AP CHEMISTRY

TOPIC 2: STOICHIOMETRY, PART E (PART II) Day 19:

Stoichiometry:

- Precipitation Reactions

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1) Calculate the mass, in grams, of the precipitate formed when 58.3 mL of 3.58 *M* aluminum chlorate is mixed with an ammonium chromate solution (that is in excess). ***SHOW ALL WORK***

Answers:

$$2\ Al(ClO_3)_3 + 3\ (NH_4)_2CrO_4 \rightarrow 6\ NH_4ClO_3 + \boxed{Al_2(CrO_4)_3}$$

$$\frac{58.3\ mL\ Al(ClO_3)_3}{} \times \frac{1\ L}{1000\ mL} \times \frac{3.58\ mol\ Al(ClO_3)_3}{L} \times \frac{1\ mol\ Al_2(CrO_4)_3}{2\ mol\ Al(ClO_3)_3} \times \frac{401.96\ g}{1\ mol\ Al_2(CrO_4)_3} = 41.9\ g\ Al_2(CrO_4)_3$$

2) Calculate the moles, of the precipitate formed when 422 mL of a 13.5 *M* lead(II) acetate solution is mixed with an lithium carbonate solution (that is in excess). ***SHOW ALL WORK***

Answers:

$$\_\_\_\ Pb(C_2H_3O_2)_2 + \_\_\_\ Li_2CO_3 \rightarrow \underline{\ 2\ }\ LiC_2H_3O_2 + \boxed{PbCO_3}$$

$$\frac{422\ mL}{} \times \frac{1\ L}{1000\ mL} \times \frac{13.5\ mol\ Pb(C_2H_3O_2)_2}{L} \times \frac{1\ mol\ PbCO_3}{1\ mol\ Pb(C_2H_3O_2)_2} = 5.70\ mol\ PbCO_3$$

3) Calculate the mass, in grams, of the precipitate formed when 3.22 liters of a 3.85 *M* zinc sulfate solution is mixed with 1550 mL of a 8.33 *M* calcium iodide solution. ***SHOW ALL WORK***

Answers:

$$\_\_\_\ ZnSO_4 + \_\_\_\ CaI_2 \rightarrow \_\_\_\ ZnI_2 + \boxed{CaSO_4}$$

$$\frac{3.22\ L}{} \times \frac{3.85\ mol\ ZnSO_4}{L} \times \frac{1\ mol\ CaI_2}{1\ mol\ ZnSO_4} \times \frac{L}{8.33\ mol\ CaI_2} \times \frac{1000\ mL}{1\ L} = 1488\ mL\ CaI_2$$

$ZnSO_4$ is the Limiting Reactant

$$\frac{3.22\ L}{} \times \frac{3.85\ mol\ ZnSO_4}{L} \times \frac{1\ mol\ CaSO_4}{1\ mol\ ZnSO_4} \times \frac{136.14\ g}{1\ mol\ CaSO_4} = 1.69 \times 10^3\ g\ CaSO_4$$

4) Calculate the mass, in milligrams, of the precipitate that is produced when 75.0 mL of a 9.75 *M* manganese(III) sulfate solution is added to 378 mL of a 6.75 *M* sodium hydroxide solution. ***SHOW ALL WORK***

Answers:

$$\_\_\_ \ Mn_2(SO_4)_3 + \underline{6} \ NaOH \rightarrow \boxed{\underline{2} \ Mn(OH)_3} + \underline{3} \ Na_2SO_4$$

$$\frac{378\ mL}{} \times \frac{1\ L}{1000\ mL} \times \frac{6.75\ mol\ NaOH}{L} \times \frac{1\ mol\ Mn_2(SO_4)_3}{6\ mol\ NaOH} \times \frac{L}{9.75\ mol\ Mn_2(SO_4)_3} \times \frac{1000\ mL}{1\ L} = 43.6\ mL\ Mn_2(SO_4)_3$$

NaOH is the Limiting Reactant

$$\frac{378\ mL}{} \times \frac{1\ L}{1000\ mL} \times \frac{6.75\ mol\ NaOH}{L} \times \frac{2\ mol\ Mn(OH)_3}{6\ mol\ NaOH} \times \frac{105.9617\ g}{1\ mol\ Mn(OH)_3} \times \frac{1000\ mg}{1\ g} = 9.01 \times 10^4\ mg\ Mn(OH)_3$$

5) Calculate the mass, in grams, of the precipitate formed when 2.25 L of a nickel(III) chlorate solution is mixed with 865.3 grams potassium phosphate dissolved in enough water so that the total volume of the solution equals 3.50 liters. The density (at room temperature) for "this" nickel(III) chlorate solution is 1.236 g/cm^3. ***SHOW ALL WORK***

Answers:

$$\_\_\_ \ Ni(ClO_3)_3 + \_\_\_ \ K_3PO_4 \rightarrow \underline{3} \ KClO_3 + \boxed{\_\_\_ \ NiPO_4}$$

$$\frac{2.25\ L}{} \times \frac{1000\ mL}{1\ L} \times \frac{1\ cm^3}{1\ mL} \times \frac{1.236\ g\ Ni(ClO_3)_3}{cm^3} \times \frac{1\ mol\ Ni(ClO_3)_3}{309.049} \times \frac{1\ mol\ K_3PO_4}{1\ mol\ Ni(ClO_3)_3} \times \frac{212.274\ g}{1\ mol\ K_3PO_4} = 1.91 \times 10^3\ g\ K_3PO_4$$

K_3PO_4 is the Limiting Reactant

$$\frac{865.3\ g\ K_3PO_4}{} \times \frac{1\ mol\ K_3PO_4}{212.274\ g} \times \frac{1\ mol\ NiPO_4}{1\ mol\ K_3PO_4} \times \frac{153.664\ g}{1\ mol\ NiPO_4} = 626\ g\ NiPO_4$$

6) Nitric acid (75.3 mL of 2.35 *M*) is added to 225.0 mL of 0.755 *M* calcium hydroxide solution. What is the concentration of the excess H^{+1} or OH^{-1} ions left in this solution?

Answers:

$$\underline{2} \ HNO_3 + \_\_\_ \ Ca(OH)_2 \rightarrow \underline{2} \ HOH + \_\_\_ \ Ca(NO_3)_2$$

$$\frac{75.3\ mL}{} \times \frac{1\ L}{1000\ mL} \times \frac{2.35\ mol\ HNO_3}{L} \times \frac{1\ mol\ Ca(OH)_2}{2\ mol\ HNO_3} \times \frac{L}{0.755\ mol\ Ca(OH)_2} \times \frac{1000\ mL}{1\ L} = 117.189\ mL$$

HNO_3 is the Limiting Reactant

$Ca(OH)_2$ used = 117.189 mL ; $Ca(OH)_2$ remaining = 225 mL - 117.189 mL = 107.81 mL

$$\frac{107.81\ mL}{} \times \frac{1\ L}{1000\ mL} \times \frac{0.755\ mol\ Ca(OH)_2}{L} \times \frac{2\ mol\ OH^{-1}}{1\ mol\ Ca(OH)_2} = 0.162795\ mol\ OH^{-1}$$

$$\left[OH^{-1} \right] = \frac{0.162795\ mol\ OH^{-1}}{0.3003\ L} = 0.542\ mol\ OH^{-1}$$