

Qualitative Analysis

PURPOSE

- To develop a systematic scheme for the identification of an unknown solution.

INTRODUCTION

In this experiment, you will use aqueous solutions of the following six compounds: copper(II) sulfate, copper(II) nitrate, barium chloride, sodium carbonate, ammonium sulfate, and zinc sulfate. Only the two solutions containing copper compounds are coloured. The other four are colourless. You will mix these six solutions in various combinations and make careful observations of the results. Based on your observations, you will design a method to identify an unknown solution which is one of the four colourless solutions.

APPARATUS

150 mm test tubes (10)
test tube rack

MATERIALS

copper(II) sulfate (0.1 mol/L)	ammonium sulfate (0.1 mol/L)
copper(II) nitrate (0.1 mol/L)	zinc sulfate (0.1 mol/L)
barium chloride (0.1 mol/L)	unknown solution
sodium carbonate (0.1 mol/L)	

PROCEDURE

- Using the chart on the inside front cover of this manual as a guide, transfer about 10 mL of each of the six solutions to labelled test tubes in your test tube rack. Use these solutions in the remaining parts of the experiment.
- Mix 1 mL of CuSO_4 with 1 mL of each of the four colourless solutions in separate test tubes. Rinse the four test tubes thoroughly.
- Repeat part B using $\text{Cu}(\text{NO}_3)_2$ instead of CuSO_4 . Rinse the four test tubes thoroughly.
- Mix 1 mL of Na_2CO_3 with 1 mL of each of the colourless solutions that *did not* produce a change in *either* part B or C.

- E. Based on your observations in parts B, C, and D, devise a method to identify an unknown which is one of the four colourless solutions.
- F. Obtain 10 mL of an unknown solution. Use your scheme to identify the unknown.

EXAMINING THE OBSERVATIONS

1. Summarize your observations systematically in a data table.
2. Which mixtures of solutions produced precipitates?
3. Based on your observations, how can you distinguish between BaCl_2 and Na_2CO_3 ?
4. Based on your observations, how can you distinguish between Na_2CO_3 and $(\text{NH}_4)_2\text{SO}_4$?
5. Based on your observations, how can you distinguish between $(\text{NH}_4)_2\text{SO}_4$ and ZnSO_4 ?
6. Construct a diagram that shows your systematic scheme for the analysis of the unknown.
7. What was your unknown solution? What observations led you to this conclusion?

FOR FURTHER THOUGHT

8. How could you distinguish between CuSO_4 and $\text{Cu}(\text{NO}_3)_2$?
9. How could you determine whether an unknown was distilled water, an aqueous solution of $\text{Cu}(\text{NO}_3)_2$, an aqueous solution of ZnSO_4 , or an aqueous solution of both $\text{Cu}(\text{NO}_3)_2$ and ZnSO_4 ?