

Q3-1: Consider the reaction $O_2 + 2e^- + 2H^+ \rightleftharpoons H_2O_2$. Assume pH = 7, $pO_2 = 0.21 \text{ atm}$, $[H_2O_2] = 1000 \text{ mg/L}$, temperature = 25°C . What is the equilibrium electrode potential, E_{eq} ?

Q3-2: Assume the same conditions as in Q3-1. Also assume $i_0 = 5 \times 10^{-4} \text{ A/m}^2$, $\alpha = 0.5$, $E_{\text{electrode}} = -0.29 \text{ V}$ vs SHE.

- What is the current density at the electrode?
- Is the current anodic or cathodic?
- What is the rate of production or consumption of H_2O_2 if the electrode surface area is 0.015 m^2 ? Give the answer in mg/h.

Q3-3: Look at the overpotential vs current density data in the accompanying Excel file. Determine the exchange current density and α .

Q3-4: Use the values i_0 and α that you estimated in Q3-3. Assume that the addition of a catalyst on the electrode surface increased the exchange current density 10 times.

- Draw the new overpotential vs current relationship in Excel.
- What do you think the maximum current density will be with the new catalyst and at which overpotential will this maximum current density be reached?