Exercises on the outcome of chemical reactions

Data: M(O)=16.0 g.mol^{-1}; M(H)=1.00g.mol^{-1}; M(Ca)=40.0 g.mol^{-1}; M(C)=12.0 g.mol^{-1}; M(Al)=27.0 g.mol^{-1}; M(Cl) = 35.5 g.mol^{-1} ; M(Cu)=63.5 g.mol^{-1}.
V_M = 24.0 L.mol^{-1}.

CuC!

We mix a mass m = 4.77 g of copper oxide (CuO) with carbon. Metallic copper and carbon dioxide are formed.

1. **Determine the initial quantity of copper oxide.**
2. **Write the equation associated to the chemical reaction.**
3. **Determine the exact mass of carbon needed to consume all the copper oxide.**

Ceramics class

Aluminum oxide ($Al_2O_{3(s)}$) can react with carbon ($C_{(s)}$), in presence of chlorine gas ($Cl_{2(g)}$), to form aluminum chloride ($AlCl_{3(s)}$) and carbon monoxide ($CO_{(g)}$).

1. **Write the equation associated to the chemical reaction.**

Initially, we have: $m(Al_2O_3)_i$ = 1.53 kg ; $V(Cl_2)_i$ = 806 L ; $m(C)_i$ = 324 g.

2. **Determine the volume of carbon monoxide formed in these conditions.**

Chlorine gas is toxic. To avoid its propagation in the environment, the excess of chlorine gas can be trapped by dissolving it in 1.0 L of water.

3. **What is the quantity of chlorine gas left at the end of the reaction?**
4. **What is the molar concentration of chlorine in the solution obtained after dissolution?**

This solution should be diluted to obtain a daughter solution of a volume V' = 100 mL and a molar concentration C' = 1.0 mol.L^{-1}.

5. **Write the method for preparing this solution. Justify the volume of stock solution needed.**

Bubbling chalk

Ethanoic acid ($C_2H_4O_2$) acts on chalk ($CaCO_3$) to produce carbon dioxide, ethanoate ions ($C_2H_3O_2^-$), calcium ions and water.

This reaction can be summarised by the following equation:

$$2C_2H_4O_{2(l)} + CaCO_{3(s)} \rightarrow CO_{2(g)} + 2C_2H_3O_2{}^-{}_{aq} + Ca^{2+}{}_{aq} + H_2O_{(l)}$$

Initially, there are 1.4 g of chalk and n_0 moles of ethanoic acid. Chalk is the limiting reagent.

1. **What is the mass of water obtained at the end of the reaction?**

A mixture is considered stoichiometric when all reagents are disappearing simultaneously: none is left at the end of the reaction.

2. **What should the value of $n_0(C_2H_4O_2)$ be for this mixture to be considered stoichiometric?**