Stoichiometry Practice Problems

1. **A piece of magnesium burns in the presence of oxygen, forming magnesium oxide (MgO). How many moles of oxygen are needed to produce 12 moles of magnesium oxide? $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$**

$\left(\frac{1 \text{ mol } O_2}{2 \text{ mol } MgO}\right)$ $12 \text{ mol MgO} \times \frac{1 \text{ mol } O_2}{2 \text{ mol MgO}} = 6 \text{ mol } O_2$

2. **The carbon dioxide exhaled by astronauts can be removed from a spacecraft by reacting it with lithium hydroxide (LiOH). The reaction is as follows: $CO_2(g) + 2LiOH(s) \rightarrow Li_2CO_3(s) + H_2O(l)$. An average person exhales about 20 moles of CO_2 per day. How many moles of LiOH would be required to maintain two astronauts in a spacecraft for three days?**

$\left(\frac{1 \text{ mol } CO_2}{2 \text{ mol } LiOH}\right)$ $20 \text{ mol } CO_2 \times \frac{2 \text{ mol LiOH}}{1 \text{ mol } CO_2} = 40 \text{ mol LiOH}$

$40 \text{ mol LiOH} \times 2 \text{ astronauts} = 80 \text{ mol LiOH}$

$80 \text{ mol LiOH} \times 3 \text{ days} = 240 \text{ mol LiOH}$

3. **Balance the following equation and answer the questions below. $2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$**

a. How many moles of O_2 are produced from 10 moles of $KClO_3$?

$\left(\frac{2 \text{ mol } KClO_3}{3 \text{ mol } O_2}\right)$ $10 \text{ mol } KClO_3 \times \frac{3 \text{ mol } O_2}{2 \text{ mol } KClO_3} = 15.0 \text{ mol } O_2$

b. How many moles of KCl are produced using 3 moles of $KClO_3$?

$\left(\frac{2 \text{ KClO}_3}{2 \text{ KCl}}\right)$ $3 \text{ mol } KClO_3 \times \frac{2 \text{ mol KCl}}{2 \text{ mol } KClO_3} = 3 \text{ mol KCl}$

c. How many moles of $KClO_3$ are needed to produce 50 moles of O_2?

$\left(\frac{3 \text{ mol } O_2}{2 \text{ mol } KClO_3}\right)$ $50 \text{ mol } O_2 \times \frac{2 \text{ mol } KClO_3}{3 \text{ mol } O_2} = 33 \text{ mol } KClO_3$

4. **The following reaction occurs in plants undergoing photosynthesis.** $6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(s) + 6O_2(g)$
How many grams of glucose ($C_6H_{12}O_6$) are produced when 24.0 moles of carbon dioxide reacts in excess water?

$$24.0 \text{ mol } CO_2 \times \frac{1 \text{ mol } C_6H_{12}O_6}{6 \text{ mol } CO_2} = 4.00 \text{ mol } C_6H_{12}O_6$$

$$4.00 \text{ mol } C_6H_{12}O_6 \times \frac{180.18 \text{ g } C_6H_{12}O_6}{1 \text{ mol } C_6H_{12}O_6} = 721 \text{ g } C_6H_{12}O_6$$

5. **Calculate the mass of sodium chloride (NaCl) produced when 5.50 moles of sodium reacts in excess chlorine gas.**

$$2 Na + Cl_2 \rightarrow 2 NaCl$$

$$5.50 \text{ mol Na} \times \frac{2 \text{ NaCl}}{2 \text{ mol Na}} = 5.50 \text{ mol NaCl}$$

$$5.50 \text{ mol NaCl} \times \frac{58.44 \text{ g NaCl}}{1 \text{ mol NaCl}} = 321 \text{ g NaCl}$$

6. **How many grams of chlorine gas must be reacted with excess sodium iodide (NaI) to produce 6.00 moles of sodium chloride?**

   a. Balance the equation: $2\,NaI(aq) + Cl_2(g) \rightarrow 2\,NaCl(aq) + I_2(s)$.

   b. Perform the calculation.

$$6.00 \text{ mol NaI} \times \frac{1 \text{ mol } Cl_2}{2 \text{ mol NaI}} = 3 \text{ mol } Cl_2$$

$$3 \text{ mol } Cl_2 \times \frac{70.90 \text{ g } Cl_2}{1 \text{ mol } Cl_2} = 213 \text{ g } Cl_2$$

