1. Under standard conditions, a solution containing A and its reduced form AH_2 has a standard electrode potential of -0.6 V. A solution containing B and BH_2 has a standard potential of -0.16 V. If a cell were constructed with these two systems as half-cells, would AH_2 be oxidized by B or BH_2 oxidized by A? What would be the reversible emf of the cell?

$A + 2H^+ + 2e^- \rightarrow AH_2 \quad E_0 = -0.60V$
$B + 2H^+ + 2e^- \rightarrow BH_2 \quad E_0 = -0.16V$
$\Rightarrow AH_2 + B \rightarrow A + BH_2$
AH_2 is oxidized by B

reversible emf of cell: $-0.16V - (-0.6V) = 0.44V$

2. The solubility of AgCl in water at 25 °C is 1.274×10^{-5} mol dm^{-3}. On the assumption that the Debye-Hückel limiting law applies,

a. Calculate $\Delta G°$ for the process $AgCl(s) \rightarrow Ag^+(aq) + Cl^-(aq)$.

$s = 1.274 \times 10^{-5}$ mol/L ; $K_s = s^2 \gamma_\pm^2$; $\log_{10} \gamma_\pm = z_+ |z_-| \cdot 0.51 \cdot \sqrt{I}$
$= 0.51 \sqrt{s}$ $(I = \frac{1}{2} \sum_c c_i z_i^2)$
$= -1.82 \times 10^{-3}$
$\Rightarrow \gamma_\pm = 0.996$

$\Rightarrow K_s = (0.996 \cdot 1.274 \times 10^{-5})^2$
$= 1.609 \times 10^{-10}$

$\Delta G° = -RT \ln K_s = 55.90$ kJ/mol

b. Calculate the solubility of AgCl in an 0.005 *M* solution of K_2SO_4.

$I = \frac{1}{2} \sum_c c_i z_i^2 = \frac{1}{2}(0.005M \times 1^2 + 0.005M \times 1^2 + 0.005M \times 2^2) = 0.015M$

$\log_{10} \gamma_\pm = z_+ |z_-| \sqrt{I/m°} \cdot B = -0.51 \cdot 1 \cdot 1 \cdot \sqrt{0.015} = -0.0625$

$\Rightarrow \gamma_\pm = 0.866$; $K_s = \text{const} = 1.609 \times 10^{-10}$ ((from a)) $= s^2 \gamma_\pm^2$

$\Rightarrow s = \frac{\sqrt{K_s}}{\gamma_\pm} = \frac{\sqrt{1.609 \times 10^{-10}}}{0.866} = 1.46 \times 10^{-5} M$

3. A 0.1 M solution of sodium palmitate, $C_{15}H_{31}COONa$, is separated from a 0.2 M solution of sodium chloride by a membrane that is permeable to Na^+ and Cl^- ions but not to palmitate ions. Calculate the concentrations of Na^+ and Cl^- ions on the two sides of the membrane after equilibrium has become established.

	palmitate side	other side
initial concentrations	$[Na^+] = 0.1M$ $[P^-] = 0.1M$	$[Na^+] = 0.2M$ $[Cl^-] = 0.2M$
Final concentrations	$[Na^+] = 0.1M + x$ $[P^-] = 0.1M$ $[Cl^-] = x$	$[Na^+] = 0.2M - x$ $[Cl^-] = 0.2M - x$

$\Rightarrow (0.2M - x)^2 = (0.1 + x)x \Rightarrow x = 0.08$

$\Rightarrow$ Palmitate side: $[Na^+] = 0.18M$, $[Cl^-] = 0.08M$; other side: $[Na^+] = [Cl^-] = 0.12M$