AME 598i
Prof. J. M. Powers
Homework 6
Due: Friday, 28 February 2003

1. Consider a reaction mechanism for the combustion of H_2 with O_2 as given by Singh, *et al.* [1] in their Table 1. This is available on the links section of the course web page. Consider combustion in a volume which is initially a cube whose side is of length 200 mm, and for which one of the walls behaves as a frictionless piston, of a gas which has initial mole fractions of $X_{H_2} = 0.1$, $X_{O_2} = 0.1$, $X_{Ar} = 0.8$, and an initial pressure and temperature of 1 MPa and 1000 K,

   (a) For adiabatic, isobaric combustion, determine the variation of all species concentrations, temperature, pressure, and time scales of reaction as functions of time; give computer-generated plots on logarithmic scales. Plot all species concentrations on a single plot. Plot all time scales on a single plot. Plot the relative error in pressure $\frac{P(t)-P(0)}{P(0)}$, the relative error in enthalpy $\frac{h(t)-h(0)}{h(0)}$, and the relative error in moles for each atom versus time.

   (b) Repeat the previous problem if there is lumped heat transfer from the volume to the surroundings. Take the heat transfer coefficient to be $\hat{h} = 10\ W/m^2/K$ and the far field temperature to be 300 K. Perform your calculations until the temperature reaches the far field temperature.

[1] Singh, S. Rastigejev, Y., Paolucci, S., and Powers, J. M.., 2001, "Viscous detonation in $H_2 - O_2 - Ar$ Using Intrinsic Low-Dimensional Manifolds and Wavelet Adaptive Multilevel Representation," *Combustion Theory and Modeling*, Vol. 5, pp. 163-184.