Chemistry NYB – Precipitation Stoichiometry Questions

1. John Doe does not believe in global warming and creates a reaction to produce more greenhouse gases. He first mixes 229.90 g of manganese(II) carbonate in enough water to make a 2.00×10^3 mL solution. He then mixes 3.20×10^5 mg of phosphoric acid into enough water to make a 25.0 mL solution. Both solutions are mixed and allowed to react.
   a) Write a balanced chemical reaction.
   b) Which reactant is limiting John Doe's plan to produce more carbon dioxide?
   c) How many grams of carbon dioxide gas are formed from the reaction?
   d) What is the concentration of manganese(II) ions remaining in the solution after the reaction has taken place?

2. Jane Doe wants to create a component of rat poison. She mixes 30.0 mL of 1.00 *M* aqueous barium nitrate with 2.60 g of sodium carbonate dissolved in 100.0 mL of solution.
   a) Determine the chemical equation for this reaction. Identify the precipitate.
   b) Determine the limiting and excess reagents.
   c) Determine the mass of the precipitate formed.
   d) Determine the total concentration of all ions present in the final solution.

3. 7.20 g of solid barium hydroxide is added to 35.0 mL of 1.50 *M* aqueous aluminum nitrate. Water is then added to make the total volume of the mixture 500.0 mL.
   a) Write a balanced chemical reaction.
   b) Determine the limiting reactant by calculation.
   c) Calculate the mass of precipitate formed.
   d) Calculate the concentrations of any remaining, aqueous ions present in the solution.

4. 0.0300 kg of iron(II) nitrate is mixed with 200.0 mL of 3.50 *M* potassium phosphate solution.
   a) Write a balanced chemical reaction.
   b) Determine the limiting reactant by calculation.
   c) Calculate the mass of precipitate formed.
   d) Calculate the concentrations of any aqueous ions that remain in solution.

5. 30.0 mL of 1.50 *M* aqueous iron(III) nitrate reacts with 7.10 g of magnesium acetate dissolved in 50.0 mL of water. Assume the mass of magnesium acetate does not appreciably change the total volume of the resulting solution.
   a) Write a balanced chemical reaction.
   b) Determine the limiting reactant by calculation.
   c) Calculate the mass of precipitate formed.
   d) Calculate the concentrations of any aqueous ions that remain in solution.

Chemistry NYB – Precipitation Stoichiometry Solutions

Question 1

a) $3\ MnCO_3(aq) + 2\ H_3PO_4(aq) \rightarrow Mn_3(PO_4)_2(s) + 3\ H_2O(l) + 3\ CO_2(g)$
b) $MnCO_3$
c) 88.0 g of CO_2
d) 0 (see answer b)

Question 2

a) $Ba(NO_3)_2(aq) + Na_2CO_3(aq) \rightarrow BaCO_3(s) + 2\ NaNO_3(aq)$
b) Limiting: Na_2CO_3 Excess: $Ba(NO_3)_2$
c) 4.83 g of $BaCO_3$
d) $[Ba^{2+}] = 0.042$ mol/L, $[Na^+] = 0.38$ mol/L, $[NO_3^-] = 0.46$ mol/L

Question 3

a) $3\ Ba(OH)_2(aq) + 2\ Al(NO_3)_3(aq) \rightarrow 2\ Al(OH)_3(s) + 3\ Ba(NO_3)_2(aq)$
b) $Ba(OH)_2$
c) 2.19 g of $Al(OH)_3$
d) $[Al^{3+}] = 0.0490$ mol/L, $[Ba^{2+}] = 0.0841$ mol/L, $[NO_3^-] = 0.315$ mol/L

Question 4

a) $3\ Fe(NO_3)_2(aq) + 2\ K_3PO_4(aq) \rightarrow Fe_3(PO_4)_2(s) + 6\ KNO_3(aq)$
b) $Fe(NO_3)_2$
c) 20.0 g of $Fe_3(PO_4)_2$
d) $[K^+] = 10.4$ mol/L, $[PO_4^{3-}] = 2.89$ mol/L, $[NO_3^-] = 1.68$ mol/L

Question 5

a) $2\ Fe(NO_3)_3(aq) + 3\ Mg(CH_3COO)_2(aq) \rightarrow 2\ Fe(CH_3COO)_3(s) + 3\ Mg(NO_3)_2(aq)$
b) $Mg(CH_3COO)_2$
c) 7.75 g of $Fe(CH_3COO)_3$
d) $[Fe^{3+}] = 0.146$ mol/L, $[Mg^{2+}] = 0.624$ mol/L, $[NO_3^-] = 1.69$ mol/L