Stoichiometry Class Worksheet

1. According to the equation below, adding copper (Cu) to silver nitrate ($AgNO_3$) allows a chemical reaction to occur that produces silver (Ag) and copper nitrate ($Cu(NO_3)_2$).

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

A- You need 2.0 g of silver (Ag) for an experiment. What mass of the silver nitrate will you require to obtain the 2.0 g of silver that you need?

G — m m — R

$$2.0\ g\ Ag \times \frac{1\ mol\ Ag}{107.87\ g\ Ag} \times \frac{2\ mol\ AgNO_3}{2\ mol\ Ag} \times \frac{169.88\ g\ AgNO_3}{1\ mol\ AgNO_3} = 3.1\ g\ AgNO_3$$

B- You need 2.0 g of silver (Ag) for an experiment. How many moles of the Cu will you require to obtain the 2.0 g of silver that you need?

G — m m

$$2.0\ g\ Ag \times \frac{1\ mol\ Ag}{107.87\ g\ Ag} \times \frac{1\ mol\ Cu}{2\ mol\ Ag} = .0093\ mol\ Cu$$

2. To neutralize hydrochloric acid (HCl), magnesium hydroxide ($Mg(OH)_2$), a base is added. The neutralization reaction is represented by the following equation:

$$2\ HCl + Mg(OH)_2 \rightarrow MgCl_2 + 2\ H_2O$$

A- You have 4.0 moles of HCl, what mass of $Mg(OH)_2$ is required to neutralize the 4.0 moles of HCl?

G — R

$$4.0\ mol\ HCl \times \frac{1\ mol\ Mg(OH)_2}{2\ mol\ HCl} \times \frac{58.33\ g\ Mg(OH)_2}{1\ mol\ Mg(OH)_2} = 120\ g\ Mg(OH)_2$$

B- You have 4.0 moles of HCl, how many moles of $Mg(OH)_2$ (H_2O) is required to neutralize the 4 moles of HCl?

G — R

$$4.0\ mol\ HCl \times \frac{2\ mol\ H_2O}{2\ mol\ HCl} = 4.0\ mol\ H_2O$$

3. The following equation describes how iron oxide, Fe_2O_3, is produced.

$$4\ Fe + 3O_2 \rightarrow 2Fe_2O_3$$

How much Fe_2O_3 is formed by the complete oxidation of 448 g of iron?

G — m m — R

$$448\,g\,Fe \times \frac{1\,mol\,Fe}{55.85\,g\,Fe} \times \frac{2\,mol\,Fe_2O_3}{4\,mol\,Fe} \times \frac{159.70\,g\,Fe_2O_3}{1\,mol\,Fe_2O_3} = 641\,g\,Fe_2O_3$$

4. How many moles of ammonia (NH_3) are needed to obtain 7.00 g of copper (Cu)?

$$3\ CuO + 2\ NH_3 \rightarrow N_2 + 3\ Cu + 3\ H_2O$$

G

$$7.00\,g\,Cu \times \frac{1\,mol\,Cu}{63.55\,g\,Cu} \times \frac{2\,mol\,NH_3}{3\,mol\,Cu} = 0.0734\,mol\,NH_3$$

5. According to the equation below, adding copper (Cu) to silver nitrate ($AgNO_3$) allows a chemical reaction to occur that produces silver (Ag) and copper nitrate ($Cu(NO_3)_2$).

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

A- If 3.33×10^7 molecules of Cu are available, how many moles of silver nitrate $AgNO_3$ would react with it?

G — m m — R

$$3.33 \times 10^7\,molecules\,Cu \times \frac{1\,mol\,Cu}{(6.02 \times 10^{23})\,molecules} \times \frac{2\,mol\,AgNO_3}{1\,mol\,Cu} = 1.11 \times 10^{-6}\,mol\,AgNO_3$$

B- If 400.0 g of copper nitrate $Cu(NO_3)_2$ was produced, how many Cu atoms must have reacted with the copper nitrate?

