The Atomic Mass of Zinc

# Introduction

The relative atomic mass of an element is an important quantity found on the periodic table. We use atomic mass to determine the number of atoms or molecules in a sample, since one mole of a substance is equal to the formula mass of a substance measured in grams. In this experiment, we collect experimental data to calculate the atomic mass of the element zinc.

Zinc metal dissolves in a concentrated acid, producing hydrogen gas. Each atom of zinc produces one molecule of hydrogen; or equivalently, one mole of zinc produces one mole of hydrogen gas. We also know that one mole of hydrogen gas at room pressure and temperature occupies a volume of 24400 mL. Therefore, if we measure the volume of gas produced by the reaction, we can convert it into moles of hydrogen and then to moles of zinc. Since the mass of zinc that dissolved can also be measured, the molar mass of zinc can be calculated by dividing the mass of zinc by the moles of zinc.

# Materials and Methods

Centrifuge tube

Ring stand and clamp

Evaporating dish

Plastic pipet

A piece of mossy zinc

Concentrated hydrochloric acid – Corrosive, Poisonous, Toxic

Metal spatula

# Procedure

1. Fill a centrifuge tube to the top with water and cap it. When inverted, there should be NO air bubbles in the tip.
2. Fill the evaporating dish at least half full with tap water. Place the inverted tube in the water and remove the cap: no air bubbles should enter the tube. Remove the cap from the dish. Use a clamp to hold the tube in place and move the apparatus to the fume hood.
3. Find the mass of a piece of zinc to the closest 0.001 g and record the mass on the Report Sheet.
4. Place the zinc in the evaporating dish, under the water. Lift the centrifuge tube high enough to position the zinc underneath the tube. None of the zinc should extend past the edge of the tube; otherwise, some of the hydrogen gas generated will be lost. Lower and clamp the tube so that there is about a millimeter of space between the bottom of the tube and the evaporating dish.
5. Use a plastic pipet to remove water from the dish until the water level is approximately one millimeter above the lip of the centrifuge tube. This water may be discarded.
6. Begin the reaction by adding approximately 2.0 mL of concentrated HCl to the dish. The reaction will start immediately, and bubbles of hydrogen gas will begin collecting, forcing water out of the tube, and diluting the solution. As acid is used up and the solution is diluted, the rate of gas production will slow.
7. When at least 10.0 mL of gas has been produced (but no more than 20.0 mL – the limit of an exact reading of the tube volume), end the reaction by lifting the tube enough to slide the zinc out from the dish using a metal spatula.
8. Allow the final bubbles of gas to collect and read the volume to the closest 0.1 mL. Record the volume on the Report Sheet.
9. Dry the piece of zinc and weigh it on a balance. Record the mass on the Report Sheet.

# Data and Results

1. Subtract the final mass of zinc from the initial mass of zinc to find the mass of zinc consumed.
2. Use the method of conversions and the relationship, 1 mol H2 = 24400 mL to calculate the moles of hydrogen gas produced.
3. Use the method of conversions and the fact that one mole of zinc dissolved produced one mole of hydrogen gas to calculate the moles of zinc consumed.
4. Use the mass and moles of zinc consume and the definition of molar mass as mass per mole to calculate the atomic mass of zinc.
5. Calculate the percent error of the answer by assuming the correct molar mass of zinc is 65.4 g/mole.

# Clean Up

Pour the solution in the labelled waste container. Rinse and dry the evaporating DISH. Return the dish, zinc, and centrifuge tube to their proper locations.