Combustor Calculations

- Perform **adiabatic flame temperature** calculation with full equilibrium products
  - pressure = chamber pressure
  - total enthalpy unchanged
Example Method – Gaseq

\[ \frac{m_{O_2}}{m_{H_2}} = \frac{(0.2 \times 32)}{(0.8 \times 2)} = 4 \]
Isentropic Expansion

- Constant $\gamma$ is a very poor assumption for high temperature rocket product gases
  - can’t use $p/p_o=(T/T_o)^{\gamma/\gamma-1}$
  - even worse assumption if gas is reacting
- Can still calculate isentropic nozzle expansion for two cases
  - flow stays in equilibrium through nozzle (shifting equil.) $h$
  - flow is frozen - composition can not change
  - find $h$ (and thus $u$) that matches given $p$ and $s$
Example Method – Gaseq

Want to examine expansion of products
Example – Frozen Chemistry

- Set $p_e$ for nozzle expansion

\[ T_e \]

\[ \gamma_e \]

\[ MW_e \]

\[ h_0 \]

\[ h_e \]
Example – Shifting Equilibrium

- Exit composition

\[ T_e \]

\[ \gamma_e \]

\[ MW_e \]

\[ h_o \]

\[ h_e \]