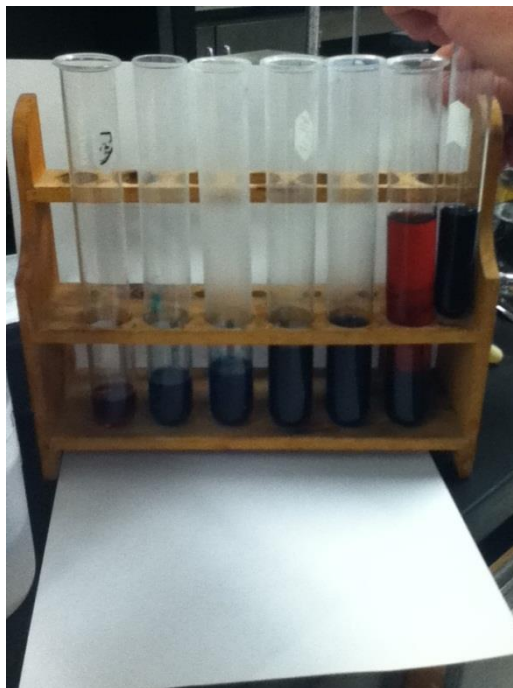




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Cobalt Chloride Demonstration



Standards:

B10 C.1 - Explain the properties of metals due to delocalized electrons: molecular orbital model.

Introduction:

This demo illustrates several phenomena associated with the binding of ligands to the Cobalt (II) ion. Firstly, Co (II) is a kinetically labile ion. That is, the positioning of the electrons allows for some repulsion of the ligands. In the complex, water is a somewhat stronger ligand than chloride ion, but their positions can be altered by such manipulations as (1) increasing the concentration of chloride with concentrated HCl, (2) adding more water, (3) adding 100% ethanol [95% works as well]. The ethanol changes the polarity of the solvent system and forces the chloride to coordinate more closely with the cobalt. Furthermore, an aqueous solution of cobalt (II) chloride that has been treated with just sufficient HCl as to be purple can be immersed in 50-55 °C H₂O and the color will change to blue. This indicates that the association of the chloride ions with the cobalt is also influenced by endothermic equilibrium.

Materials:

- Cobalt (II) Chloride Hexahydrate
- 95-100% Ethanol
- Conc. HCl (aq)
- Hot water bath 50-60°C (beaker on a hot plate plus thermometer is sufficient)
- Glass dropper and bulb

Safety:

- Always have an adult with you to help you during your experiment.
- Always wear eye protection and gloves when doing chemistry experiments
- Cobalt is moderately toxic and should be handled following MSDS precautions.

Procedure: In the picture above: L to R

1. Tube 1: Aqueous solution of Co (II) Chloride—dark pink
2. Tube 2: Co (II) Chloride in 100% ethanol—dark blue
3. Tube 3: Co (II) Chloride – dissolved with Concentrated HCl added—Deep blue
4. Tube 4: Co (II) Chloride—first dissolved with some H₂O then with Ethanol added—deep blue
5. Tube 5: Co (II) Chloride—first dissolved with some H₂O then with Concentrated HCl added—deep blue
6. Tube 6: Co (II) Chloride—first dissolved with some H₂O then with ethanol added then with more H₂O added—goes from rose to blue to rose as H₂O and chloride change places
7. Tube 7: Co (II) Chloride—first dissolved in some H₂O then with Concentrated HCL added dropwise until a purple color is obtained (this is at the cusp of the equilibrium). At this point the tube is immersed in a 50-55°C water bath—the color changes to deep blue indicating the equilibrium is endothermic.

Data and Observations:

Record your observations in this space

Questions:

1. What is an endothermic (endergonic) reaction and what does the last tube signify.

2. Which base is the strongest, water or chloride ion?

3. What is the use of the ethanol?

References:

1. Cobalt (II) Chloride Hexahydrate; MSDS No. 05345 [Online] Fisher Scientific Catalogue number 19209-0000
2. Notes from demos. Done by P.K. Mascharak, PhD, Professor, UCSC and Sam Hudson, PhD, Associate Professor, CSUB