The following problems concern Gibbs energy (G) and Helmholtz energy (A)

(1) Please define A (10%)

(2) Please define dA in terms of dT and dV (10%)

(3) Justify that $\triangle A$ = maximum available work (15%)

(4) Please define G (10%)

(5) Please define dG in terms of dT and dP (10%)

(6) Justify that $\triangle G$ = maximum non-expansion work (15%)

(7) You wish to construct a fuel cell based on the oxidation of octane. Calculate the maximum total work and non-expansion work available through the combustion of this hydrocarbons on a per gram basis at 298 K and 1 bar. $\triangle H^{0}_{combustion}(C_8H_{18},liq)$ = -5471 $kJmol^{-1}$, $\triangle S^{0}_{combustion}(C_8H_{18},liq)$= -590 $J\ mol^{-1}K^{-1}$, R=8.314 $Jmol^{-1}K^{-1}$. (30%)