Chemistry 30

Introductory Redox Lab

Teacher notes and answers

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_ Score \_\_\_\_\_\_\_

Purpose:

* To predict whether redox reactions are spontaneous or not
* To compare the relative tendency of metals and their metallic ions to react with each other.

Prelab:

1. Copper strip in solution of iron (III) nitrate

2Fe3+ + Cu 🡪 2Fe2+ + Cu2+ Eo = 0.43 V

1. Copper strip in solution of nickel (II) nitrate

Ni2+ + Cu 🡪 Ni + Cu2+ Eo = -0.60 V

1. Copper strip in solution of zinc sulfate

Zn2+ + Cu 🡪 Zn + Cu2+ Eo = -1.10 V

1. Copper strip in solution of copper (II) sulfate

Cu + Cu2+ 🡪 Cu + Cu2+ Eo = 0.00 V

1. Zinc strip in solution of copper (II) nitrate

Zn + Cu2+ 🡪 Zn2+ + Cu Eo = 1.10 V

1. Zinc strip in solution of nickel (II) nitrate

Zn + Ni2+ 🡪 Ni + Zn2+ Eo = 0.50 V

1. Zinc strip in solution of iron (III) nitrate

Zn + 2Fe3+ 🡪 2Fe2+ + Zn2+ Eo = 1.53 V

1. Zinc strip in solution of zinc sulfate

Zn + Zn2+ 🡪 Zn + Zn2+ Eo = 0.00 V

1. Nickel strip in solution of copper (II) nitrate

Ni + Cu2+ 🡪 Ni2+ + Cu Eo = 0.43 V

1. Nickel strip in solution of iron (III) nitrate

Ni +2 Fe3+ 🡪 Ni2+ + 2Fe2+ Eo = 1.03 V

1. Nickel strip in solution of zinc sulfate

Ni + Zn2+ 🡪 Zn + Ni2+ Eo = -0.50 V

1. Nickel strip in solution of nickel (II) nitrate

Ni + Ni2+ 🡪 Ni + Ni2+ Eo = 0.00 V

1. Iron strip in solution of copper (II) nitrate

Fe + Cu2+ 🡪 Cu + Fe2+ Eo = 0.79 V

1. Iron strip in solution of zinc sulfate

Fe + Zn2+ 🡪 Fe2+ + Zn Eo = -0.31 V

1. Iron strip in solution of nickel (II) nitrate

Fe + Ni2+ 🡪 Ni + Fe2+ Eo = 0.19 V

1. Iron strip in solution of iron (III) nitrate

Fe + 2Fe3+ 🡪 Fe2+ +2 Fe2+ Eo  1.22 V

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Metal / solution | Cu2+ | Zn2+ | Ni2+ | Fe3+ |
| Cu(s) | Nothing | Nothing | Nothing | Colour change |
| Zn­(s) | Colour change | Nothing | Colour change | Colour change |
| Ni­(s)­ | Colour change | Nothing | Nothing | Colour change |
| Fe­(s) | Colour change | Nothing | Colour change | Colour change |

Questions:

1. Write a generalization about the likelihood of a reaction between a metal and its own aqueous ion?

Generally a metal and its ion will have NO reaction

1. Is the answer to question one dependent upon whether the metal has more than one ion charge? Why or why not? (Hint 🡪 you have three ‘two charge’ metals …. Ni, Fe, Cu. Explore your data booklet for some help!

Multi charge ions like iron will have a reaction when you have the metal and the larger of the ion charges.

1. When metallic ions want to form metals, they are undergoing Reduction. List the metallic ions in order of their tendency to form metals. Start with the most likely one!

Fe3+, Cu2+, Ni2+, Zn2+

1. When metals want to form their metallic ions, they are undergoing oxidation List the metals in order of their tendency to form metallic ions. Start with the most likely one.

Zn, Fe, Ni, Cu

1. For the mixtures below, write the expected redox reaction. Be sure to give voltage and expected colours for reactants and products. Identify the oxidizing agent (OA) and the reducing agent (RA)

Hydrochloric acid, potassium bromide solution, manganese (IV) oxide crystals and copper strips

Reduction half reaction

MnO2 + 4H+ + 2e- 🡪 Mn2+ + 2H2O Eo = 1.22V

Oxidation half reaction

Cu 🡪 Cu2+ + 2e- Eo = -0.34V

Redox reaction

2MnO2 + 4H+ + Cu 🡪 Mn2+ + Cu2+ + 2H2O Eo = 0.88 V

Pale pink Blue