Q4-1: All of the following reduction reactions could occur on the surface of an electrode. For which of the reactions do you think a microbial catalyst would be beneficial? Why?

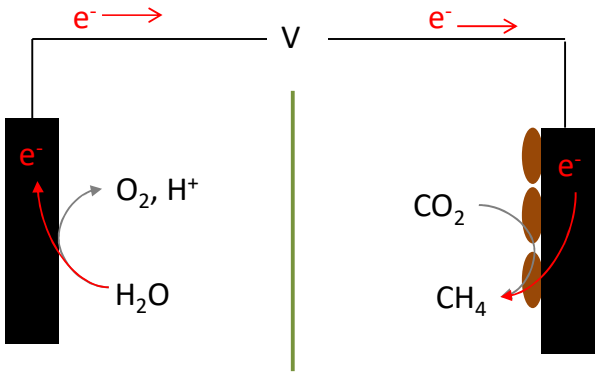
a) $Cd^{2+} + 2e^- \rightarrow Cd(s)$
b) $O_2 + 2e^- + 2H^+ \rightarrow H_2O_2$
c) $C_2H_5COO^- + 4H_2O \rightarrow 3CO_2 + 14e^- + 13H^+$
d) $2Cl^- \rightarrow Cl_2 + 2e^-$
e) $H_2 \rightarrow 2H^+ + 2e^-$

Q4-2: Assume the standard reduction potential (at pH 7) for NAD^+/NADH is -0.32 V. What is the actual reduction potential if the ratio inside the microbial cells is (assume 25°C):

a) NAD^+/NADH = 100
b) NAD^+/NADH = 1/100

Q4-3: Consider a microbial electrolysis cell with an abiotic water-oxidizing anode and a biological methane-producing cathode operating at pH 7. Assume we get renewable energy from wind power, which on average produces 200 kW.

a) How many moles of CH_4 could be produced in 1 day if the cathode had an overpotential of 0.5 V, the anode had an overpotential of 0.8 V, and the ohmic resistance was negligible?
b) How large surface area of the cathode is needed if the current density is 12 A/m^2?



Q4-4: Do a literature search. Write a half-page summary of an article relevant for your research topic. The article should involve electrochemistry in some form.