CHEMISTRY 116 - Fall 2021
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Worksheet Week 4 - Chapters 4.7 - 4.12

1. Write balanced **net ionic** equations for the following reactions
   a) mixing aqueous solutions of
      1) calcium hydroxide and perchloric acid
      2) barium hydroxide and sulfuric acid
      3) ammonia and hydrochloric acid
      4) iron(II) chloride and sodium sulfide
   b) adding to aqueous sodium hydroxide
      1) gaseous carbon dioxide
      2) aqueous iron(III) nitrate
      3) aqueous hydroselenic acid
   c) mixing aqueous solutions of ammonium carbonate and hydroiodic acid
   d) adding to aqueous nitric acid
      1) solid sodium hydrogen carbonate
      2) solid cobalt(II) oxide
      3) aqueous ammonium carbonate
   e) adding to aqueous sodium hydroxide
      1) solid ammonium hydrogen sulfate
      2) aqueous ammonium carbonate
      3) liquid Cl_2O_7

2. 1.07 g of H_3AsO_4 is dissolved in 100 ml of water and titrated with 0.500 M KOH. If 30.0 mL of base were required to neutralize the acid, how many protons were neutralized in each molecule of H_3AsO_4? [2]

3. For the reaction: $Mg(s) + 2HCl(aq) \rightarrow MgCl_2\ (aq) + H_2(g)$, what volume of 6.00 M HCl is required to react with 20.0 g Mg? [274 mL]

4. For each of the following give the formula for its acid or base anhydride:

$CsOH$ HNO_2 H_5IO_6 $HClO_4$ $Ba(OH)_2$ H_3AsO_4

5. Write balanced equations for the following. (Hint: identify the acidic and/or basic oxide, add water to form the acid or base, complete the reaction using the acid or base, and then remove the water to find the product.)

   a) $Na_2O(s) + CO_2(g) \rightarrow$

   b) $SO_3(g) + KOH(aq) \rightarrow$

   c) $CaO(s) + SO_2(g) \rightarrow$

6. How many grams of potassium hydrogen phthalate (KHP) should be weighed into a flask to standardize ~0.05 M NaOH if you wish to use ~30 mL of base for the titration? $C_8H_5O_4K + NaOH \rightarrow C_8H_4O_4NaK + H_2O$

7. For the following oxidation/reduction reaction state what is oxidized, what is reduced, and how many moles of electrons are transferred in the equation as written. $As_4O_6(s) + 6\ C(s) \rightarrow As_4(g) + 6\ CO(g)$

8. In the following reactions you need to give **both balanced half reactions** (one for oxidation and one for reduction) and then the **overall balanced equation**. Do not break apart any of the following ions or molecules.

Balance in acidic solution:

a) $MnO_4^-(aq) + H_2C_2O_4(aq) \rightarrow Mn^{2+}(aq) + CO_2(g)$

b) $As_2S_3(s) + ClO_3^-(aq) \rightarrow H_2AsO_4{}^-(aq) + SO_4^{2-}(aq) + Cl^-(aq)$

c) $Cr(CN)_6^{4-}(aq) + Ce^{4+}(aq) \rightarrow Cr^{3+}(aq) + Ce^{3+}(aq) + NO_3^-(aq) + CO_2(g)$

d) $P_4S_3(aq) + NO_3^-(aq) \rightarrow H_3PO_4(aq) + SO_4^{2-}(aq) + NO(g)$

e) $As_4O_6(s) + MnO_4^-(aq) \rightarrow AsO_4^{3-}(aq) + Mn^{2+}(aq)$

Balance in basic solution:

f) $CrO_2^-(aq) + ClO^-(aq) \rightarrow CrO_4^{2-}(aq) + Cl_2(g)$

g) $Cl_2(aq) + CrI_3(s) \rightarrow Cl^-(aq) + CrO_4^{2-}(aq) + IO_4^-(aq)$

h) $C_3H_8O_3(aq) + V_5O_{14}^{3-}(aq) \rightarrow HCO_2^-(aq) + VO(OH)_2(aq)$

i) $Ce^{4+}(aq) + Fe(SCN)_6^{4-}(aq) \rightarrow Ce(OH)_3(s) + Fe(OH)_3(s) + SO_4^{2-}(aq) + CO_3^{2-}(aq) + NO_3^-(aq)$

j) $Al(s) + NO_2^-(aq) \rightarrow AlO_2^-(aq) + NH_3(g)$

9. The concentration of hydrogen peroxide in a solution can be determined by titration with potassium permanganate as described by the net ionic equation

$$5\ H_2O_2(aq) + 2\ MnO_4^-(aq) + 6\ H^+(aq) \rightarrow 2\ Mn^{2+}(aq) + 8\ H_2O(l) + 5\ O_2(g)$$

A 15.00 mL sample of the peroxide solution required 18.77 mL of 0.141 M permanganate to reach the endpoint. What is the concentration of the peroxide solution? [0.441 M]