Colors of Manganese Ions

Purpose

To illustrate the various oxidation states of an element.

Materials

- Potassium permanganate, $KMnO_4$ (0.1 M)
- Sodium hydroxide, NaOH (2.0 M)
- Sulfuric acid, H_2SO_4 (3.0 M)
- Sodium bisulfite, $NaHSO_3$ (0.1 M)
- EDTA (1.0 M)
- Manganese(II) sulfate, $MnSO_4$ (powder)
- (5) 100-mL beakers
- 50 mL graduated cylinder

Safety

- Read the SDS sheets for all chemicals before using them.
- Wear safety glasses, gloves, and lab coat.
- Concentrated acids and bases are used.
- Permanganate solution will stain.

Procedure

1. Pour 50 mL of 0.1 M potassium permanganate in five 100-mL beakers (labeled 1 to 5).
2. To beaker number 1 add 15 mL of 3.0 M sulfuric acid and then, while stirring slowly, add 0.1 M sodium bisulfite until a color change takes place.
3. To beaker number 2 add 20 mL of 2.0 M sodium hydroxide and then, while stirring slowly, add 0.1 M sodium bisulfite until a color change takes place.
4. To beaker number 3 slowly add 0.1 M sodium bisulfite while stirring until a color change takes place.
5. To beaker number 4 add 5 mL of 1.0 M EDTA and a pinch of solid manganese(II) sulfate; then stir.

Follow-up Teaching Notes

- The chart below outlines color corresponding to the various oxidation states of manganese

Beaker	Oxidation State of Mn	Color
1	+2	colorless
2	+6	green
3	+4	brown
4	+3	violet/rose
5	+7	purple

Concepts

- Oxidation states, balancing redox equations.

Extension

- Students can be asked to write balanced equations for beakers 1, 2, and 3 if they are told the oxidation half-reaction is $HSO_3^{-1} \rightarrow SO_4^{-2}$
- The reduction half-reaction is $MnO_4^{-1} \rightarrow Mn^{?}$ where the ? refers to the oxidation state of manganese in the appropriate beaker.

Disposal/Clean-up

- Remaining contents can be placed in the science department's heavy metal waste container for proper disposal.