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Colorful Oxidation States of Manganese

Oxidation State of Mn	Color	Molecule or Ion
+2	Pale pink	Mn^{2+}
+3	Rose color	Mn ³⁺
+4	Brown solid	MnO_2
+5	Blue	MnO_4^{3-}
+6	Green	MnO_4^{2-}
+7	Violet	MnO_4^-

Data Table

Well	Reactants	Observations	
wen	Reactants	Initial Color	Final Color
A1	Mn ²⁺ (aq)		
A2	$Mn^{2+}(aq) + MnO_4^{-}(aq) + H^+(aq)$		
A3	$Mn^{2+}(aq) + MnO_4^{-}(aq)$		
B1	MnO ₄ ⁻ (aq)		
B2	$MnO_{4}^{-}(aq) + SO_{3}^{2-}(aq) + OH^{-}(aq)$		
B3	$MnO_4^{-}(aq) + OH^{-}(aq)$		

Based on your observations and the table of manganese oxidation states, balance the following reactions.

1. In well A2, potassium permanganate is added to an acidified solution of manganese(II) sulfate. Explain the color of the product. Balance the following half-cell reactions and write the overall balanced equation for the reaction.

 $\begin{array}{rcl} \mathrm{Mn}^{2+}(\mathrm{aq}) \ \rightarrow \ \mathrm{Mn}^{3+}(\mathrm{aq}) \\ \mathrm{MnO}_{4}^{-}(\mathrm{aq}) \ \rightarrow \ \mathrm{Mn}^{3+}(\mathrm{aq}) \end{array}$

2. In well A3, potassium permanganate is added to manganese(II) sulfate. Explain the color of the product. Balance the following half-cell reactions and write the overall balanced equation for the reaction.

$$Mn^{2+}(aq) \rightarrow MnO_2(s)$$

 $MnO_4^{-}(aq) \rightarrow MnO_2(s)$

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3. In well B2, sodium sulfite is added to a basic potassium permanganate solution. Explain the color of the product. Balance the following half-cell reactions and write the overall balanced equation for the reaction.

$$MnO_{4}^{-}(aq) \rightarrow MnO_{4}^{3-}(aq)$$

SO_{3}^{2-}(aq) \rightarrow SO_{4}^{2-}(aq)

4. In well B3, a concentrated sodium hydroxide solution (caustic) is added to potassium permanganate. Explain the color of the product. Balance the following half-cell reactions and write the overall balanced equation for the reaction.

$$\begin{array}{rcl} \mathrm{MnO_4}^-(\mathrm{aq}) & \rightarrow & \mathrm{MnO_4}^{3-}(\mathrm{aq}) \\ \mathrm{H_2O(l)} & \rightarrow & \mathrm{O_2(g)} \end{array}$$

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