

Lab: Determination of the Empirical Formula of a Compound

Introduction

Empirical means based on experiment. Therefore, an empirical formula is one that is obtained from experimental data and represents the smallest whole number ratio of atoms in a compound.

The determination of formulas for compounds is done by laboratory analysis. Experiments are done to measure the amount of each element in the compound. The interpretation of the results make use of molar masses. Knowing the mass of each element, one can find the number of moles of each element in the sample of the compound. Dividing the number of moles of each element by the smallest number of moles will give the ratio of atoms present in the compound.

Thus, the analysis of the data provides the simplest ratio of atoms present in the compound.

In this experiment, a measured mass of magnesium metal will be reacted with an excess of 2 mol dm^{-3} hydrochloric acid, $\text{HCl}_{(\text{aq})}$. The excess hydrochloric acid will be evaporated and the mass of the magnesium chloride product will be measured. This data will be used to calculate the empirical formula for magnesium chloride.

Purpose

To determine the simplest formula for the compound magnesium chloride.

Materials

balance, 150 cm^3 beaker, graduated cylinder, ring stand and ring with wire gauze, hot plate, magnesium ribbon, 2 mol dm^{-3} hydrochloric acid, $\text{HCl}_{(\text{aq})}$.

Safety

Hydrochloric acid is corrosive to skin, eyes, and clothing.

Procedure

1. Mass a clean, dry 150 cm^3 beaker and watch glass. Record your results in a suitable quantitative data table.
2. Place a piece of magnesium ribbon provided by your teacher, it should be $< 0.30 \text{ g}$, and record the data in the data table.
3. Add $\sim 20 \text{ cm}^3$ of $\text{mol dm}^{-3} \text{ HCl}_{(\text{aq})}$ slowly, record all your observation in a suitable qualitative data table.
4. When all reaction appears to have ceased, place the beaker together its contents and with the watch glass on the hot plate, and heat until dry.
5. Allow the beaker and the magnesium chloride to cool. When cool mass the beaker, watch glass and magnesium chloride and record the mass in the data table.
6. Repeat steps 4 and 5 until a constant mass is obtained.
7. Wash the magnesium chloride out of the beaker, wash all equipment and clear up!

Data Collection

Prepare suitable Data Tables

Data Processing and Presentation

Analyze the data you obtained in this lab to determine the empirical formula of magnesium chloride. Prepare a suitable summary table of all your data analysis.

Conclusion and Data Evaluation

Respond to the purpose of the lab.

Evaluate the weaknesses and the limitations observed in the procedure, the apparatus, materials, and in the data analyses.

Suggest ways to improve these weaknesses and limitations.

Write the net ionic equation for the reaction of magnesium with hydrochloric acid.