentration of anion = _____

2. (3 points) Suppose you place 5 drops of 0.15 M CuSO_4 in a test tube and add 10 drops of water. What is the approximate concentration of the now diluted CuSO_4 solution?

- (a) 0.15 M
(b) 0.12 M
(c) 0.10 M
(d) 0.075 M
(e) 0.050 M

SOLUTION STOICHIOMETRY

1. (3 points) What mass of oxalic acid, $\text{H}_2\text{C}_2\text{O}_4$ (molar mass = 90.0 g/mol) is required to react with 35.2 mL of 0.456 M NaOH?

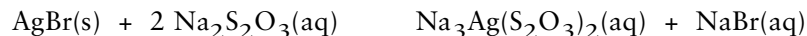


- (a) 2.89 g
- (b) 1.61 g
- (c) 0.803 g
- (d) 0.722 g
2. (3 points) Cisplatin, $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$ (molar mass = 300. g/mol) is used in cancer chemotherapy. It is produced by the reaction



What volume of aqueous 0.150 M NH_3 is required to produce 25.0 g of cisplatin?

- (a) 278 mL
- (b) 556 mL
- (c) 1110 mL
- (d) 1500 mL
3. (3 points) In the photographic process silver bromide is dissolved by adding sodium thiosulfate.

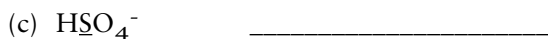
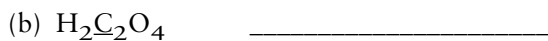


If you add 193 mL of 0.0138 M aqueous $\text{Na}_2\text{S}_2\text{O}_3$ to a sample of AgBr (molar mass = 187.8 g/mol), what mass of AgBr can be dissolved?

- (a) 0.125 g
- (b) 0.250 g
- (c) 0.500 g
- (d) 0.750 g

OXIDATION-REDUCTION REACTIONS

1. (6 points) Give the oxidation number of each underlined element:



2. (10 points) Oxidation-Reduction Reactions and Titrations.

To analyze an iron-containing compound, you convert all the iron to Fe^{2+} in aqueous solution and then titrate the solution with aqueous KMnO_4 (the source of the MnO_4^- ion) according to the following *balanced, net ionic* equation:



(a) The oxidation number of Mn in MnO_4^- is _____

(b) The substance oxidized is _____ and the substance reduced is _____.

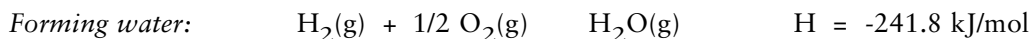
(c) The oxidizing agent in this reaction is _____.

Suppose you titrate 4.567 g of an iron-containing sample with a 0.0256 M KMnO_4 solution. If 28.90 mL of the KMnO_4 solution are required to reach the equivalence point, what is the weight percent of iron in the sample?

6. (4 points) Acetylene burns according to the balanced equation

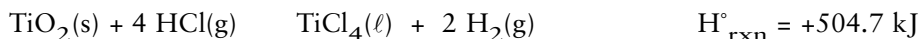


- (a) Is the reaction predicted to be exo- or endothermic? _____
- (b) What is the enthalpy change for the combustion of acetylene, C_2H_2 ? That is, how much heat is transferred when C_2H_2 burns in O_2 ? The following information is used to calculate this quantity:



Possible answers are:

- (a) $H_{\text{rxn}} = -862.0 \text{ kJ}$
- (b) $H_{\text{rxn}} = -1255.5 \text{ kJ}$
- (c) $H_{\text{rxn}} = -802.1 \text{ kJ}$
- (d) $H_{\text{rxn}} = -787.0 \text{ kJ}$
- (e) $H_{\text{rxn}} = +862.0 \text{ kJ}$
- (f) $H_{\text{rxn}} = +1255.5 \text{ kJ}$
7. (4 points) Titanium(IV) chloride is formed by the following reaction with an enthalpy change of 504.7 kJ.



- (i) Is the reaction exothermic or endothermic? _____
- (ii) What quantity of heat is involved if 12.0 g of $\text{TiCl}_4(\ell)$ is formed?

- (a) 31.9 kJ released
- (b) 31.9 kJ absorbed
- (c) 2.66 kJ absorbed
- (d) 319 kJ released
- (e) 504.7 kJ released

GROUP QUESTION (10 points)***Serial Dilutions***

To make very dilute solutions accurately, we do serial dilutions. That is, we add water to a solution to make a more dilute solution. We then take this new solution and dilute it again to make an even more dilute solution.

Suppose you take 25.0 mL of 0.110 M solution of Na_2CO_3 and dilute it to exactly 100.0 mL. You then take exactly 10.0 mL of this diluted solution and add it to a 250 mL volumetric flask. After filling the volumetric flask to the mark indicating the volume of the new solution is exactly 250 mL, what is the concentration of the diluted Na_2CO_3 solution?

Heat and Heat Energy

1. Which has the higher temperature (or are they the same)? *Beaker A*: 100 g of gently boiling water. *Beaker B*: 100 g of furiously boiling water. Explain your answer briefly.

2. Which has the higher final temperature (or are they the same)? *Beaker A*: 100 g of water initially at 25 °C. A 10 g bar of copper at 100 °C is dropped into the water. *Beaker B*: 200 g of water initially at 25 °C. A 20 g bar of copper at 100 °C is dropped into the water. Explain your answer briefly.