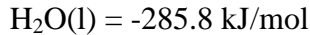
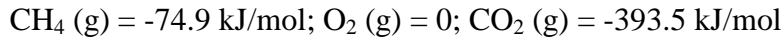


Renewable Energy Systems 402

Tutorial 7

Fuel Cell Systems

1. Find the change in enthalpy of formation of methane (CH_4) in kJ/mol and kJ/kg when it is oxidized to CO_2 and liquid H_2O at Standard Temperature and Pressure (STP). The enthalpy of formation of reactants and products at STP are given below.



(Ans: -890.2 kJ/mol, -55637.5kJ/kg)

2. The enthalpy of formation (h_f) and entropy (s) of both reactants and products of a hydrogen fuel cell at 100°C and standard pressure are given in Table-1. Calculate the following per cell at the standard pressure.

- Change in Gibbs Free Energy of formation (Δg_f)
- Maximum Efficiency
- Maximum EMF
- Maximum EMF as a percentage of that at STP.

Table-1

	Enthalpy of Formation (J/mol)	Entropy (J/mol/K)
Hydrogen (H_2)	2188	131
Oxygen (O_2)	2271	206
Steam (H_2O)	-239276	187.4

Note: Faraday constant is $F = 96485$ Coulombs.

(-225217.7 J/mol, 92.83%, 1.167 V, 5.12%,)

3. The pressure of reactants and products given in Problem 2 are changed as given below while maintaining the temperature at 100°C . Calculate the percentage change in maximum EMF, with respect to the value at standard pressure calculated in Problem 2, part (iii).

- Partial Pressure of Hydrogen = 10 bar, the partial pressures of others remaining unchanged.
- Overall pressure at both anode and cathode increased to 10 bar.

(3.17%, 1.58%)