## Practice 4-1

Calculate the formula mass of each of the following: $Fe(NO_3)_2$ and $C_{12}H_{22}O_{11}$.

**Answer**

**$Fe(NO_3)_2$ = (1 x 55.85 amu) + (2 x 14.01 amu) +(6 x 16.00 amu)= 179.87 amu**

**$C_{12}H_{22}O_{11}$ = (12 x 12.01 amu) + (22 x 1.01) + (11 x 16.00 amu) = 342.34 amu**

## Practice 4-2

How many atoms are present in 0.0045 mol of xenon?

**Answer**

$$0.0045 \text{ mol Xe} \times \frac{6.02 \times 10^{23} \text{ atoms Xe}}{1 \text{ mol Xe}} = 2.7 \times 10^{21} \text{ mol Xe}$$

## Practice 4-3

Calculate the formula mass and molar mass of each of the following:
$Fe(NO_3)_2$ and $C_{12}H_{22}O_{11}$.

**Answer**

**$Fe(NO_3)_2$ = (1 x 55.85 amu) + (2 x 14.01 amu) +(6 x 16.00 amu)= 179.87 amu**
**$C_{12}H_{22}O_{11}$ = (12 x 12.01 amu) + (22 x 1.01) + (11 x 16.00 amu) = 342.34 amu**

**The formula mass of $Fe(NO_3)_2$ is 179.87 amu,**
**so the molar mass is 179.87 g/mol.**

**The formula mass of $C_{12}H_{22}O_{11}$ is 342.34 amu,**
**so the molar mass is 342.34 g/mol.**

## Practice 4-4

Calculate the number of moles in 45.8 g of sucrose, $C_{12}H_{22}O_{11}$.

**Answer**

**The molar mass of sucrose is 342.34 g/mol.**

$$45.8\ g\ C_{12}H_{22}O_{11} \times \frac{1\ mol\ C_{12}H_{22}O_{11}}{342.34\ g\ C_{12}H_{22}O_{11}} = 0.134\ mol\ C_{12}H_{22}O_{11}$$

## Practice 4-5

Balance each of the following chemical equations:

a) $PCl_3 + HF \rightarrow PF_3 + HCl$

b) $N_2O_4 + N_2H_4 \rightarrow N_2 + H_2O$

c) $NaH_2PO_4 + NaOH \rightarrow Na_3PO_4 + H_2O$

**Answer**

**a) $PCl_3 + 3\,HF \rightarrow PF_3 + 3\,HCl$**

**b) $N_2O_4 + 2N_2H_4 \rightarrow 3\,N_2 + 4\,H_2O$**

**c) $NaH_2PO_4 + 2\,NaOH \rightarrow Na_3PO_4 + 2H_2O$**

## Practice 4-6

State whether each of the following compounds is soluble or insoluble in water.
NaOH, $PbI_2$, $Ba_3(PO_4)_2$, $(NH_4)_2S$, $CoCO_3$, $Al(NO_3)_3$, $Hg(OH)_2$.

**Answer**

| | |
|---|---|
| **NaOH** | **Soluble (contains sodium)** |
| **$PbI_2$** | **Insoluble (contains iodide "exception")** |
| **$Ba_3(PO_4)_2$** | **Insoluble (contains phosphate)** |
| **$(NH_4)_2S$** | **Soluble (contains ammonium)** |
| **$CoCO_3$** | **Insoluble (contains carbonate)** |
| **$Al(NO_3)_3$** | **Soluble (contains nitrate)** |
| **$Hg(OH)_2$** | **Insoluble (contains hydroxide)** |

## Practice 4-7

Write the formula equation, total ionic and net ionic equations for the reaction of $MgCl_2$ and $Na_2CO_3$.

