EXAM IV

THERE ARE 5 PAGES TO THIS EXAM (including the cover page). Significant Figures must be correct. All set-ups must be shown (22 points)

1. Complete, balance and write the chemical equations for the following reactions [you must include physical states, (g),(l),(s), or (aq)]

   a. Solutions of stannous chloride and sodium sulfide are mixed

      \[ \text{SnCl}_2(\text{aq}) + \text{Na}_2\text{S}(\text{aq}) \rightarrow \text{SnS}(s) + 2\text{NaCl}(\text{aq}) \]

   b. Calcium metal falls into a puddle of water.

      \[ \text{Ca}(s) + 2\text{H}_2\text{O}(l) \rightarrow \text{Ca(OH)}_2(\text{aq}) + \text{H}_2(\text{g}) \]

   c. Aqueous copper (II) sulfate is poured into an aluminum container.

      \[ 3 \text{CuSO}_4(\text{aq}) + 2 \text{Al}(s) \rightarrow \text{Al}_2(\text{SO}_4)_3(\text{aq}) + 3 \text{Cu}(s) \]

   d. Liquid C_5H_10O_2 is burned.

      \[ 2 \text{C}_5\text{H}_{10}\text{O}_2(l) + 13 \text{O}_2(g) \rightarrow 10 \text{CO}_2(g) + 10 \text{H}_2\text{O}(g) \]

   e. Aqueous lead (II) cyanide is poured into a container of hydrochloric acid

      \[ 2 \text{HCl}(\text{aq}) + \text{Pb(CN)}_2(\text{aq}) \rightarrow 2 \text{HCl}(\text{aq}) + \text{PbCl}_2(\text{aq}) \uparrow \text{WA!} \]

   f. Barium carbonate is heated

      \[ \text{BaCO}_3(s) \rightarrow \text{BaO}(s) + \text{CO}_2(g) \]

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(12 points) 2. Phosphorus trihydride is reacted with oxygen:

\[ 4 \text{PH}_3 + 8 \text{O}_2 \rightarrow \text{P}_4\text{O}_{10} + 6 \text{H}_2\text{O} \]

a) How many grams of water will be produced from 13 g of oxygen?

\[
13 \text{ g O}_2 \times \frac{1 \text{ mol O}_2}{32.0 \text{ g O}_2} \times \frac{6 \text{ mol H}_2\text{O}}{8 \text{ mol O}_2} \times \frac{18.0 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 5.5 \text{ g H}_2\text{O}
\]

ANSWER \( 5.5 \text{ g H}_2\text{O} \)

b) If \(1.4 \times 10^{444}\) molecules of phosphorus trihydride reacts, how many g of \(\text{P}_4\text{O}_{10}\) are produced?

\[
1.4 \times 10^{444} \text{ molecules} \times \frac{1 \text{ mol PH}_3}{6.02 \times 10^{23} \text{ molecule PH}_3} \times \frac{1 \text{ mol P}_4\text{O}_{10}}{4 \text{ mol PH}_3} \times \frac{284.0 \text{ g P}_4\text{H}_{10}}{1 \text{ mol P}_4\text{H}_{10}} = 1.7 \times 10^{424} \text{ g P}_4\text{O}_{10}
\]

ANSWER \( 1.7 \times 10^{424} \text{ g P}_4\text{O}_{10} \)

(10 points) 3. Under appropriate reaction conditions carbon, sodium carbonate and nitrogen, react according to the equation below:

\[ 4 \text{C} + \text{Na}_2\text{CO}_3 + \text{N}_2 \rightarrow 2 \text{NaCN} + 3 \text{CO} \]

The percent yield of the reaction is 85.7%. Calculate the number of grams of sodium carbonate is needed to produce 97.0 mg of carbon monoxide.

\[
97.0 \text{ mg CO} \times \frac{1 \text{ mol CO}}{1 \text{ mg CO}} \times \frac{1 \text{ mol Na}_2\text{CO}_3}{26.0 \text{ g CO}} \times \frac{1 \text{ mol Na}_2\text{CO}_3}{1 \text{ mol Na}_2\text{CO}_3} \times \frac{100 \text{ g (T) Na}_2\text{CO}_3}{85.7 \text{ g (T) Na}_2\text{CO}_3} = 0.154 \text{ g Na}_2\text{CO}_3
\]

ANSWER \( 0.154 \text{ g Na}_2\text{CO}_3 \)

(10 points) 4. According to the following equation...........

\[ 2 \text{AgNO}_3 + \text{Na}_2\text{CO}_3 \rightarrow \text{Ag}_2\text{CO}_3 + 2 \text{NaNO}_3 \]

