Notre Dame University
Faculty of engineering
Department of Mechanical Engineering

Thermodynamics I	Test I	March 2, 2008
MEN 210A	Open Book & Notes	Wednesday
Instructor: Dr. W. Assaf	Time: 50 minutes	

Problem One: **40%**

Two rigid tanks are connected by a valve. Tank A is 0.2 cubic meters in volume contains 0.54 kg of water at 400 kPa and a quality of 80% and internal energy of 2163.7 kJ per kg. Tank B has a volume 0.5 cubic meters and contains 0.4171 kg of water at 200 kPa and 250°C and internal energy equal to 2731.2 kJ per kg. The valve is now opened and the two tanks eventually come to same state at 25°C in equilibrium with the surroundings.

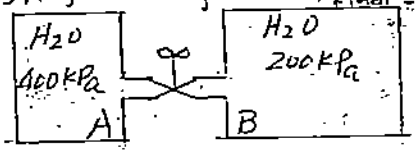
Determine:

(a) quality of the system after equilibrium has been reached

(b) internal energy of the system in kJ

(c) the final pressure at equilibrium

(d) the amount of heat transferred with the surroundings



$Q = m_2u_2 - \Sigma(mu)_{A\&B}$

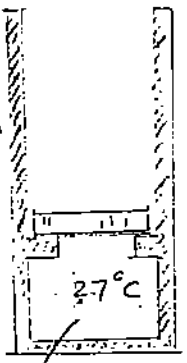
$= (.9571)(\quad) - .54 \times 2163.7 - .4171 \times 2731.2$

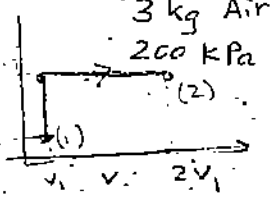
$= 131.4 - 1168.4 - 1139 = -2176$ kJ

Problem Two: **30%**

A piston cylinder-device, whose piston is resting on a set of stops initially contains 3 kilograms of air 200 kPa and 27°C. The mass of the piston is such that a pressure of 400 kPa is required to move it. Heat is now transferred to the air until its volume doubles. Determine the work done by the air and the total heat transferred to the air during this process.

Show the process on a P-V diagram.





Final Air Temp

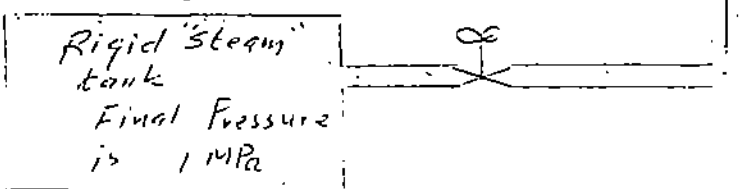
$Q_2 = m\Delta u + W_2$

$Q_2 = (3\text{ kg})(.717\ \frac{kJ}{kg\,K})(1200 - 300) + 516.6$

$= 2452.5$ kJ

Problem Three: **30%**

A rigid, insulated tank that is initially evacuated is connected through a valve to a supply line that carries steam at 1 MPa and 300°C. Now the valve is opened, and steam is allowed to flow slowly into the tank until the final pressure reaches 1 MPa, at which point the valve is closed. Determine the final temperature of the steam in the tank.



$\frac{400 - T}{-100} = \frac{-93.86}{-167.05} = 0.56$

$-56 = 400 - T$

$T = 456$ °C