

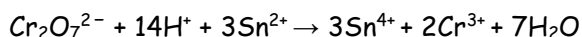
## Redox Titrations

- Which of the following could be used to determine the  $[\text{Fe}^{+2}]$  by a redox reaction?
 

A.  $\text{I}_2$       B.  $\text{Cl}^-$       C.  $\text{Cu}^{2+}$       **D.  $\text{MnO}_4^-$  (acidified)**
- Which of the following could be used to determine the acidified  $[\text{BrO}_3^-]$  by a redox reaction?
 

A.  $\text{NO}_3^-$  (acidified)      **B.  $\text{I}^-$**       C.  $\text{Cu}^{2+}$       D.  $\text{MnO}_4^-$  (acidified)
- Which of the following could be titrated using acidified  $\text{MnO}_4^-$  ions?
 

A.  $\text{Na}^+$       B.  $\text{IO}_3^-$       C.  $\text{SO}_4^{2-}$       **D.  $\text{H}_2\text{O}_2$**
- The titration of a 25.0 mL  $\text{SnCl}_2$  sample, in acidic solution, requires 14.4 mL of 0.030 M  $\text{K}_2\text{Cr}_2\text{O}_7$ . The balanced equation for the reaction is shown below:



What is the number of moles of  $\text{SnCl}_2$  in the original sample?

- A.  $1.4 \times 10^{-4} \text{ mol}$       B.  $4.3 \times 10^{-4} \text{ mol}$       **C.  $1.3 \times 10^{-4} \text{ mol}$**       D.  $5.2 \times 10^{-2} \text{ mol}$
- A 10.0 mL water sample was analyzed for  $[\text{Fe}^{+2}]$  using a redox titration with acidified  $\text{KMnO}_4$ . The equation for the reaction is:
 
$$\text{MnO}_4^- + 5\text{Fe}^{2+} + 8\text{H}^+ \rightarrow \text{Mn}^{2+} + 5\text{Fe}^{3+} + 4\text{H}_2\text{O}$$

A 10.0 mL sample was titrated with 12.5 mL of 0.10 M  $\text{KMnO}_4$  solution. What is the  $[\text{Fe}^{+2}]$  in the water sample?

A. 0.025 M      B. 0.13 M      C. 0.28 M      **D. 0.63 M**
  - Acidified potassium permanganate ( $\text{KMnO}_4$ ) solution is often used in redox titrations. Permanganate reacts with  $\text{Sn}^{+2}$  as follows:
 
$$2\text{MnO}_4^- + 5\text{Sn}^{2+} + 16\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 5\text{Sn}^{4+} + 8\text{H}_2\text{O}$$

A 10.0 mL solution containing  $\text{Sn}^{+2}$  is titrated with 19.3 mL of 0.10 M  $\text{KMnO}_4$ . What is the  $[\text{Sn}^{+2}]$ ?

**Answer** -  $0.0193 \text{ L} \times \frac{0.10 \text{ mol MnO}_4^-}{1 \text{ L MnO}_4^-} \times \frac{5 \text{ mol Sn}^{+2}}{2 \text{ mol MnO}_4^-} \times \frac{1}{0.010 \text{ L Sn}^{+2}} = 0.4825 \text{ M}$        **$[\text{Sn}^{+2}] = 0.48 \text{ M}$**

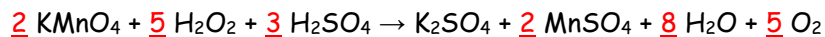
- In the process of extracting tin from a sample of ore, the tin is removed as  $\text{Sn}^{2+}$  ions. A titration requires 21.43 mL of 0.0170 M  $\text{K}_2\text{Cr}_2\text{O}_7$  to reach the equivalence point with the  $\text{Sn}^{2+}$  in a 0.750 g sample of the ore.
 
$$3\text{Sn}^{2+} + \text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ \rightarrow 3\text{Sn}^{4+} + 2 \text{Cr}^{3+} + 7\text{H}_2\text{O}$$

Using the reaction above, calculate the percent mass of tin in the ore sample.

**Answer** -  $0.02143 \text{ L} \times \frac{0.0170 \text{ mol Cr}_2\text{O}_7}{1 \text{ L Cr}_2\text{O}_7} \times \frac{3 \text{ mol Sn}^{+2}}{1 \text{ mol Cr}_2\text{O}_7} \times \frac{118.71 \text{ g Sn}^{+2}}{1 \text{ mol Sn}^{+2}} = 0.12974 \text{ g Sn}^{+2}$        $\frac{0.12974 \text{ g Sn}^{+2}}{0.750 \text{ g}} \times 100$

**$\text{Sn}^{+2} = 17.29889\%$**        **$\text{Sn}^{+2} = 17.3\%$**

8. Consider the following redox reaction in acidic solution:



a. Balance the above redox reaction.

b. The above reaction was used for a redox titration. At the equivalence point  $5.684 \times 10^{-4} \text{ mol KMnO}_4$  was required to titrate  $5.00 \text{ mL}$  of  $\text{H}_2\text{O}_2$  solution. Calculate  $[\text{H}_2\text{O}_2]$ .

$$\underline{\text{Answer}} - 5.684 \times 10^{-4} \times \frac{5 \text{ mol H}_2\text{O}_2}{2 \text{ mol MnO}_4^-} \times \frac{1}{0.00500 \text{ L H}_2\text{O}_2} = 0.2842 \text{ M} \quad [\text{H}_2\text{O}_2] = 0.284 \text{ M}$$

9. A titration is performed to determine the  $[\text{Fe}^{2+}]$  in  $25.00 \text{ mL}$  of an  $\text{FeSO}_4$  solution. It requires  $22.52 \text{ mL}$  of  $0.015 \text{ M KMnO}_4$  to reach the equivalence point in which  $\text{Mn}^{2+}$  and  $\text{Fe}^{3+}$  are produced.

a. balance the redox reaction:  $\underline{8} \text{H}^+ + \text{MnO}_4^- + \underline{5} \text{Fe}^{2+} \rightarrow \text{Mn}^{2+} + \underline{5} \text{Fe}^{3+} + \underline{4} \text{H}_2\text{O}$

b. Calculate the  $[\text{Fe}^{2+}]$

$$\underline{\text{Answer}} - 0.02252 \text{ L} \times \frac{0.015 \text{ mol MnO}_4^-}{1 \text{ L MnO}_4^-} \times \frac{5 \text{ mol Fe}^{2+}}{1 \text{ mol MnO}_4^-} \times \frac{1}{0.02500 \text{ L Fe}^{2+}} = 0.675 \text{ M} \quad [\text{Fe}^{2+}] = 0.68 \text{ M}$$