

- 1) The hydrolysis of adenosine triphosphate ATP to adenosine diphosphate ADP and inorganic phosphate at pH 8 and 25°C.



has a standard enthalpy change of -13 kJ mol^{-1} . The standard enthalpy changes of acid dissociation of HATP^{-3} , HADP^{-2} , and $\text{H}_2\text{PO}_4^{-1}$ are -8 , 0 , and $+8 \text{ kJ mol}^{-1}$, respectively. Calculate the standard enthalpy change for the reaction (12%)

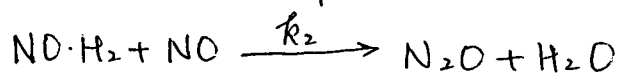
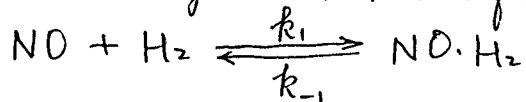
- 2) One mole of supercooled water at -10°C and 1 atm pressure turns into ice. Calculate the entropy change in the system and in the surroundings and the net entropy change. Take the heat capacities of water and ice to be constant at 75.3 and $37.7 \text{ JK}^{-1}\text{mol}^{-1}$, respectively, and the heat of fusion of ice as 6.02 kJ mol^{-1} . (17%)

- 3) (a) Is the Joule-Thomson experiment reversible? Explain briefly.
 (b) Is the entropy of the gas constant in the Joule-Thomson experiment? If not, express $(\partial S/\partial p)_H$ in term of any or all of the variables P , V , T , C_p , and C_v . (14%)

- 4) The sublimation pressures of solid Cl_2 are 352 Pa at -112°C and 35 Pa at -126.5°C . The vapor pressure of liquid Cl_2 are 1590 Pa at -110°C and 7830 Pa at -80°C . Calculate ΔH_{sub} , ΔH_{vap} , ΔH_{fus} , and the triple point. (16%)

- 5) Outline the kinetics of branching chain reactions, illustrating your answer with reference to the reactions between hydrogen and oxygen (16%)

- 6) Derive the steady-state rate equation for the mechanism:



Show under what condition this reduces to the form of $\frac{d[\text{N}_2\text{O}]}{dt} = kK(\text{NO})^2(\text{H}_2)$

(13%)

7) A sharp boundary is formed between a dilute aqueous solution of sucrose and water at 25°C . After 5 hr the standard deviation of the concentration gradient is 0.434 cm. (a) What is the diffusion coefficient for sucrose under these conditions? (b) What will be the standard deviation after 10 hr?

(12%)