AEE 343 Compressible Flow
Problem set 2
Due date: 2/12/2015

Problem 1
Determine the Mach number of a car moving in standard air at a speed of (a) 25 *mph*, (b) 55 *mph*, and (c) 100 *mph*.

Problem 2
At the seashore, you observe a high-speed aircraft moving overhead at an elevation of 10,000 *ft*. You hear the plane 8 *s* after it passes directly overhead. Using a nominal air temperature of 40°F, estimate the Mach number and speed of the aircraft (in *ft/s*).

Problem 3
A normal shock stands in a duct. The fluid is air, which may be considered an ideal gas. Properties upstream of the shock are $T_1 = 5^oC$, $p_1 = 65$ *kPa*, and $V_1 = 668$ *m/s*. Determine properties downstream of the shock and the entropy rise ($s_2 - s_1$) across the shock.

Problem 4
Just upstream of a normal shock in an ideal gas flow, $M_1 = 3$, $p_1 = 65$ *psia*, $T_1 = 600^oR$. Determine (M_2, p_2, T_2, P_{02}, T_{02}) downstream of the shock if the gas is (a) air, and (b) helium. Note that $\gamma = 1.66$ for helium.

Problem 5
The Pitot tube on a supersonic aircraft cruising at an altitude of 30,000 *ft* senses a stagnation pressure of 12 *psia*. If the atmosphere is considered standard, determine the air speed and Mach number of the aircraft.

Problem 6
Derive the following relation

$$M^{*2} = \frac{(\gamma+1)M^2}{2+(\gamma-1)M^2}$$