STOICHIOMETRY - LECTURE NOTES

Homework Answers (solutions to the homework) (the 4's) – *Craig*

EXAMPLE #7:

In a single replacement reaction, aluminum metal replaces zinc in a zinc nitrate solution. Calculate the mass (in mg) of zinc metal produced in this reaction when 200 mL of a 0.440 *M* solution of zinc nitrate is reacted with 0.305 grams of aluminum metal.

Answer:

0.305g, 200 mL 0.440 M, ? mg

$$\underline{2}\,Al + \underline{3}\,Zn(NO_3)_2 \rightarrow \underline{2}\,Al(NO_3)_3 + \underline{3}\,Zn$$

L.R. STEP:

$$\frac{200\,mL}{1000\,mL}\left|\frac{1\,L}{}\right.\left|\frac{0.440\,mol}{L}\right.\left|\frac{2\,mol\ Al}{3\,mol\ Zn(NO_3)_2}\right.\left|\frac{26.98\,g}{1\,mol\ Al}\right. = 1.58\,g\ Al$$

Al IS L.R.! IF ALL 200 mL OF THE 0.440 M $Zn(NO_3)_2$ WERE REACTED, ONE WOULD NEED AT LEAST 1.58g OF Al. WE DO NOT HAVE ENOUGH Al. $Zn(NO_3)$ IS IN EXCESS.

$$\longrightarrow \frac{0.305\,g\ Al}{}\left|\frac{1\,mol\ Al}{26.98\,g}\right.\left|\frac{3\,mol\ Zn}{2\,mol\ Al}\right.\left|\frac{65.39\,g}{1\,mol\ Zn}\right.\left|\frac{1000\,mg}{1\,g}\right. = \boxed{1.11\times10^3\ mg}$$

EXAMPLE #8:

325 grams of lead metal is mixed with a 3.45 *M* solution of iron(III) nitrate. Calculate the volume (in milliliters) of iron(III) nitrate needed to completely react all of the lead metal in this single replacement reaction.

Answer:

325g, ? mL 3.45 M

$$\underline{3}\,Pb + \underline{2}\,Fe(NO_3)_3 \longrightarrow \underline{3}\,Pb(NO_3)_2 + \underline{2}\,Fe$$

- NOT A L.R. PROBLEM!
- START WITH THE "SET" THAT IS COMPLETE!

$$\frac{325\,g}{}\left|\frac{1\,mol\ Pb}{207.2\,g}\right.\left|\frac{2\,mol\ Fe(NO_3)_3}{3\,mol\ Pb}\right.\left|\frac{L}{3.45\,mol\ Fe(NO_3)_3}\right.\left|\frac{1000\,mL}{1\,L}\right. =$$

3.45 M

$$\boxed{303\,mL\ Fe(NO_3)_3}$$

HOMEWORK PROBLEMS :

4a.) When copper ions replace silver ions in 208 mL of 0.100 *M* silver nitrate, $AgNO_3$, how many grams of silver will be produced?

Answer:

208 mL
0.100 M

$$Cu + 2\,AgNO_3 \rightarrow Cu(NO_3)_2 + 2\,Ag$$

?g

- IF YOU ARE GIVEN THE VOLUME AND MOLARITY, ALWAYS START WITH THE VOLUME.

$$208\text{ mL} \left|\frac{1\text{ L}}{1000\text{ mL}}\right| \frac{0.100\text{ mol } AgNO_3}{\text{L}} \left|\frac{2\text{ mol Ag}}{2\text{ mol } AgNO_3}\right| \frac{107.87\text{g}}{1\text{ mol Ag}} =$$

2.24 g Ag

THIS IS NOT GIVEN IN THE QUESTION, BUT IT IS A PRODUCT OF A DOUBLE REPLACEMENT REACTION

4b.) When an excess of lead(II)carbonate, $PbCO_{3\,(s)}$, reacts with 27.5 mL of 3.00 *M* nitric acid, $HNO_{3\,(aq)}$, what mass (in grams) of lead(II) nitrate, $Pb(NO_3)_{2\,(aq)}$, will be formed?

Answer:

EXCESS
27.5 mL
3.00 M
?g

$$PbCO_3 + 2\,HNO_3 \rightarrow Pb(NO_3)_2 + H_2CO_3$$

$$27.5\text{mL} \left|\frac{1\text{L}}{1000\text{mL}}\right| \frac{3.00\text{ mol } HNO_3}{\text{L}} \left|\frac{1\text{ mol } Pb(NO_3)_2}{2\text{ mol } HNO_3}\right| \frac{207.2\text{g} + 2(14.01\text{g}) + 6(16\text{g})}{1\text{ mol } Pb(NO_3)_2} =$$

13.7 g $Pb(NO_3)_2$

4c.) How much (in grams) zinc metal will react with 24.5 mL of 2.0 *M* hydrochloric acid, HCl?

Answer:

$$\overset{?\,g}{Zn} + 2\,\overset{24.5\,mL,\ 2.0\,M}{HCl} \rightarrow ZnCl_2 + H_2$$

$$24.5\,mL \left|\frac{1\,L}{1000\,mL}\right| \frac{2.0\,mol\,HCl}{L} \left|\frac{1\,mol\,Zn}{2\,mol\,HCl}\right| \frac{65.39\,g}{1\,mol\,Zn} = \boxed{1.60\,g\,Zn}$$

NOT A LIMITING REACTANT PROBLEM. BE SURE TO BALANCE THE EQUATION BEFORE YOU DO THE MATH - EVEN THOUGH YOU ARE NOT ASKED ABOUT EITHER OF THE PRODUCTS.

4d.) When an excess of iron(II) chloride reacts with 35.0 mL of 2.5 *M* potassium sulfide, what mass (in grams) of potassium chloride will be formed? Also, iron(II) sulfide is produced?

Answer:

$$\overset{\text{EXCESS}}{FeCl_2} + \overset{35\,mL,\ 2.5\,M}{K_2S} \rightarrow \overset{?\,g}{2\,KCl} + FeS$$

$$35\,mL \left|\frac{1\,L}{1000\,mL}\right| \frac{2.5\,mol\,K_2S}{L} \left|\frac{2\,mol\,KCl}{1\,mol\,K_2S}\right| \frac{39.1\,g + 35.45\,g}{1\,mol\,KCl} =$$

$$\boxed{13.0\,g\,KCl}$$