1. (a) Define the upper critical solution temperature (UCST) and the lower critical solution temperature (LCST). (b) Sketch briefly the phase diagram of the poly N-isopropylacryl amide-water mixture containing LCST (at 32°C). (c) Based on the equation of Gibbs free energy, enthalpy and entropy ($\Delta G=\Delta H-T\Delta S$), explain LCST of the system is driven by favorable or unfavorable entropy of mixing? (20%)

2. In a process of mixing of ideal materials, the final common volume is the sum of the initial separate compartment volumes. (a) Prove the entropy of mixing two ideal compounds with similar size is always positive. (b) Prove the Gibbs free energy of mixing is always negative. (c) Thus, systems tend to get more "disordered" relative to their original "ordered" state over time, unless a directed influence outside the system reorganizes the system. Give an example that you encountered in your life experience. (20%)

3. One g of ice at 0°C is added to 10 g of water at the boiling point. What will be the final temperature and what is the entropy change accompanying the process? (20%)

4. The molar volume of a liquid is 88.9 cc at 20°C and 1 atm pressure. Assuming the volume to be constant, find the changes of Gibbs free energy and Helmholtz free energy for compressing 1 mole of liquid from 1 to 100 atm. (20%)

5. The heats of combustion of quinone and hydroquinone at 25°C and 1 atm are 656.29 and 681.75 kcal/mole, respectively. Entropy computed from the specific data is 38.55 eu for quinone and 32.77 eu for hydroquinone. (a) Compute the standard heat of formation of quinone. (b) Compute the change of standard enthalpy for the reduction of quinone to hydroquinone. (c) Compute the change of standard entropy and Gibbs free energy for the reduction. (20%)

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