1. The normal melting point of tin at a pressure of 1 atm is 120°C. The change in volume during fusion is 41 cm^3kg^{-1} and $\triangle H_{fus}$ is 420 cal mol^{-1}. Find the melting point of tin when the pressure is raised to 500 atm. (atm= 101325 pascals; cal=4.18 J; MW of Tin =119) **(10 pt)**

2. The Arrhenius equation is expressed by $k=Ae^{-Ea/RT}$

   What is the physical meaning of E_a? **(5 pt)**

3. For a system with the two competing elementary reactions $A \xrightarrow{k_1} B$ and $A \xrightarrow{k_2} C$, in which E_1 and E_2 are the reaction energies correspond to k_1 and k_2, respectively. Calculate the observed activation energy E_a of the system in the relation of E_1, k_1, E_2 and k_2. **(10 pt)**

4. (a) Please write down the three necessary and sufficient conditions for the validity of the Langmuir equation. **(5 pt)**
   (b) A gas G_2 adsorbs onto a surface S as represented by
   $$G_2(g) + 2S(surface) \leftrightarrow 2GS(surface)$$
   Assume that the adsorption process follows the Langmuir isotherm, i.e. $\theta = \dfrac{K^{1/2}[G]^{1/2}}{1+K^{1/2}[G]^{1/2}}$ where θ = fractional coverage and [G]= partial pressure of G_2, and K=k_a/k_d.
   Derive the above expression of Langmuir isotherm for the adsorption process. **(10 pt)**

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5. Estimate (a) $\triangle G$, (b) the change of the chemical potential ($\triangle u$) of 100 g of water when the pressure is increased from 1.0 atm to 10 atm at 27 °C. **(10 pt)**

6. The rate constant for a reaction at 27°C is exactly triple the value at -23°C. Calculate the activation energy: (Gas constant R=8.314 J·K^{-1}·mol^{-1}) **(10 pt)**

7. For the reaction A+B→ C consider the following mechanism:

$$A + B \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} AB^* \qquad\qquad (1)$$

$$AB^* \overset{k_2}{\to} C \qquad\qquad\qquad (2)$$

Derive the rate law using the steady state approximation to eliminate the concentration of AB*. **(10 pt)**

8. CCl_4 (carbon tetrachloride) melts at 260 K. The vapor pressure of CCl_4 is 10500 Pa at 290 K, 74500 Pa at 340 K, 270 Pa at 232 K and 1090 Pa at 250 K. Calculate:
   (1) The enthalpy of vaporization **(5 pt)**
   (2) The enthalpy of sublimation **(5 pt)**
   (3) The normal boiling point **(5 pt)**
   (4) The entropy of vaporization at the normal boiling point **(5 pt)**

9. Explain the following terms: **(10 pt)**
   (a) Boltzmann thermal distribution
   (b) Michaelis constant
   (c) Zero-point energy
   (d) Ideal solution

參考用

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