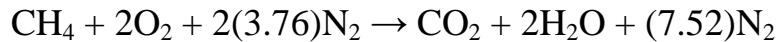


ME 417

Design of Alternative Energy Systems

Quiz #3 Solution

A direct methane-water fuel cell operates with the following overall reaction



Determine the specific electric work and ideal voltage of this fuel cell at 320 K.

Equations and Data for Quiz #1

Enthalpy and Entropy Data

	CH ₄	O ₂	N ₂	CO ₂	H ₂ O
\bar{h}_f (kJ / kmole)	-74,850	0	0	-393,520	-241,820
\bar{h}_{298}^o (kJ / kmole)	8,248	8,682	8,669	9,364	9,904
\bar{h}_{320}^o (kJ / kmole)	9,046	9,325	9,306	10,186	10,639
\bar{s}_{298}^o (kJ / kmole · K)	186.16	205.04	191.61	213.80	188.83

$$\bar{h} = \bar{h}_f + \Delta h$$

$$\bar{s}_i = \bar{s}_i^o - R_u \ln(y_i) \quad \text{with } R_u = 8.314 \text{ kJ/(kmole·K)}$$

$$y_i = \frac{v_i}{\sum_j v_j}$$

$$\bar{w}_{elec} = \sum_{\text{reactants}} v_i \bar{h}_i - \sum_{\text{products}} v_j \bar{h}_j - T_{FC} \left\{ \sum_{\text{reactants}} v_i \bar{s}_i - \sum_{\text{products}} v_j \bar{s}_j \right\} l$$

$$V_{ideal} = \frac{\bar{w}_{elec}}{(96,487)N_e}$$

For a general hydrocarbon fuel, C_xH_yO_z

$$N_e = 4x + y - 2z$$