What is the molarity of a \(\text{Na}_2\text{CO}_3\) solution if 50.0 mls of 0.100 M \(\text{AgNO}_3\) reacted with 35.0 ml of the \(\text{Na}_2\text{CO}_3\) solution.

\[
0.0500 \text{ L soln} \times 0.100 \text{ mol} \text{AgNO}_3 \times \frac{1 \text{ mol Na}_2\text{CO}_3}{2 \text{ mol Ag NO}_3} = 2.50 \times 10^{-3} \text{ mol Na}_2\text{CO}_3
\]

\[
\text{M Na}_2\text{CO}_3 = \frac{2.50 \times 10^{-3} \text{ mol Na}_2\text{CO}_3}{0.0350 \text{ L soln}} = 607.1 \text{ M Na}_2\text{CO}_3
\]

ANSWER \( 607.1 \text{ M Na}_2\text{CO}_3 \)

4/19/2011
5. Complete, balance and write net-ionic equations for the following reactions. (You must include physical states):
   a) Solutions of iron (II) acetate and potassium carbonate are mixed.

   Molecular equation

   Total ionic

   Net ionic $\text{Fe}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{FeCO}_3(\text{s})$

   b) Chromium metal is mixed with a Copper (I) bromide solution

   Molecular equation

   Total ionic

   Net ionic $\text{Cr}(\text{s}) + 2\text{Cu}^+ (\text{aq}) \rightarrow 2\text{Cu}(\text{s}) + \text{Cr}^{3+}(\text{aq})$

   c) Aqueous sodium nitrite is added to sulfuric acid.

   Molecular equation

   Total ionic

   Net ionic $\text{H}^+(\text{aq}) + \text{NO}_2^-(\text{aq}) \rightarrow \text{HNO}_2(\text{aq})$

   d) A solution of Lead (IV) cyanide is mixed with Cesium phosphate

   Molecular equation

   Total ionic

   Net ionic $3\text{Pb}^{4+}(\text{aq}) + 4\text{PO}_4^{3-}(\text{aq}) \rightarrow \text{Pb}_3(\text{PO}_4)_4(\text{s})$

6. A 101.5 g sample of a mixture of BaCO$_3$ and NaHCO$_3$ is heated, and the compounds decompose as follows:
   BaCO$_3$ $\rightarrow$ BaO + CO$_2$
   2 NaHCO$_3$ $\rightarrow$ Na$_2$CO$_3$ + CO$_2$ + H$_2$O

The decomposition of the sample yields 5.0 g of H$_2$O. What is the percent BaCO$_3$ and percent NaHCO$_3$ by mass of the original sample.

$5.0 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.01 \text{ g H}_2\text{O}} \times \frac{2 \text{ mol NaHCO}_3}{1 \text{ mol H}_2\text{O}} \times \frac{106.89 \text{ g NaHCO}_3}{1 \text{ mol NaHCO}_3} = 59.9 \text{ g NaHCO}_3$

$\% \text{ NaHCO}_3 = \frac{59.9 \text{ g NaHCO}_3}{101.5 \text{ g mix}} = 58.9 \% \text{ NaHCO}_3$

$\% \text{ BaCO}_3 = 100\% - 58.9\% \text{ NaHCO}_3 = 42.9 \% \text{ BaCO}_3$

ANSWER

4/19/2011
(12 points) 7. Fool's gold is so named because it looks much like gold, however, when it is mixed with aqueous HCl it dissolves, whereas real gold does not. 60.0 grams of FeS₂ is reacted with 20.0 grams of HCl:

\[ \text{FeS}_2 + 2 \text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2\text{S} + \text{S} \]

a. How many grams of sulfur do I obtain?

\[
60.0 \text{g FeS}_2 \times \frac{1 \text{ mol FeS}_2}{120.0 \text{g FeS}_2} \times \frac{1 \text{ mol S}}{1 \text{ mol FeS}_2} \times \frac{32.1 \text{g S}}{1 \text{ mol S}} = 16.1 \text{g S}
\]

\[
20.0 \text{g HCl} \times \frac{1 \text{ mol HCl}}{36.5 \text{g HCl}} \times \frac{1 \text{ mol S}}{2 \text{ mol HCl}} \times \frac{32.1 \text{g S}}{1 \text{ mol S}} = 8.80 \text{g S}
\]

b. How many grams of excess reactant will be present at the end of the reaction?

\[
60.0 \text{g FeS}_2 \text{ initial} - \left( 8.80 \text{g S} \times \frac{1 \text{ mol S}}{32.1 \text{g S}} \times \frac{1 \text{ mol FeS}_2}{1 \text{ mol S}} \times \frac{120.0 \text{g FeS}_2}{1 \text{ mol FeS}_2} \right) = 27.1 \text{g FeS}_2 \text{ x S}
\]

Answer: 27.1g FeS₂ x S