

Testing for Different Charges

PROBLEM

What evidence is there that iron can have more than one oxidation state?

INTRODUCTION

The periodic table shows that many metals have more than one common oxidation state. Iron, for example, occurs as iron II (Fe^{+2}) and iron III (Fe^{+3}). As a result, iron atoms can have two different reactions and form two different compounds when combining with the same nonmetal. In this laboratory investigation, you will do qualitative tests to identify both forms of iron. Then you will do a chemical reaction to convert one form of iron to the other.

MATERIALS (per group)

Hydrogen peroxide (3%); iron II sulfate solution; iron III chloride solution; medicine dropper; sodium hydroxide solution; stirring rod; test tube rack; test tubes

PROCEDURE

1. Fill a test tube partway (about $\frac{1}{3}$ of the way) with iron III chloride solution.
2. Using a medicine dropper, add a few drops of sodium hydroxide. Then mix with a stirring rod. Note whether or not a precipitate forms. Record your observations in the data table on the next page in the column entitled "Description of Mixture".
3. Note the color of the iron III chloride solution after addition of sodium hydroxide. The color is characteristic of iron III cations. Record your observations in the data table on the next page in the column entitled "Description of Mixture".
4. Set the test tube containing the iron III chloride solution aside in a test tube rack for later use.
5. Repeat steps 1 and 2 using iron II sulfate solution. Note the color of the iron II sulfate solution after addition of sodium hydroxide. The color is characteristic of iron III cations. Record your observations in the data table on the next page.
6. Compare the colors of the cations in the test tubes containing the two forms of iron. Note whether the colors are the same or different.
7. Using a clean medicine dropper, add some hydrogen peroxide to the test tube containing the iron II sulfate solution. Note whether or not there is a color change. Record your observations in the data table on the next page.
8. After addition of hydrogen peroxide to the iron II sulfate, compare the colors of the cations in the two test tubes again. Note whether the colors are the same or different.



OBSERVATIONS

Appearance of Mixture in the Test Tube

Test tube description	Description of Mixture
Iron III chloride solution after addition of sodium hydroxide	
Iron II sulfate solution after addition of sodium hydroxide	
Iron II sulfate solution after addition of hydrogen peroxide	

CONCLUSIONS

- Compounds of iron and hydroxide are not soluble. What evidence did you observe that showed that iron hydroxides formed when sodium hydroxide was added to test tubes containing iron III chloride and iron II sulfate? _____

- The iron compounds were reacted with sodium hydroxide to produce iron hydroxides. As a result, the comparisons you made were between iron II hydroxide [Fe(OH)₂] and iron III hydroxide [Fe(OH)₃] rather than between iron II sulfate and iron III chloride. Why was this important? _____

- What evidence is there that the iron hydroxides formed during the reactions contained two different forms of iron? (HINT: Refer to the colors in your answer.) _____

- What evidence is there that addition of hydrogen peroxide caused a chemical change to the iron II hydroxide that formed from the iron II sulfate? _____

- What kind of change occurred to iron II hydroxide after the hydrogen peroxide was added? How do you know? _____

- What evidence is there that iron can have more than one oxidation state? _____

