ME 456
Prof. J. M. Powers
Homework 6
Due: Friday, 19 March 1999

1. Consider a 3 kg sphere of the solid energetic material LX-14 (a common explosive). Assume the LX-14 has a spatially uniform temperature and that all of its material properties are as given by Powers [1]. Take the initial temperature to be $T(0) = 500\ K$.

   (a) For an adiabatic sphere, estimate the induction time from thermal explosion theory.

   (b) Solve numerically, using whatever technique, language, or machine you care to, the energy and species equations for the adiabatic case. Give plots of $T(t)$ and $\lambda(t)$. Compare the induction time with that predicted by thermal explosion theory.

   (c) If we include a mechanism of convective heat transfer from the surface of the sphere to the surroundings, with a heat transfer coefficient of $h = 20\ W/m^2/K$ and an ambient temperature of $300\ K$, recalculate $T(t)$ and $\lambda(t)$ and compare to previous results.

2. *Design Problem* Choose a fuel, and give an estimate of the fuel consumption and air intake requirements for an automobile travelling at a steady velocity on a highway. Repeat your estimate for a second fuel. Comment as appropriate.

[1] Powers, J. M., 1999, "Thermal explosion theory for shear localizing energetic solids," *Combustion Theory and Modelling*, Vol. 3, pp. 103-122.