FLINN SCIENTIFIC

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Iron(II) and Iron(III) Reactions

Data Table A. Reactions of Iron(II) Ions with Oxidizing Agents

Well	Reactants	Observations (Initial Color)	Color After Adding KSCN
A1	$Fe^{2+}(aq)$		
A2	$Fe^{3+}(aq)$		
B1	Fe^{2+} + HCl + H_2O_2		
B2	Fe^{2+} + HCl + $KMnO_4$		
B3	Fe^{2+} + NaOCl		

Data Table B. Reactions of Iron(III) Ions with Reducing Agents

Well	Reactants	Observations (Initial Color)	Color After Adding $K_3Fe(CN)_6$
C1	$Fe^{2+}(aq)$		
C2	$Fe^{3+}(aq)$		
D1	Fe^{3+} + HCl + Na_2SO_3		
D2	Fe^{3+} + NaBr		
D3	Fe^{3+} + NaI		
D4	Fe^{3+} + Vitamin C		
D5	Fe^{3+} + Pineapple Juice		

Post-Lab Questions

1. How can potassium thiocyanate be used to confirm that Fe^{2+} ions have been oxidized to Fe^{3+}?
2. Use the oxidation state rules to assign oxidation states for the indicated atoms in each oxidizing agent and its product (Part A).

Atom	*Oxidizing Agent*	*Oxidation State*	*Product*	*Oxidation State*
Mn	MnO_4^-		Mn^{2+}	
O	H_2O_2		H_2O	
Cl	OCl^-		Cl^-	

3. Determine the number of electrons *(n)* involved in each half-reaction.
   a. $MnO_4^-(aq) + 8H^+(aq) + n\,e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$
   b. $H_2O_2(aq) + 2H^+(aq) + n\,e^- \rightarrow 2H_2O(l)$
   c. $OCl^-(aq) + H_2O(l) + n\,e^- \rightarrow Cl^-(aq) + 2OH^-(aq)$
4. Combine the oxidation half-reaction for Fe^{2+} (see the *Background* section) with the appropriate half-reaction from Question #3 and write the balanced equation for the overall redox reaction of Fe^{2+} with (a) permanganate ion, (b) hydrogen peroxide, and (c) hypochlorite ion.
5. Circle the correct choices: An oxidizing agent is a substance that causes the (oxidation/reduction) of another reactant in a redox reaction. The oxidation state of the oxidizing agent (increases/decreases) and the oxidizing agent itself undergoes (oxidation/reduction) during the reaction.
6. How can potassium ferricyanide be used to confirm that Fe^{3+} ions have been reduced to Fe^{2+}?
7. *a.* Sulfite ion (SO_3^{2-}) is a strong reducing agent. Assign oxidation states to the sulfur atom in SO_3^{2-} and its product, sulfate ion (SO_4^{2-}).
   b. Determine the number of electrons *(n)* in the following half-reaction.
   $SO_3^{2-}(aq) + H_2O(l) \rightarrow SO_4^{2-}(aq) + 2H^+(aq) + n\,e^-$
   c. Write the balanced equation for the overall redox reaction of Fe^{3+} with a sulfite ion.
8. Circle the correct choices: A reducing agent is a substance that causes the (oxidation/reduction) of another substance in a redox reaction. The oxidation state of the reducing agent (increases/decreases) and the reducing agent itself undergoes (oxidation/reduction) during the reaction.
9. Based on the observations in Part B, which halide—bromide ion or iodide ion—is the stronger reducing agent? Explain.
10. Iron(II) compounds in foods are more easily absorbed by the body than iron(III) compounds. Vitamin C improves the absorption of dietary iron. Explain based on your observations in this experiment.
11. *(Optional)* Suggest a possible reason for the results obtained using pineapple juice in this experiment.