

Quiz # 5 (May 6, 2008)

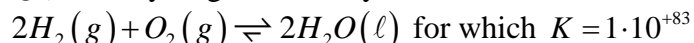
Value: 10 points; Time: 10 minutes

Name KEY

Section _____

Compare with problem Z11.38 $\Delta G_{rxn}^{\circ} = -RT \ln K = -nF\mathcal{E}^{\circ}$

$$R = 8.3 \text{ J/mol-K} \quad @ T = 298 \quad RT = 2.48 \text{ kJ/mole} \quad \frac{RT}{F} = .025 \text{ V/mole}$$

For all of the short answer questions below, explain your conclusion.**Q5)** The hydrogen economy and the fuel cell are based on the reaction:

a) Calculate the Gibbs Free Energy change per mole of reaction, under standard conditions, for this reaction (as written).

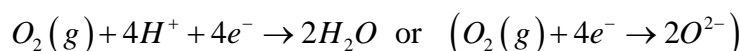
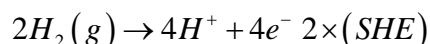
$$\Delta G_{rxn}^{\circ} = -RT \ln K = -2.5 \cdot 2.3 \cdot 83 = -475 \text{ kJ/mol-rxn}$$

b) Calculate the voltage for a fuel cell (battery) run using this reaction, under standard conditions.

$$\mathcal{E}^{\circ} = \frac{RT}{nF} \ln K = \frac{0.025}{4} \cdot 2.3 \cdot 83 = 1.2 \text{ V}$$

c) Explain your choice for the value of n used above.

Must analyze the number of electrons needed for the reaction above (as written). To do this we need the two balanced half reactions that add to the net reaction above:

This shows that $n = 4$, the stoichiometric coefficient for the number of electrons used in the reaction. This is the number of moles of electrons used per mole of reaction (as written) run.

d) Predict the sign of the standard entropy for this reaction

The entropy is negative because two gasses (3 total volumes of gas) go to a liquid (condensed phase) substance. (So the entropy disfavors the reaction.)