AA210A Homework 7, 2020 – 2021 Cantwell, Fall 2020
Due Wednesday November 4

Suggested viewing: Take 35 minutes and watch the film CHANNEL FLOW OF A COMPRESSIBLE FLUID on the MIT website. http://web.mit.edu/hml/ncfmf.html

**Read Chapter 10**

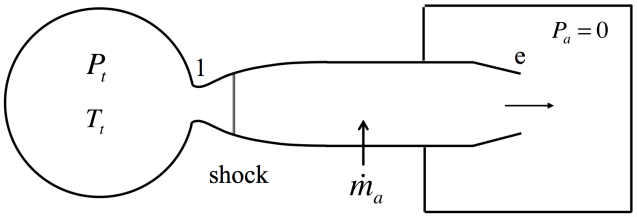
Solve:

**Chapter 9 – Problem 10**. We worked this problem in class. In part 3 the stagnation temperature was worked out at stations 1, 2 and 3 in a frame of reference at rest with respect to the gas at station 1. In this frame the body is moving right to left at 694.4 M/sec. I would like you to now work out the stagnation pressure at stations 1, 2 and 3 in this frame of reference.

**Chapter 10 – Problem 5**

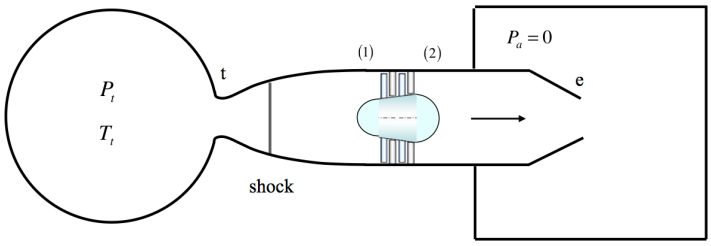
Two problems from previous final exams

**Problem** The figure below shows an ideal gas flowing from a very large plenum through an adiabatic wind tunnel with two throats. The throat area ratio is $A_e / A_1 = 2$. A normal shock is stabilized upstream of the test section. In addition, gas of the same type with the same stagnation temperature $T_t$ is injected through a choked throat (not shown) directly into the test section where it mixes fully with the main flow. The added mass flow rate is 1/5 of the mass flow rate from the plenum, $\dot{m}_a = \dot{m}_1 / 5$.




1) Determine $P_{te} / P_t$.
2) What would happen to the shock strength if $\dot{m}_a$ is increased slightly? What if $\dot{m}_a$ is decreased slightly?

**Problem** – The figure below shows a wind tunnel used to test a compressor with pressurized air. Work is done by the compressor between stations 1 and 2 such that $T_{t2} / T_{t1} = 1.5$. The compressor is ideal; there is no entropy change between stations 1 and 2. The throat area ratio is $A_e / A_t = 1/2$.




1) Determine the stagnation pressure ratio across the shock. State your assumptions.
2) Suppose the exit area is varied. What value of $A_e / A_t$ would cause the upstream throat to unchoke?