EAS 4300 Project I

Due Thursday, March 17th at the beginning of class

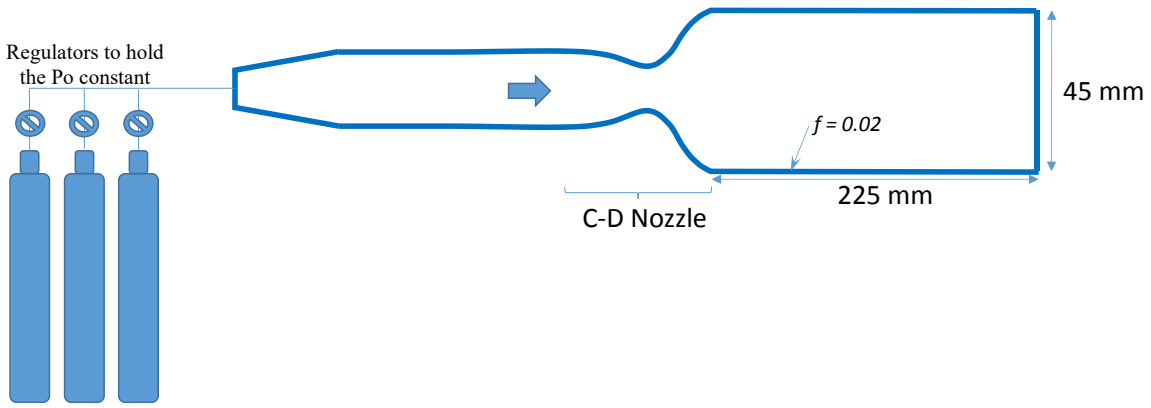
Hypersonic Advanced Propulsion Technology:

The Propulsion & Energy Research Laboratory at University of Central Florida is working on the research development of an advanced propulsion technology system for next generation Air Force hypersonic engines. The hypersonic flow path of the jet engine technology is shown in the Figure below.

The testing rig facility is composed of Mach 5 C-D nozzle connected to an optically accessible channel for data acquisition. The goal is to initiate the facility non-reacting with a normal shock present at the exit plane of the channel. Then, hydrogen fuel will be added for reacting combustion testing. The facility is supplied with an air source that is regulated by a series of high-pressure air tanks as shown below. The tanks are initially pressurized at 4,500 PSI with a capacity of 49 liters. Each tank has a throat diameter of 1/8". The rig is exhausting in to a fixed ambient pressure (1atm).

Design the hypersonic facility by finding the following:

1. Determine the $A_{nozzle\ exit}/A^*$ required to achieve a Mach 5 flow at the inlet of the channel with a cross-sectional area of 45 mm x 45 mm.
2. What is the stagnation pressure needed for C-D nozzle to maintain a normal shock at the exit plane of the channel.
3. How many tanks are required to run the facility for 2 mins?
4. Determine the heat release for a stoichiometric combustion of hydrogen (ignoring friction).
5. Compare the stagnation pressure required for the ideally expanded scenario to that of maintain a normal shock at the exit plane of the channel from 2 (non-reacting).



Format:

I encourage you to discuss this project with your classmates, but all formulas, analysis, computer coding, or reports should be done individually. The best way to really learn is through doing it yourself. Please show all your relevant work and steps of how you solved the problem.