**Iron (II) vs Iron (III) – Lab Makeup**

**Background Information:**

When atoms lose or gain electrons, an **ion** forms. These ions can be positively or negatively charged. Metallic elements typically **lose** one or more electrons and form positively charged ions (**cations**) while non-metals tend to gain electrons and form negatively charged ions (**anions**).

In order to write out the chemical formulas of ionic compounds, you must be able to predict the types of ions and their charges of the atoms that make up the compound. These charges follow a nice pattern as you move from left to right across the periodic table. The transition metals however, make those predictions more difficult because they can form **more than one type of cation**.

An example of this is with iron ions. This metal can form Iron (II) or Iron (III) ions. We use the roman numerals to distinguish these two types of iron and their charges (Fe+2, Fe+3). The purpose of this lab is for you to see how different ions will react. Just because iron ions can exist in two forms, doesn’t mean they will react the same. You will also see how reactions can lead to the loss of electrons and increase in positive charge (**oxidation reaction**) or how they can gain electrons and decrease in positive charge (**reduction reaction**).

1. When atoms lose electrons they form positive ions called: (circle one) cations or anions.
2. \_\_\_\_\_\_\_\_\_\_\_\_\_ metals can have more than one type of charge.
3. If cobalt (III) became cobalt (II), it would have gone through a \_\_\_\_\_\_\_\_\_\_\_\_ reaction.

Iron (II) sulfate and Iron (III) nitrate are tested with the chemicals listed below with the following results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Ion** | **Symbol** | **Potassium Thiocyanate (KSCN)** | **Potassium Ferrocyanide (K4Fe(CN)6)** | **Potassium Ferricyanide**  **(K3Fe(CN)6)** | **Ammonium Hydroxide (NH4OH)** |
| **Iron (II)** | Fe+2 | Turned reddish orange | Turned a medium blue color | Turned very dark blue | Formed a grey-green semi-solid that sank down |
| **Iron (III)** | Fe+3 | Turned very dark red | Turned a dark blue solid | Turned brown and cloudy | Formed an orange-red semi-solid that floated on the liquid |

1. Which test above is the most helpful in differentiating between iron (II) and iron (III) ions? WHY?

When Iron (III) nitrate is heated with tin (II) chloride, the resulting solution is tested with Ammonium Hydroxide and a greyish semi-solid forms that sinks to the bottom of the test tube

1. What Iron ion does the test tube contain now? \_\_\_\_\_\_\_\_\_\_\_\_
   1. How do you know?
2. The change in the Iron ion is called \_\_\_\_\_\_\_\_\_\_\_\_\_ because there was a (n) **increase/decrease** in the charge and the ion became **more/less** positive.

When Iron (II) sulfate is mixed with sulfuric acid (H2SO4) and potassium permanganate (KMnO4) the resulting solution is tested with Potassium Ferricyanide and the liquid turns brown and cloudy.

1. What Iron ion does the test tube contain now? \_\_\_\_\_\_\_\_\_\_\_\_
   1. How do you know?
2. The change in the Iron ion is called \_\_\_\_\_\_\_\_\_\_\_\_\_ because there was a (n) **increase/decrease** in the charge and the ion became **more/less** positive.
3. You read earlier that there are many transition metals with more than one charge. To distinguish between these, we use roman numerals in the name to indicate the charge of the ion. Many of these transition metals have symbols that don’t match up with their name at all and it is because we use the classical name for many of these metals. An older system uses suffixes “ic” for ions with the higher charge and “ous” for the ion with the lower charge. Fe+3 is called ferric and Fe+2 is called ferrous. Use your book, your “names of common metal ions” reference sheet or even the charts in the lab to complete the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Ion symbol** | **Charge** | **Stock Name** | **Classical Name** |
|  |  | Iron (III) |  |
| 1. Fe+2 |  |  |  |
|  |  |  | Cupric |
| 1. Cu+1 |  |  |  |
|  |  | Tin (IV) |  |
|  |  |  | Mercurous |
| 1. Pb+2 |  |  |  |