**Answer**

1. **Reactants: magnesium chloride, $MgCl_2$, and sodium carbonate $Na_2CO_3$.**
2. **Products: magnesium carbonate, $MgCO_3$, and sodium chloride, NaCl (exchange cations).**
3. $MgCl_2 + Na_2CO_3 \rightarrow MgCO_3 + NaCl$
4. $MgCl_2(aq) + Na_2CO_3(aq) \rightarrow MgCO_3(s) + NaCl(aq)$
5. $MgCl_2(aq) + Na_2CO_3(aq) \rightarrow MgCO_3(s) + 2NaCl(aq)$
6. $Mg^{2+}(aq) + 2Cl^-(aq) + 2Na^+(aq) + CO_3^{2-}(aq) \rightarrow MgCO_3(s) + 2Na^+(aq) + 2Cl^-(aq)$
7. $Mg^{2+}(aq) + CO_3^{2-}(aq) \rightarrow MgCO_3(s)$

## Practice 4-8

Assign oxidation number to the nitrogen in each of the following:

$N_2H_4$ NO $N_2$ $NO_3^-$ $NO_2^-$ $NH_3$

**Answer**

| $N_2H_4$ | NO | $N_2$ | $NO_3^-$ | $NO_2^-$ | $NH_3$ |
|---|---|---|---|---|---|
| 2- | 2+ | 0 | 5+ | 3+ | 3- |

## Practice 4-9

In each of the following reactions, determine what is oxidized and what is reduced?

a) $2Na + 2H_2O \rightarrow 2NaOH + H_2$

b) $Cr + 2H^+ \rightarrow Cr^{2+} + H_2$

c) $Pb + 2Hg^{2+} \rightarrow Pb^{2+} + Hg$

d) $MnO_2 + 4HBr \rightarrow MnBr_2 + Br_2 + 2H_2O$

**Answer**

**a) Oxidized: Na** **Reduced: $H^+$**
**b) Oxidized: Cr** **Reduced: $H^+$**
**c) Oxidized: Pb** **Reduced: $Hg^{2+}$**
**d) Oxidized: Br-** **Reduced: $Mn^{4+}$**

## Practice 4-10

How many grams of $Cl_2$ can be produced from 3.1 g of HCl?
Given the equation: $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + 1Cl_2$
Perform a continuous calculation.

**Answer**

$$3.1 \text{ g HCl} \times \frac{1 \text{ mol HCl}}{36.46 \text{ g HCl}} \times \frac{1 \text{ mol } Cl_2}{4 \text{ mol HCl}} \times \frac{70.90 \text{ g } Cl_2}{1 \text{ mol } Cl_2} = 1.5 \text{ g } Cl_2$$

## Practice 4-11

Calculate the mass of carbon required to produce 18.6 g of iron.
Given the equation: $2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$
Perform a continuous calculation.

**Answer**

$$18.6 \text{ g Fe} \times \frac{1 \text{ mol Fe}}{55.85 \text{ g Fe}} \times \frac{3 \text{ mol C}}{4 \text{ mol Fe}} \times \frac{12.01 \text{ g C}}{1 \text{ mol C}} = 3.00 \text{ g C}$$

## Practice 4-12

How many grams of phosphorus are required to react completely with 6.6 g $O_2$?
$4P + 5O_2 \rightarrow 2P_2O_5$
Perform a continuous calculation.

**Answer**

$$6.6 \text{ g } O_2 \times \frac{1 \text{ mol } O_2}{32.00 \text{ g } O_2} \times \frac{4 \text{ mol P}}{5 \text{ mol } O_2} \times \frac{30.97 \text{ g P}}{1 \text{ mol P}} = 5.1 \text{ g P}$$

## Practice 4-13

Given the equation: $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

Calculate the following:

a) How many moles of Fe are produced from 1.80 mol of CO?

b) How many moles of $Fe_2O_3$ are needed to produce 66.0 g of $CO_2$?

c) How many grams of Fe will be produced from 7.52 g of CO?

**Answer**

a) $1.80 \text{ mol CO} \times \frac{2 \text{ mol Fe}}{3 \text{ mol CO}} = 1.20 \text{ mol Fe}$

b) $66.0 \text{ g } CO_2 \times \frac{1 \text{ mol } CO_2}{44.01 \text{ g } CO_2} \times \frac{1 \text{ mol } Fe_2O_3}{3 \text{ mol } CO_2} = 0.500 \text{ mol } Fe_2O_3$

c) $7.52 \text{ g CO} \times \frac{1 \text{ mol CO}}{28.01 \text{ g CO}} \times \frac{2 \text{ mol Fe}}{3 \text{ mol CO}} \times \frac{55.85 \text{ g Fe}}{1 \text{ mol Fe}} = 10.0 \text{ g Fe}$