November 4, 2005

PHY 711 – Problem Set # 23

Assume that an ideal gas characterized by a specific heat ratio γ is in a state of adiabatic streamline flow with fluid velocity v and sound velocity c. When the fluid is at rest the fluid properties are denoted by subscript "0" (T_0, p_0, ρ_0, c_0) for temperature, pressure, density, and sound velocity respectively. Derive the following relationships between these quantities:

1. $c^2 = c_0^2 - \frac{1}{2}(\gamma - 1)c_0^2$.
2. $T_0/T = 1 + \frac{1}{2}(\gamma - 1)M^2 \quad \text{where} \quad M \equiv v/c$.
3. $\rho_0/\rho =?$