

1. (20%) Describe the following terms.

(1) osmotic pressure, (2) Fermi level, (3) Boltzmann distribution law,
(4) n-type semiconductor, (5) activity.

2. (10%) $\Delta G = \Delta H - T\Delta S$ is an equation of the second thermodynamics.

Please describe the relationship between this equation and chemical reaction.

3. (20%) Please describe:

(i) physical adsorption and chemisorption.

(ii) the Langmuir adsorption isotherm

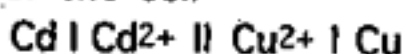
4. (10%) Derive the expression for the half-life of a reaction with the rate law:

$$-d[A]/dt = k[A]^{1/2}$$

5. (10%) (i) State the Arrhenius law.

(ii) A second-order reaction in solution has a rate constant (k) of $5.7 \times 10^{-5} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ at 25°C and of $16.4 \times 10^{-5} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ at 40°C . Calculate the activation energy (E) and the preexponential factor (A), assuming the Arrhenius law to apply. (R is the gas constant, equal to $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

6. (10%) Calculate E° at 25°C for the cell

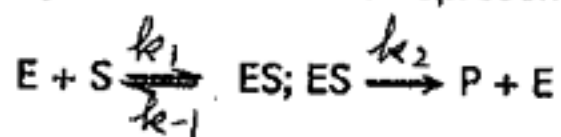


and determine the cell reaction and its equilibrium constant.

Here $\text{Cd}^{2+} + 2e^- = \text{Cd}$ $E^\circ = -0.4022 \text{ V}$

$\text{Cu}^{2+} + 2e^- = \text{Cu}$ $E^\circ = +0.3394 \text{ V}$

7. (20%) An enzymatic reaction is represented as



The concentration of enzyme-substrate complex [ES] is assumed to maintain at a constant value throughout the reaction.

Please derive an equation to express the reaction rate.