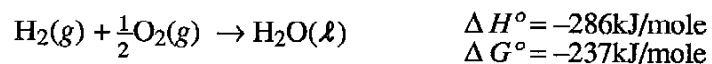


Chemistry 1B S'99, Exam II RJ Saykally Name _____ 1

1. (5 points each) Consider the following chemical reaction as a source of abundant clean energy for the world:



- A. Calculate the maximum possible efficiency for using this reaction in an internal combustion engine operating between temperatures of 3000K and 1000K with a compression ratio of 7.

- B. Calculate the maximum work available per cycle from this engine.

- C. Calculate the maximum electrical work obtainable from a H_2/O_2 fuel cell operating at $P_{\text{H}_2} = 10$ atm, $P_{\text{O}_2} = 2$ atm, and $T = 1000\text{K}$.

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- D. Calculate the maximum voltage obtainable from the fuel cell above.
- E. Calculate the energy equivalent (in kJ/kg) of this fuel cell.
- F. Calculate the equilibrium constant for the H_2/O_2 reaction at 25°C.
- G. Calculate the maximum total work obtainable from this reaction under standard conditions (hint: use ideal gas approximation).

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H. Calculate the efficiency of a H_2/O_2 fuel cell operating under standard conditions.

I. In this fuel cell, _____ is being oxidized at the _____,
_____ is being reduced at the _____,
and the _____ is the positive electrode.

2. (5+5+5+5+10 points)

A. The total world energy consumption is _____, of which _____ % is
chemical energy, _____ % is nuclear energy, _____ % is used for
transportation, and which is increasing by _____ % per year.

B. Write a balanced equation for the alpha emission by $^{155}_{70}\text{Yb}$.

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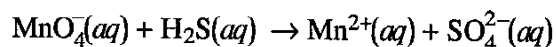
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- C. Calculate the energy equivalent (kJ/kg) for the fusion of deuterium (2.0141079u) to make ${}^4_2\text{He}$ (4.002033u).

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- D. Complete and balance the following equation for reactions taking place in acidic solution.



- E. Diagram the following galvanic cell, indicating the direction of flow of electrons in the external circuit and the motion of ions in the salt bridge.



Write a balanced equation for the overall reaction in this cell.

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3. (5+5+5+5+5 points) Benzene's enthalpy of vaporization is 30.8 kJ mol^{-1} at its normal boiling point, 80.1°C . Calculate q , w , ΔE , ΔS_{sys} , and ΔG when 1.00 mol of benzene is vaporized reversibly at 78°C and 1 atm. Assume that the vapor is an ideal gas and neglect the volume of liquid benzene relative to that of its vapor.

$$\Delta E =$$

$$q =$$

$$w =$$

$$\Delta S_{\text{sys}} =$$

$$\Delta G =$$