Learning Objectives for
Acids & Bases

- To describe the Arrhenius model for acids and bases.
- To determine whether a given chemical substance is an Arrhenius acid or an Arrhenius base (or neither).
- To list one acid, and one base, whose behavior is not consistent with the Arrhenius model for acids and bases.
- To describe the relationship between “H⁺(aq)” and “H₃O⁺(aq)”.
- To list six (6) strong acids and eight (8) strong bases.
- To describe the difference(s) between strong acids/bases and weak acids/bases.
- To write the molecular, total ionic and net ionic equations for an acid-base reaction.
- To identify “spectator ions” in a total ionic equation.
- To describe the Bronsted-Lowry model for acids and bases.
- To determine whether a given chemical substance is a Bronsted acid or a Bronsted base (or neither).
- To list one acid whose behavior is not consistent with the Bronsted-Lowry model for acids and bases.
- To describe an “amphoteric” substance.
- To identify the chemical species that function as the Bronsted acid, the Bronsted base, the conjugate acid and the conjugate base from the molecular equation for an acid-base reaction.
- To identify conjugate acid-base pairs.
- To write Lewis structures (in particular, for acids and bases).
- To illustrate electron reorganization in an acid-base reaction by using Lewis structures and “arrow-pushing”.
- To write the equilibrium reaction for the dissociation of pure water to produce H₃O⁺ and OH⁻ ions.
- To write the equilibrium constant expression for the dissociation of pure water (K_w).
- To list the molar concentrations of H₃O⁺ and OH⁻ in pure water at 25°C.
- To describe pH and pOH.
- To describe a "p function".
- To calculate the pH, pOH, [H₃O⁺]_tot and/or [OH⁻]_tot for a solution given one of these values.
- To describe the “strength” of an acid or base in terms of the extent to which its molecules donate (acids) or accept (bases) protons.
- To write the equilibrium constant expression for the reaction of an acid (K_a) or a base (K_b) with water.
- To describe how the strength of either an acid or a base is indicated by the magnitude of its equilibrium constant (i.e., K_a or K_b).
- To draw atomic-scale diagrams that illustrate the degree of dissociation of strong and weak acids/bases.
• To describe how the strength of an acid or base in aqueous solution is indicated by the electrical conductivity of the solution.
• To describe “ionic strength”.
• To calculate the ionic strength for a solution.
• To describe the relationship between both equilibrium constant expressions and pH, and activities/activity coefficients.
• To describe the main assumption that is used when an equilibrium constant, or pH, expression is written using molar concentrations.
• To describe the condition(s) where molar concentration and activity are not equal to one another.
• To describe the two main factors that need to be considered to determine if a substance will behave as an acid, a base, or neither.
• To describe the (periodic) trends in acid-base properties for compounds having the structure: H-X.
• To describe the (periodic) trends in acid-base properties for compounds having the structure: H-O-X, and how these properties are affected by bonding of electronegative atoms to atom X.
• To identify “carboxylic acid” and “amine” functional groups in Lewis structures of organic molecules.
• To write a general Lewis structure for an “amino acid”.
• To describe a “zwitterion”.
• To describe why amino acids tend to exist as zwitterions in the solid state and in pH-neutral solutions.
• To write Lewis structures for amino acids as they exist in solution at low pH, and at high pH.