NAME:
ME 456/AME 598E
Examination 2
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1. Consider a reactive *calorically imperfect* ideal gas:

$$e = a_0 + a_1 T + a_2 T^2 - \lambda q$$

$$P = \rho R T$$

with $q = 1.0 \times 10^6 \ \frac{J}{kg}, R = 287 \ \frac{J}{kg \ K}, a_o = 4640 \ \frac{J}{kg}, a_1 = 706 \ \frac{J}{kg \ K}, a_2 = 0.062 \ \frac{J}{kg \ K^2}$.
Take the ambient conditions in the gas to be $P_o = 1 \times 10^5 \ Pa, T_o = 300 \ K$, and assume the gas is well modelled by the one-dimensional reactive Euler equations. If a detonation wave traveling at $D = 3000 \ \frac{m}{s}$ propagates into the gas,

- carefully pose the algebraic jump conditions for this case,
- numerically find the pressure at the inert shock state N, and at the complete reaction states ($\lambda = 1$) S and W,
- plot via computer on single graph the Rayleigh line, inert Hugoniot, and complete reaction Hugoniot.

2. Consider a point source of $3 \times 10^9 \ J$ expanding into helium with $\gamma = \frac{5}{3}, R = 2077 \ \frac{J}{kg \ K}$.
Plot $R(t), u(r = 1 \ m, t)$.