

1. Calculate E° at 25°C for the cell $\text{Cd} | \text{Cd}^{2+} || \text{Cu}^{2+} | \text{Cu}$ and determine the cell reaction and its equilibrium constant!

Here $\frac{1}{2}\text{Cd}^{2+} + e^- = \frac{1}{2}\text{Cd}$ $E^\circ/v = -0.402$

$\frac{1}{2}\text{Cu}^{2+} + e^- = \frac{1}{2}\text{Cu}$ $E^\circ/v = +0.3394$

2. Show the isoelectric point of glycine. ($\text{NH}_2-\overset{\text{H}}{\underset{\text{H}}{\text{C}}}-\text{COOH}$)
Here, $pK_1 = 2.35$, $pK_2 = 9.78$.

3. For any process in a closed system of constant composition that can only perform pressure-volume work, the first ~~and~~ and second laws of thermodynamics may be combined to obtain

$$dU = Tds - Pd\bar{v} \quad (\text{where } U \text{ is internal energy})$$

In addition, there are three properties; H , A , G defined in terms of Enthalpy, Helmholtz energy, Gibbs energy, respectively.

From the above equation we may express in three other ways

by use of $H = U + PV$

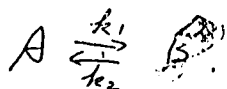
$$A = U - TS$$

$$G = U + PV - TS$$

Please show that

$$\left(\frac{\partial U}{\partial S}\right)_V = \left(\frac{\partial H}{\partial S}\right)_P, \quad \left(\frac{\partial H}{\partial P}\right)_S = \left(\frac{\partial G}{\partial P}\right)_T$$

4. Derive the integrated rate equation for a reversible first-order reaction. (Assume; only A is present initially)



5. Calculate the value of the ionic strength of these solutions:

a) $0.10\text{M Na}_2\text{PO}_4$

b) 0.50M KCl

c) $0.1\text{M Na}_2\text{PO}_4 + 0.50\text{M KCl}$

(五題擇四題作答, 每題 25 分)