Chapter 2 The Reduction and Oxidation of Metals

The ’69 Chevelle was marketed to a boisterous generation of young people as an affordable performance car. The year 1969 saw the first person step on the surface of the moon, the Woodstock Music and Arts Fair made rock music history, and a powerful car was ready to assert itself on the road.

Christine first saw a ’69 Chevelle when she was just a little girl. The car she saw, though, had fallen into disrepair. The once powerful sprinter was rusting on a pile of hay bales. It was purchased as a salvage vehicle by Christine’s father. Over the years, Christine watched her father meticulously work to restore the vehicle to its former glory. Since Christine shared her father’s passion for this restoration, she was given the car. Years later, she hired professionals to complete the work.

The most expensive and time-consuming work in restoration is rust repair and panel replacement. To a car, rust is like a cancer that must be completely cut out to prevent it from spreading. Bumpers usually need to be removed, chemically cleaned, and put through a process that puts a new coating of chrome on the surface. Restoration also extends to the mechanical and electrical systems. The battery would be depleted of the reactants that enable it to produce an electric current. The copper in most of the electrical switches and contacts would most likely be corroded and have to be replaced.

The process of corrosion, the production of electricity in a battery, and the plating of chrome over steel all have something in common. What is it? You might be surprised to know that chemistry is at the heart of each one. Each process is explained by the exchange of electrons between different metals and metal ions.

In this chapter you will learn how metals are mined, protected from corrosion, used to generate an electric current, and plated onto the surface of other metals. Throughout this chapter, your knowledge of valence electrons, solutions, and bonding from Chapter 1 will be used to support your new learning.

Try This Activity

Observing the Reactivity of Zinc

In some chemical reactions, one type of ion replaces another type of ion in a solution. The ion that is replaced often precipitates out of the solution. In this activity you will observe the reaction between zinc metal and a solution of silver nitrate, $AgNO_3(aq)$.

Science Skills

- ✓ Performing and Recording
- ✓ Analyzing and Interpreting
- ✓ Communication and Teamwork

Materials

- small samples of plastic
- small samples of zinc metal
- 0.500-mol/L silver nitrate solution
- eyedropper
- multi-well dish (or 2 Petri dishes)
- dissecting microscope

CAUTION!

Use gloves, safety glasses, and a lab apron for this activity.

Procedure

step 1: Take a small piece of plastic and a small piece of zinc metal, and place each in a separate well of the multi-well dish (or in separate Petri dishes).

step 2: Place the dish containing the plastic under a dissecting microscope, and focus the microscope so you have a clear image of the edge of the plastic piece.

The next steps involve one partner observing changes through the microscope as the other partner adds a few drops of solution. Organize your group so that each person will have an opportunity to make observations through the microscope.

step 3: Have one of your partners add a few drops of silver nitrate solution, and observe any changes that occur to the plastic or to the solution while looking through the microscope.

step 4: Repeat steps 2 and 3 for the piece of zinc.

step 5: Clean your equipment, and dispose of the waste materials as directed by your teacher.

Analysis

1. Which substance is more reactive—the strip of plastic or the zinc? Please give a reason for your answer.
2. Infer what you think occurs to the zinc during the chemical reaction.
3. Infer which material is produced during the chemical reaction.
4. Describe the change by completing the following word chemical equation:

   zinc + silver nitrate →
5. Describe what you saw while looking at the zinc and silver nitrate solution through the microscope.
6. Use the word equation from question 4 to write a balanced chemical equation that describes the reaction between zinc metal and aqueous silver nitrate.

Photo Credits and Acknowledgements

All photographs, illustrations, and text contained in this book have been created by or for Alberta Education, unless noted herein or elsewhere in this Science 20 textbook.

Alberta Education wishes to thank the following rights holders for granting permission to incorporate their works into this textbook. Every effort has been made to identify and acknowledge the appropriate rights holder for each third-party work. Please notify Alberta Education of any errors or omissions so that corrective action may be taken.