Oxidation-Reduction Reaction Lab 29

PRE-LAB DISCUSSION

Substances that lose electrons (increasing the oxidation number) during a chemical reaction are said to be oxidized. Those that gain electrons (decreasing the oxidation number) are said to be reduced. If one reactant gains electrons, another must lose an equal number of electrons. Thus, oxidation and reduction most occur simultaneously. The relative strengths of oxidation and reduction agents can be determined experimentally by observing the reactions.

PURPOSE

To perform several reactions with metals to determine their relative strengths as oxidizing and reducing agents and to observe redox reactions involving two different polyatomic ions that behave as oxidizing agents.

EQUIPMENT

test tubes test tube rack

MATERIALS

copper iron
zinc I *two strips of each*
0.1 M $Cu(NO_3)_2$ 0.1 M $Fe(NO_3)_2$
0.1 M $Zn(NO_3)_2$ 0.05 M $KMnO_4$
0.5 M $FeSO_4$ 0.02 M $K_2Cr_2O_7$
concentrated H_2SO_4

PROCEDURE

PART A: Relative Reducing Strengths of Metals

1. Prepare five test tubes as follows and label them
   First and second test tubes having 0.5M $Cu(NO_3)_2$
   Third and fourth test tubes having 0.1M $Fe(NO_3)_2$
   Fifth and sixth test tubes having 0.1M $Zn(NO_3)_2$
2. Place iron strips into the first and fifth test tubes, copper strips into the third and sixth test tubes, and zinc strips into the second and fourth test tubes.
3. Wait for 5-10 minutes and record your observations.

PART B: Reactions between Selected Redox Couples

Reduction of permanganate ion

1. Put about 5ml of 0.05M $KMnO_4$ into a test tube.
2. Add 10-15 drops of concentrated H_2SO_4.
3. Add 0.5M $FeSO_4$ solution drop by drop until purple color of the permanganate ion, MnO_4^-, just disappears. Chemical reaction occurring is:

$$5Fe^{2+}_{(aq)} + MnO_4^-{}_{(aq)} + 8H^+_{(aq)} \Rightarrow 5Fe^{3+}_{(aq)} + Mn^{2+}_{(aq)} + 4H_2O_{(l)}$$
(purple)

Reduction of dichromate ion to chromate ion

4. Put about 5ml of 0.02M $K_2Cr_2O_7$ solution into a test tube.
5. Add 10-15 drops of concentrated H_2SO_4.
6. Add 0.5M $FeSO_4$ solution drop by drop until the orange color of the dichromate, $Cr_2O_7^{2-}$, ion turns to green. Chemical reaction occurring is:

$$Cr_2O_7^{2-}{}_{(aq)} + 6Fe^{2+}_{(aq)} + 14H^+_{(aq)} \Rightarrow 2Cr^{3+}_{(aq)} + 6Fe^{3+}_{(aq)} + 7H_2O_{(l)}$$
(orange) (green)

DATA TABLE

PART A: Relative Reducing Strengths of Metals

Test Tube	Reactants	Reaction observed	Products
1	$Fe_{(s)} + Cu^{2+}_{(aq)}$		
2	$Zn_{(s)} + Cu^{2+}_{(aq)}$		
3	$Cu_{(s)} + Fe^{2+}_{(aq)}$		
4	$Zn_{(s)} + Fe^{2+}_{(aq)}$		
5	$Fe_{(s)} + Zn^{2+}_{(aq)}$		
6	$Cu_{(s)} + Zn^{2+}_{(aq)}$		

CONCLUSIONS AND QUESTIONS

1. Write the chemical reactions and indicate oxidizing and reducing agents.
2. Order the metals according their relative reducing strength.
3. What were the reducing and oxidizing agents in the reaction in Part B?