

普通化學 (50%)

1. (12) Indicate whether each of the following statements is true or false. Explain if it is false.
 - (a) All spontaneous reactions occur quickly.
 - (b) If a reaction is spontaneous, the reverse reaction is non-spontaneous.
 - (c) All spontaneous processes release heat.
 - (d) The boiling of water at 100°C and 1 atm is a spontaneous process.
 - (e) If a process increases the randomness of the particles of a system, the entropy of the system decreases.
 - (f) The energy of the universe is constant; the entropy of the universe decreases toward a minimum.
 - (g) All systems become disordered spontaneously.
 - (h) Both ΔS_{sys} and ΔS_{surr} equal zero at equilibrium.

2. (8) During the electrolysis of aqueous sodium chloride (Brine), what are the products of anode and cathode? If mercury is used as the cathode for the electrolysis, what are the products of anode and cathode? Why? The standard reduction potential (ϵ°) is -2.71 V for sodium, -0.83 V for water, 1.36 V for chlorine, and 1.23 V oxygen.

3. (5) Colligative properties depend on
 - a. the chemical properties of the solute
 - b. the chemical properties of the solvent
 - c. the number of particles dissolved
 - d. the molar mass of the solute

4. (7) Which has the lowest (ground-state) energy, an electron trapped in a one-dimensional box of length 10^{-6} m or one with length 10^{-10} m? Explain

5. (8) Use the MO model to predict the magnetism and bond order of the NO^+ and CN^- ions.

6. (10) A certain first-order reaction has a half-life of 20.0 min.
 - a. Calculate the rate constant for this reaction.
 - b. How much time is required for this reaction to be 75% complete?