Problem Set 2 (PS1) Due Tuesday January 31

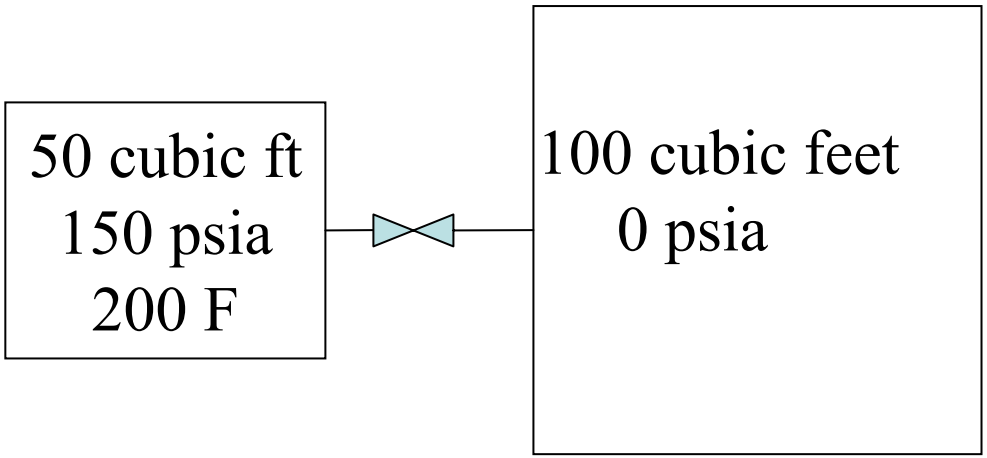
PS 2.1. A well insulated tank containing 100 cu ft of air at 150 psia and 200 degrees F is connected by a short pipe and valve to another well insulated tank of 100 cu ft which is completely evacuated. The valve is opened and the air pressure is allowed to equalize between the two tanks. Assume the air is an ideal gas.

1) **What is the final pressure in the tanks?**
2) **What is the final temperature in the tanks?**
3) **What is the change in enthalpy?**
4) **What is the work done by the system?**

PS 2. 2 Discuss the difference in deriving a flow model from a control volume and a flow model from a fluid element. Which is the better approach ?

PS 3.3 What is the difference between conservative and non-conservative forms of the governing equations of fluid mechanics ? What is conserved in these equations ?

PS 2.1



The thermodynamic system is the mass in the pressurized tank.There is no mass in the evacuated tank and thus no system to transfer heat or work to. Neither heat or work are transferred to the system outside the two tanks. Work=0. It is given that Q=0

$$Q = \Delta U + W$$

$$0 = \Delta U$$

1)

$$p_1 v_1 = p_2 v_2$$

$$150 \times 50 = p_2 \times 150$$

$$p_2 = 50\text{psia}$$

2)

$$0 = \Delta U = mc_c (T_2 - T_1)$$

$$T_2 = 200\ ^{o}\text{F}$$

3)

$$\Delta h = c_p \Delta T = 0$$

4)

$$\text{Work} = 0$$

2.2 Both result in correct equations in which mass and energy are conserved and forces balance.

2.3 In both conservative and non conservative forms of the equations mass and energy are conserved and forces balance. The term “non-conservative” refers to the numerical mathematics parameters of computational fluid dynamics (CFD).