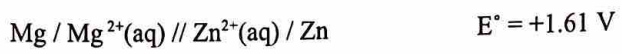


Free Energy and Cell Potential

Name Answer Key

1. Given the electrochemical reaction shown, what is the standard free energy change ΔG° if $E^\circ = +1.61$ V?



$$\Delta G^\circ = -2(96,500)(+1.61V)$$

$$= -310.7 \text{ kJ/mol}$$

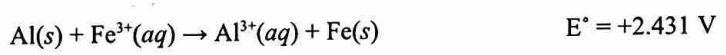
2. The oxidation of hydrogen by oxygen is one of the most-used reactions in fuel-cell technology. The overall reaction, which is given below, has a ΔG° value of -474 kJ/mol. What is the standard cell potential for this fuel cell?



$$-474,000 = -2(96,500)(E)$$

$$|E^\circ = +2.46V|$$

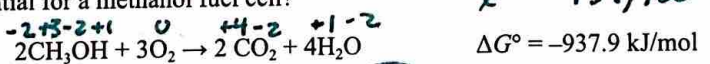
3. What is ΔG° for the following balanced reaction, if $E^\circ = +2.431$ V?



$$\Delta G^\circ = -3(96,500)(2.431)$$

$$|\Delta G^\circ = -703.8 \text{ kJ/mol}|$$

4. The oxidation of methanol, as described by the equation below, has a ΔG° value of -937.9 kJ/mol. What is the standard cell potential for a methanol fuel cell?



$2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$ $\Delta G^\circ = -937,900 = -6(96,500)(E)$
 $E^\circ = +1.62V$

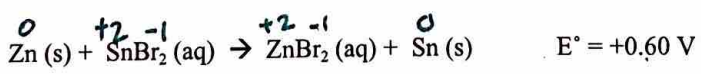
$4(H_2O + CH_3OH \rightarrow CO_2 + 6e^- + 6H^+)$ $4CH_3OH + 6O_2 \rightarrow 4CO_2 + 8H_2O$

$6(4e^- + 4H^+ + O_2 \rightarrow 2H_2O)$

$3(2e^- + 2H^+ + 1/2 O_2 \rightarrow H_2O)$ $6e^- + 6H^+ + 3/2 O_2 \rightarrow 3H_2O$

$4H_2O + 4CH_3OH + 24H^+ + 6O_2 \rightarrow 4CO_2 + 24H^+ + 12H_2O$ $2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$

5. For the following reaction, all of the reactants and products are in their standard states/standard 1.0 mol dm⁻³ concentrations. Which of the following statements must be true?



- a. The reaction would be **product-favored** as written \rightarrow true, E° is (+)
- b. ΔG° for the reaction as written is **positive** \rightarrow false, $\Delta G^\circ < 0$
- c. Zinc is undergoing reduction \rightarrow false, Zn oxidized
- d. SnBr₂ is the reducing agent \rightarrow false, SnBr₂ is oxidizing agent