

ME 456

Prof. J. M. Powers

Homework 9

Due: Friday, 16 April 1999

1. Consider a slab of the solid energetic material LX-14 (a common explosive). The slab has length $L = 0.25 \text{ m}$. Assume the LX-14 has material properties as given by Powers¹, with the following exceptions, which we take to avoid problems of numerical convergence, $a = 5 \times 10^{-5} \text{ s}^{-1}$, $E = 2.206 \times 10^4 \text{ J/mol}$. Solve the initial value problem for this scenario. Assume the temperature at the outer radius is held fixed at 300 K and the temperature evolution is governed by the following differential equation as developed in lecture:

$$\frac{\partial T}{\partial t} = \frac{1}{D} \frac{\partial}{\partial x} \left(\frac{\partial T}{\partial x} \right) + (1 - T) \exp \left(\frac{-\Theta}{1 + QT} \right).$$

Turn in a plot of $T(x, t)$. Take the initial temperature to be $T(x, 0) = 0$.

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