G

$$400.0\,g\,Cu(NO_3)_2 \times \frac{1\,mol\,Cu(NO_3)_2}{187.50\,g\,Cu(NO_3)_2} \times \frac{1\,mol\,Cu}{1\,mol\,Cu(NO_3)_2} \times \frac{6.02 \times 10^{23}\,Cu\,atoms}{1\,mol\,Cu} = 1.284 \times 10^{24}\,Cu\,atoms$$

C- If 7.5×10^4 Ag atoms are available, how many moles of silver nitrate $AgNO_3$ would react with it?

G

$$7.5 \times 10^4\,Ag\,atoms \times \frac{1\,mol\,Ag}{(6.02 \times 10^{23})\,Ag\,atoms} \times \frac{2\,mol\,AgNO_3}{2\,mol\,Ag} = 1.2 \times 10^{-19}\,mol\,AgNO_3$$

6. Use the equation below to solve questions A and B

$$2\ HCl + Mg(OH)_2 \rightarrow MgCl_2 + 2\ H_2O$$

A- If 700.0 g of water was produced, how many molecules of magnesium chloride ($MgCl_2$) must have reacted with the oxygen?

G

$700.0\,g\,H_2O \times \frac{1\,mol\,H_2O}{18.02\,g\,H_2O} \times \frac{1\,mol\,MgCl_2}{2\,mol\,H_2O} \times \frac{6.02\times10^{23}\,molec\,MgCl_2}{1\,mol\,MgCl_2} = 1.169\times10^{25}$ molecules $MgCl_2$

B- If 3.3×10^9 molecules of HCl are available, how many moles of water react with it?

G

$3.3\times10^{9}\,molec\,HCl \times \frac{1\,mol\,HCl}{(6.02\times10^{23})\,molec\,HCl} \times \frac{2\,mol\,H_2O}{2\,mol\,HCl} = 5.5\times10^{-15}$ mol H_2O

Mole and stoichiometry combination question

7. 200.0 mL of NaI whose concentration is 2.0 M are reacted with $Pb(NO_3)_2$ in order to obtain the precipitate PbI_2 . Calculate the mass of PbI_2 obtained.

$n = CV$

$\frac{2.0\,mol}{L} \times .2000\,L = .4\,mol = \text{given}$

G

$2\ NaI + Pb(NO_3)_2 \rightarrow PbI_2 + 2\ Na(NO_3)$

$.4\,mol\,NaI \times \frac{1\,mol\,PbI_2}{2\,mol\,NaI} \times \frac{461.00\,g\,PbI_2}{1\,mol\,PbI_2} = 92\,g\ PbI_2$

8. 75mL of $BaCl_2$ is used to produce $BaCrO_4$. If 4.81g of $BaCrO_4$ is made, what is the concentration of the $BaCl_2$ used? The following equation represents the reaction:

$$K_2CrO_{4\,(aq)} + BaCl_{2(aq)} \rightarrow BaCrO_{4(s)} + 2KCl_{(aq)}$$

G

$4.81\,g\,BaCrO_4 \times \frac{1\,mol\,BaCrO_4}{253.33\,g\,BaCrO_4} \times \frac{1\,mol\,BaCl_2}{1\,mol\,BaCrO_4} = \frac{0.018987092\,mol}{.075\,L} = \frac{.25\,mol}{L}$

9. How many mL of a 6.0M solution of HCl are needed to react with 4.85g of $NaHCO_3$? The equation that represents the reaction follows.

$$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$$

G

$4.85\,g\,NaHCO_3 \times \frac{1\,mol\,NaHCO_3}{84.01\,g\,NaHCO_3} \times \frac{1\,mol\,HCl}{1\,mol\,NaHCO_3} = 0.057731222\,mol\,HCl$

$\frac{6\,mol}{L} = \frac{.057}{x}$

$= 9.6\,mL$