

Copper Series (Part I – Part IV)

Copper Series Part II

Place twenty drops of 0.1 M $\text{Cu}(\text{NO}_3)_2$ in a clean test-tube. What color is the aqueous Cu^{2+} ion?

Add 10 drops of 0.2 M Na_2CO_3 to your test-tube and stir. Do you see evidence for precipitates of both CuCO_3 and $\text{Cu}(\text{OH})_2$? If so, describe the evidence. If not, propose a reason why you do not see evidence for both precipitates.

If you add HCl to your test-tube, it will react with CuCO_3 to form bubbles of CO_2 and aqueous Cu^{2+} . It will also react with $\text{Cu}(\text{OH})_2$ to produce aqueous Cu^{2+} . Add 12 drops 1 M HCl to your test-tube and stir. Watch the solution carefully and describe what happens.

Write a separate equation for the reaction of each precipitate, CuCO_3 and $\text{Cu}(\text{OH})_2$, with HCl.

From the solutions available to you, propose a reagent that will allow you to prepare a precipitate of $\text{Cu}(\text{OH})_2$ without also precipitating CuCO_3 ?

To receive the next worksheet, check your answers with the instructor.

Copper Series Part III

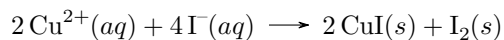
Add 10 drops of 1.0 M NaOH to your test-tube and stir. Record your observations and write an equation for this reaction.

Dissolve your $\text{Cu}(\text{OH})_2$ by adding 36 drops of 0.1 M H_2SO_4 to your test-tube with stirring. What happens? If the process does not seem complete, continue to add drops of 0.1 M H_2SO_4 until it is, mixing after every 2-3 drops.

Write a chemical equation for this reaction.

Add 5 drops of 1.0 M KI to your test-tube, stir, and record your observations.

The reaction between Cu^{2+} and I^- is shown here:

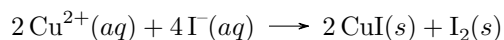


Is this an acid-base, a precipitation, an oxidation-reduction, or a complexation reaction? Or is it a combination of two or more of these reactions? Explain your reasoning.

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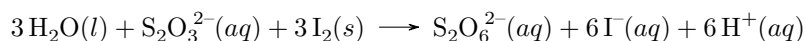
Copper Series Part IV

The reaction between Cu^{2+} and I^-



is both an oxidation–reduction reaction and a precipitation reaction. Which reactant, Cu^{2+} or I^- , is oxidized (loses electrons) and which is reduced (gains electrons)? How do you know this?

If we remove the solid iodine it is easier to see the color of $\text{CuI}(s)$. You can reduce I_2 to I^- using the thiosulfate ion, $\text{S}_2\text{O}_3^{2-}$. Notice that a number of other species take part in this reaction.



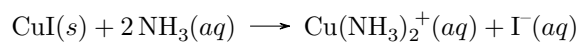
Slowly add 3 drops of 1.0 M $\text{Na}_2\text{S}_2\text{O}_3$ with stirring until the change in color is complete. What color is CuI ?

One way to dissolve a precipitate that contains a metal ion, such as Cu^+ , is to react it with a suitable ligand to form a soluble metal-ligand complex. Examine the reagents available to you and suggest one that might form a soluble complex with copper. Hint: you might wish to review your work from the first experiment.

To receive the next worksheet, check your answers with the instructor.

Copper Series Part V

Add nine drops of 3M NH_3 to your test-tube and stir. The following reaction occurs:



What color is $\text{Cu}(\text{NH}_3)_2^+$?

If you oxidize Cu^+ to Cu^{2+} , you will see the characteristic color of the $\text{Cu}(\text{NH}_3)_4^{2+}$ complex ion. Add one drop of 3% H_2O_2 , a good oxidizing agent, to your test-tube and stir. What color is your solution?

If you add Na_2S to the solution, a precipitate of CuS will form. ***Working in the hood***, add 5 drops of 0.5 M Na_2S to your test-tube. What color is CuS ? ***Before you leave the hood, empty the contents of your test-tube into the waste container and rinse your test-tube at least once, placing the rinsing in the waste container.***

Write a balanced chemical equation showing the reaction of the $\text{Cu}(\text{NH}_3)_4^{2+}$ with S^{2-} .

This completes the series of reactions for copper. Discard the contents of your test-tubes into the waste container and then begin the series of reactions for iron using a clean test-tube.