7. **Calculate the mass of hydrochloric acid (HCl) needed to react with 5.00 moles of zinc.**

   a. Balance the equation: $Zn(s) + 2\,HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$.

   b. Perform the calculation.

$$5.00 \text{ mol Zn} \times \frac{2 \text{ mol HCl}}{1 \text{ mol Zn}} = 10 \text{ mol HCl}$$

$$10 \text{ mol HCl} \times \frac{36.46 \text{ g HCl}}{1 \text{ mol HCl}} = 365 \text{ g HCl}$$

8. **How many grams of sodium hydroxide (NaOH) are needed to completely react with 50.0 grams of sulfuric acid (H_2SO_4) to form sodium sulfate (Na_2SO_4) and water? $2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4 + 2H_2O(g)$**

#1 $50.0\ g\ H_2SO_4 \times \frac{1\ mol\ H_2SO_4}{98.09\ g\ H_2SO_4} = 0.510\ mol\ H_2SO_4$

#2 $0.510\ mol\ H_2SO_4 \times \frac{2\ mol\ NaOH}{1\ mol\ H_2SO_4} = 1.02\ mol\ NaOH$

#3 $1.02\ mol\ NaOH \times \frac{40.00\ g\ NaOH}{1\ mol\ NaOH} = 40.8\ g\ NaOH$

9. **Balance each equation and solve the problem.**

a. If 40.0 g of magnesium reacts with excess hydrochloric acid (HCl), how many grams of magnesium chloride ($MgCl_2$) are produced?

$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$

#1 $40.0\ g\ Mg \times \frac{1\ mol\ Mg}{24.31\ g\ Mg} = 1.645\ mol\ Mg$

#2 $1.645\ mol\ Mg \times \frac{1\ mol\ MgCl_2}{1\ mol\ Mg} = 1.645\ mol\ MgCl_2$

#3 $1.645\ mol\ MgCl_2 \times \frac{95.21\ g\ MgCl_2}{1\ mol\ MgCl_2} = 157\ g\ MgCl_2$

b. Determine the mass of copper needed to react completely with a solution containing 12.0 g of silver nitrate ($AgNO_3$).

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

#1 $12\ g\ AgNO_3 \times \frac{1\ mol\ AgNO_3}{169.88\ g\ AgNO_3} = 0.0706\ mol\ AgNO_3$

#2 $0.0706\ mol\ AgNO_3 \times \frac{1\ Cu}{1\ mol\ AgNO_3} = 0.0353\ mol\ Cu$

#3 $0.0353\ mol\ Cu \times \frac{63.55\ g\ Cu}{1\ mol\ Cu} = 2.24\ g\ Cu$

c. How many grams of hydrogen chloride (HCl) are produced when 15.0 g of sodium chloride (NaCl) reacts with excess sulfuric acid (H_2SO_4)?

$2NaCl(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4 + 2HCl(g)$

#1 $15.0\ g\ NaCl \times \frac{1\ mol\ NaCl}{58.44\ g\ NaCl} = 0.2567\ mol\ NaCl$

#2 $0.2567\ mol\ NaCl \times \frac{2\ mol\ HCl}{2\ mol\ NaCl} = 0.2567\ mol\ HCl$

#3 $0.2567\ mol\ HCl \times \frac{36.46\ g\ HCl}{1\ mol\ HCl} = 9.36\ g\ HCl$

d. Calculate the mass of silver phosphate (Ag_3PO_4) produced if 30.0 g of silver acetate ($AgCH_3COO$) reacts with excess sodium phosphate (Na_3PO_4).

$3AgCH_3COO(aq) + Na_3PO_4(aq) \rightarrow Ag_3PO_4(s) + 3NaCH_3COO(aq)$

#1 $30.0\ g\ AgCH_3COO \times \frac{1\ mol\ Ag_3CH_3COO}{166.92\ g\ Ag_3CH_3COO} = 0.1797\ mol\ Ag_3CH_3COO$

#2 $0.1797\ mol\ Ag_3CH_3COO \times \frac{1\ mol\ Ag_3PO_4}{3\ mol\ Ag_3CH_3COO} = 0.0599\ mol\ Ag_3PO_4$

#3 $0.0599\ mol\ Ag_3PO_4 \times \frac{418.58\ g\ Ag_3PO_4}{1\ mol\ Ag_3PO_4} = 25.1\ g\ Ag_3PO_4$