

CHAPTER REVIEW

For more practice, go to the Problem Bank in Appendix D.

Oxidation and Reduction

SECTION 1 REVIEW

1. a. Distinguish between the processes of oxidation and reduction.
b. Write an equation to illustrate each process.
2. Which of the following are redox reactions?
 - a. $2\text{Na} + \text{Cl}_2 \longrightarrow 2\text{NaCl}$
 - b. $\text{C} + \text{O}_2 \longrightarrow \text{CO}_2$
 - c. $2\text{H}_2\text{O} \longrightarrow 2\text{H}_2 + \text{O}_2$
 - d. $\text{NaCl} + \text{AgNO}_3 \longrightarrow \text{AgCl} + \text{NaNO}_3$
 - e. $\text{NH}_3 + \text{HCl} \longrightarrow \text{NH}_4^+ + \text{Cl}^-$
 - f. $2\text{KClO}_3 \longrightarrow 2\text{KCl} + 3\text{O}_2$
 - g. $\text{H}_2 + \text{Cl}_2 \longrightarrow 2\text{HCl}$
 - h. $\text{H}_2\text{SO}_4 + 2\text{KOH} \longrightarrow \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$
 - i. $\text{Zn} + \text{CuSO}_4 \longrightarrow \text{ZnSO}_4 + \text{Cu}$
3. For each oxidation-reduction reaction in the previous question, identify what is oxidized and what is reduced.

PRACTICE PROBLEMS

4. Each of the following atom/ion pairs undergoes the oxidation number change indicated below. For each pair, determine whether oxidation or reduction has occurred, and then write the electronic equation indicating the corresponding number of electrons lost or gained.
 - a. $\text{K} \longrightarrow \text{K}^+$
 - b. $\text{S} \longrightarrow \text{S}^{2-}$
 - c. $\text{Mg} \longrightarrow \text{Mg}^{2+}$
 - d. $\text{F}^- \longrightarrow \text{F}_2$
 - e. $\text{H}_2 \longrightarrow \text{H}^+$
 - f. $\text{O}_2 \longrightarrow \text{O}^{2-}$
 - g. $\text{Fe}^{3+} \longrightarrow \text{Fe}^{2+}$
 - h. $\text{Mn}^{2+} \longrightarrow \text{MnO}_4^-$
5. Identify the following reactions as redox or nonredox:
 - a. $2\text{NH}_4\text{Cl}(aq) + \text{Ca}(\text{OH})_2(aq) \longrightarrow 2\text{NH}_3(aq) + 2\text{H}_2\text{O}(l) + \text{CaCl}_2(aq)$
 - b. $2\text{HNO}_3(aq) + 3\text{H}_2\text{S}(g) \longrightarrow 2\text{NO}(g) + 4\text{H}_2\text{O}(l) + 3\text{S}(s)$
 - c. $[\text{Be}(\text{H}_2\text{O})_4]^{2+}(aq) + \text{H}_2\text{O}(l) \longrightarrow \text{H}_3\text{O}^+(aq) + [\text{Be}(\text{H}_2\text{O})_3\text{OH}]^+(aq)$
6. Arrange the following in order of increasing oxidation number of the xenon atom: CsXeF_8 , Xe , XeF_2 , XeOF_2 , XeO_3 , and XeF .

7. Determine the oxidation number of each atom indicated in the following:
 - a. H_2
 - b. H_2O
 - c. Al
 - d. MgO
 - e. Al_2S_3
 - f. HNO_3
 - g. H_2SO_4
 - h. $\text{Ca}(\text{OH})_2$
 - i. $\text{Fe}(\text{NO}_3)_2$
 - j. O_2

Balancing Redox Equations

SECTION 2 REVIEW

8. Label the following half-reactions as either reduction or oxidation half-reactions.
 - a. $\text{H}_2\text{S} \longrightarrow \text{S} + 2\text{e}^- + 2\text{H}^+$
 - b. $\text{SO}_2 + 4\text{e}^- + 2\text{H}_2\text{O} \longrightarrow \text{S} + 4\text{OH}^-$
 - c. $\text{ClO}_3^- + 6\text{H}^+ + 6\text{e}^- \longrightarrow \text{Cl}^- + 3\text{H}_2\text{O}$
 - d. $\text{Mn}(\text{CN})_6^{4-} \longrightarrow \text{Mn}(\text{CN})_6^{3-} + \text{e}^-$
9. What are the oxidation states of the elements that changed oxidation states in the half-reactions in the above question?
10. Balance the equation for the following reaction in a basic solution. Give balanced equations for both half-reactions and the balanced equation for the overall reaction.
 $\text{KMnO}_4 + \text{NaIO}_3 \longrightarrow \text{MnO}_2 + \text{NaIO}_4$

PRACTICE PROBLEMS

11. For each requested step, use the half-reaction method to balance the oxidation-reduction equation below. (Hint: See Sample Problem A.)
 $\text{K} + \text{H}_2\text{O} \longrightarrow \text{KOH} + \text{H}_2$
 - a. Write the ionic equation, and assign oxidation numbers to all atoms to determine what is oxidized and what is reduced.
 - b. Write the equation for the reduction, and balance it for both atoms and charge.
 - c. Write the equation for the oxidation, and balance it for both atoms and charge.
 - d. Multiply the coefficients of the oxidation and reduction equations so that the number of electrons lost equals the number of electrons gained. Add the two equations.
 - e. Add species as necessary to balance the overall formula equation.