Chemical Reactions of Copper and Percent Yield

Pre lab questions

1. **Give an example, other than the ones listed in this experiment, of redox and metathesis reactions.**

4/4

$$2KCl_{(aq)} + MnO_{2(s)} + 2H_2SO_{4(aq)} \rightarrow K_2SO_{4(aq)} + MnSO_{4(aq)} + Cl_{2(g)} + 2H_2O_{(l)}$$

$$Pb(NO_3)_{2(aq)} + KI_{(aq)} \rightarrow PbI_{2(s)} + 2\,KNO_{3(aq)}$$

- any reasonable answer accepted.

2. **When will reactions proceed to completion?**

2/2 *Is for example, in metathesis reaction proceed to completion whenever one of the products is removed from the solution, such as in the formation of a gas or an insoluble substance.*

3. **Define *percent yield* in general terms.**

2/2 *The percent yield is expressed as the ratio of the recovered mass to initial mass, multiplied by 100:*

$$\%\ yield = \frac{recovered\ mass\ of\ Cu}{initial\ mass\ of\ Cu} \times 100$$

4. **Name six methods of separating materials.**

6/6 *Centrifugation, Filtration, Decantation, Evaporation, Simple Distillation, Fractional Distillation, Chromatography, Crystallization, Sublimation*

5. **Give criteria in terms of temperature changes for exothermic and endothermic reactions.**

4/4 *Exothermic reaction: release heat.*

Endothermic reaction: absorbs heat.

6. **If 3.35 g of $Cu(NO_3)_2$ are obtained from allowing 2.25 g of Cu to react with excess HNO_3,what is the percent yield of the reaction?**

4/4

$$Cu_{(s)} + 4HNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + 2NO_{2(g)} + 2H_2O_{(l)}$$

$$2.25\ g\ Cu \times \left(\frac{1\ mol\ Cu}{63.546\ g\ Cu}\right) = 0.0354\ mol\ Cu \qquad mol\ Cu = mol\ Cu(NO_3)_2\ Therefore$$

$$0.0354\ mol\ Cu(NO_3)_2 \times \left(\frac{187.56\ g\ Cu(NO_3)_2}{1\ mol\ Cu(NO_3)_2}\right) = 6.64\ mol\ Cu(NO_3)_2$$

$$\%\ yield = \frac{3.35\ g\ Cu(NO_3)_2}{6.64\ g\ Cu(NO_3)_2} \times 100 = 50.5\ \%\ yield$$

7. **What is the maximum percent yield in any reaction?**

2/2 100 %.

8. **What is the meant by the terms *decantation* and *filtration*?**

4/4 *Decantation is the process of separation of a liquid from a solid by gently pouring the liquid from the solid so as to not disturb the solid.*

Filtration is the process of separating a solid from a liquid by means of a porous substance, a filter, which allows the liquid to pass through but not the solid.

9. **When $Cu(OH)_{2(S)}$ is heated, copper(II) oxide ad water are formed. Write balanced equation for the reaction.**

2/2

$$Cu(OH)_{2(s)} \rightarrow CuO_{(s)} + H_2O_{(g)}$$

10. **When sulfuric acid and copper(II) oxide are allowed to react, copper(II) sulfate and water are formed. Write a balanced equation for this reaction.**

3/3

$$CuO_{(s)} + H_2SO_{4(aq)} \rightarrow CuSO_{4(aq)} + H_2O_{(l)}$$

6. If 2.00 g of Zn is allowed to react with 1.75 g of $CuSO_4$ according to Equation [5], how many grams of Zn will remain after the reaction is complete?

$$2.00 \text{ g Zn} \times \frac{1 \text{ mol Zn}}{65.37 \text{ g Zn}} = 0.0306 \text{ mol Zn}$$

$1.75 \text{ g } CuSO_4 \times \dfrac{1 \text{ mol } CuSO_4}{159.5 \text{ g } CuSO_4} = 0.0110 \text{ mol } CuSO_4$. Hence, Zn is in excess:

$$0.0306 \text{ mol} - 0.0110 \text{ mol} = 0.0196 \text{ mol Zn unreacted}$$

$$0.0196 \text{ mol Zn} \times \frac{65.37 \text{ g Zn}}{1 \text{ mol Zn}} = 1.28 \text{ g Zn}$$

7. What is meant by the term *limiting reagent*?

The substance that is completely consumed in a reaction is called the limiting reagent or limiting reactant because it determines, or limits, the amount of product formed.