• AP Chemistry

# **5** • Reactions in Aqueous Solution

#### **Overview:**

There are two kinds of reactions in the world, Oxidation-Reduction Reactions and Acid-Base Reactions. In a redox reaction, electrons are gained and electrons are lost.

Double Replacement Reactions are	(redox/non-redox/either)
Single Replacement Reactions are	(redox/non-redox/either)
Synthesis Reactions are	(redox/non-redox/either)
Decomposition Reactions are	(redox/non-redox/either)
Combustion Reactions are	(redox/non-redox/either)

Name \_\_\_\_\_ Period

An important idea to help recognize oxidation-reduction reactions it to identify the oxidation number (or oxidation state) of an atom. The oxidation number is also called the "apparent charge." Atoms in ionic compounds have charges and these are also the oxidation numbers. Atoms in molecular compounds can also have oxidation numbers, although they do not have charges.

### **Rules:**

The oxidation number of:

- an element in the uncombined state is 0.
- a monatomic ion equals the charge on the ion.
- hydrogen is generally +1; in hydrides, -1.
- oxygen is generally -2; in peroxides, -1.
- elements other than oxygen and hydrogen in a neutral compound is such that the sum of the oxidation numbers for all atoms in the compound is 0.
- elements other than oxygen and hydrogen in a polyatomic ion is such that the sum of the oxidation numbers for all atoms in the ion equals the charge on the ion.

## **Practice:**

Determine the oxidation number of the underlined element. Answers are given below:

1. <u>Ba</u> <sup>2+</sup>	2. <u>N</u> <sub>2</sub>	3. <u>H</u> I	4. $\underline{O}_{2^{2^{-}}}$
5. A <u>gBr</u>	6. $\underline{Cu}Cl_2$	7. H <u>N</u> O <sub>3</sub>	8. $\underline{Cl}O_3^-$
9. <u>S</u> O <sub>3</sub>	10. Na <sub>2</sub> SO <sub>3</sub>	11. Ba <u>Cr</u> O <sub>4</sub>	12. Ca <u>S</u> O <sub>4</sub>
1. +2	2. 0	3. +1	41
51	6. +2	7. +5	8. +5
9. +6	10. +4	11. +6	12. +6

**Oxidation Numbers & RedOx** 

Example:

od \_\_\_\_ Date \_\_/\_\_/\_\_

#### **Practice Problems from the Textbook**

- 54. Determine the oxidation number of each element in the following ions or compounds:
  - a)  $BrO_3^-$  d)  $CaH_2$ b)  $C_2O_4^{2-}$  e)  $H_4SiO_4$
  - c)  $F_2$  f)  $SO_4^{2-}$

55. Determine the oxidation number of each element in the following ions or compounds:

- a)  $SF_6$  d)  $N_2O_4$
- b)  $H_2AsO_4^-$  e)  $PCl_4^+$
- c)  $UO_2^+$  f)  $XeO_4^{2-}$
- 56. Which of the following reactions is (are) oxidation-reduction reactions? Explain your answer briefly. classify the remaining reactions.
  - a)  $Zn(s) + 2 NO_3(aq) + 4 H^+(aq) \rightarrow Zn^{2+}(aq) + 2 NO_2(g) + 2 H_2O(l)$
  - b)  $Zn(OH)_2(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + 2 H_2O(l)$
  - c)  $Ca(s) + 2 H_2O(l) \rightarrow Ca(OH)_2(s) + H_2(g)$
- 57. Which of the following reactions is (are) oxidation-reduction reactions? Explain your answer briefly. classify the remaining reactions.
  - a)  $CdCl_2(aq) + Na_2S(aq) \rightarrow CdS(s) + 2 NaCl(aq)$
  - b)  $2 \operatorname{Ca}(s) + \operatorname{O}_2(g) \rightarrow 2 \operatorname{CaO}(s)$
  - c)  $Ca(OH)_2(s) + 2 HCl(aq) \rightarrow CaCl_2(aq) + 2 H_2O(l)$
- 58. In each of the following reactions, decide which reactant is oxidized and which is reduced. Designate the oxidizing agent and reducing agent.
  - a)  $2 \text{ Mg(s)} + \text{O}_2(g) \rightarrow 2 \text{ MgO(s)}$
  - b)  $C_2H_4(g) + 3 O_2(g) \rightarrow 2 CO_2(g) + 2 H_2O(g)$
  - c) Si(s) + 2 Cl<sub>2</sub>(g)  $\rightarrow$  SiCl<sub>4</sub>(l)
- 59. In each of the following reactions, decide which reactant is oxidized and which is reduced. Designate the oxidizing agent and reducing agent.
  - a)  $Ca(s) + 2 HCl(aq) \rightarrow CaCl_2(aq) + H_2(g)$
  - b)  $Cr_2O_7^{2-}(aq) + 3 Sn^{2+}(aq) + 14 H^+(aq) \rightarrow 2 Cr^{3+}(aq) + 3 Sn^{4+}(aq) + 7 H_2O(l)$
  - c)  $FeS(s) + 3 NO_3^{-}(aq) + 4 H^{+}(aq) \rightarrow 3 NO(g) + SO_4^{2-}(aq) + Fe^{3+}(aq) + 2 H_2O(l)$