Stoichiometry 4

#1 Soln

Consider the following reaction carried out to prepare zinc phosphate in the lab.

$$3\ Zn(NO_3)_{2\,(aq)} + 2\ Na_3PO_{4\,(aq)} \rightarrow \underset{386.11\,g/mol}{Zn_3(PO_4)_{2\,(s)}} + 6\ NaNO_{3\,(aq)}$$

A technician adds excess sodium phosphate solution to 5.00L of 0.100 M zinc nitrate solution.

A) What is the theoretical yield of solid zinc phosphate?

$$\frac{5.00\,L \mid 0.100\,mol\ Zn(NO_3)_2 \mid 1\,mol\ Zn_3(PO_4)_2 \mid 386.11\,g}{1\,L \mid 3\,mol\ Zn(NO_3)_2 \mid mol} = \boxed{64.4\,g}$$

B) If the process typically has a 97.0 % yield, what mass would the technician expect to obtain when the precipitate is fully purified?

$$0.970 = \frac{AY}{TY}$$

$$AY = TY \times 0.970 = (64.4\,g)(0.97) = \boxed{62.4\,g}$$

2. What is the concentration (in mol/L) of a 50.0 mL sample of H_2SO_4 if 37.94 mL of 0.955 *M* NaOH solution is required to fully react with it?

$$H_2SO_4 + 2\ NaOH \rightarrow Na_2SO_4 + 2HOH_{(e)}$$

50.0 mL; 0.955 mol/L; 37.94 mL

find mol H_2SO_4:

$$\frac{0.03794\,L \mid 0.955\,mol\ NaOH \mid 1\,mol\ H_2SO_4}{1\,L \mid 2\,mol\ NaOH} = 0.018\overline{12}\,mol\ H_2SO_4$$

$$[H_2SO_4] = \frac{0.018\overline{12}\,mol\ H_2SO_4}{0.0500\,L} = 0.362\ \underline{M}$$

3. What mass of solid silver phosphate can be produced by the mixing of 35.0 mL of a 0.775 *M* solution of silver nitrate with 55.0 mL of a 0.667 M solution of potassium phosphate?

$$3\ AgNO_{3(aq)} + K_3PO_{4(aq)} \rightarrow 3\ KNO_{3(aq)} + Ag_3PO_{4(s)}$$

$418.56\ g/mol$

(2) $\dfrac{0.0350\ L \mid 0.775\ mol\ AgNO_3 \mid 1\ mol\ Ag_3PO_4 \mid 418.56\ g}{1\ L \mid 3\ mol\ AgNO_3 \mid 1\ mol\ Ag_3PO_4}$

* $AgNO_3$ is the LR, theoretical yield: $= 3.78\ g$

$\dfrac{0.0550\ L \mid 0.667\ mol\ K_3PO_4 \mid 1\ mol\ Ag_3PO_4 \mid 418.56\ g}{1\ L \mid 1\ mol\ K_3PO_4 \mid 1\ mol\ Ag_3PO_4}$

$= 15.4\ g$

4. Consider the catalytic decomposition of 250.0 ml of 3.00 % by mass hydrogen pe $_2O_2$, solution? (The density of the solution is 1.00 g/mL.)

$$2\ H_2O_{2(aq)} \xrightarrow{MnO_2} 2\ H_2O_{(l)} + O_{2(g)}$$

A) What mass of the H_2O_2 is in the solution?

B) What volume of oxygen gas (at STP) should be produced by the reaction?

A) $\dfrac{250.0\ mL \mid 1.00\ g \mid 3.00\ g\ H_2O_2}{1\ mL \mid 1\ g \mid 100\ g} = 7.5\ g\ H_2O_2$

B) $\dfrac{7.5\ g\ H_2O_2 \mid 1\ mol\ H_2O_2 \mid 1\ mol\ O_2 \mid 22.4\ L}{34.04\ g \mid 2\ mol\ H_2O_2 \mid 1\ mol\ O_2}$

$= 2.47\ L$