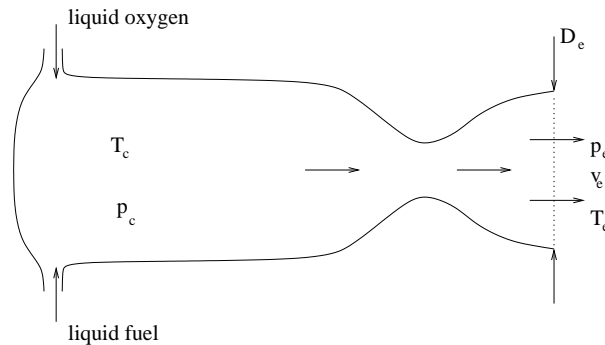


**MAE 103 Assignment 5: Due Thursday, May 9, 2002**  
**A. R. Karagozian**  
**(Please turn in at the end of the class session at 10 am)**

1. A rocket motor is operating steadily, as shown below. Liquid oxygen enters the rocket chamber at a mass flow rate  $\dot{m}_o = 0.5$  slug/sec, and liquid fuel enters the rocket at a mass flow rate  $\dot{m}_f = 0.1$  slug/sec.



In the rocket chamber, upstream of the nozzle, the flow is essentially at rest (“quiescent”). The chamber temperature  $T_c$  is equal to 4000R and the chamber pressure  $p_c$  is 400 lbf/in<sup>2</sup>. The diameter of the exhaust nozzle shown,  $D_e$ , is 5.5 inches, and the exhaust pressure  $p_e$  at the nozzle exit is 15 lbf/in<sup>2</sup>, while the exhaust temperature  $T_e$  is 1100°F. The products of combustion flowing out of the exhaust nozzle approximate a perfect gas (so  $p = \rho RT$ ) with a molecular mass of 26.

For the given conditions, calculate the exhaust velocity  $v_e$  in feet per second.

2. Given two velocity components of an incompressible flow,

$$u = xy^2 + x^2z, \quad v = y^2z,$$

what is the most **general** form of the third velocity component,  $w(x, y, z)$ , which satisfies the continuity equation (differential form)?

3. Problem 4.51 in Munson, et al.’s text.
4. Problem 5.10 in Munson, et al.’s text.
5. Problem 5.13 in Munson, et al.’s text.
6. Problem 5.15 in Munson, et al.’s text.
7. Problem 5.17 in Munson, et al.’s text.
8. Problem 6.7 in Munson, et al.’s text.