ME23, Section 03, HOMEWORK #7

Due Wednesday, 03/15/06

1. 5.7 (4 points + 1 bonus point) Superheated steam is contained in a sealed rigid tank at 600 K and 0.3 MPa (state 1). Energy is removed from the steam by heat transfer until a temperature of 350 K (state 2) is reached. Plot the process on P-v and T-v coordinates for 1 bonus point. Include the steam dome on your plots. Determine the following quantities for this process: \( W_{1\to2}/M \), \( \Delta u \), \( \Delta h \), and \( Q_{1\to2}/M \).

2. 5.11 (2.5 points) Pulverized coal particles at 300 K are injected into hot furnace gases at 1500 K. Estimate the initial heating rate of a 70-µm-diameter. Express your result in kelvins per second. The convective heat-transfer coefficient is approximately 1500 W/m².K. The specific heat and density of the coal are 1.3 kJ/kg.K and 1650 kg/m³, respectively.

3. 5.24 (1 point) A tank contains a fluid that is stirred by a paddle wheel. The work input to the paddle wheel is 4309 kJ. The heat transferred from the tank is 1371 kJ. Considering the tank and the fluid as a closed system, determine the change in the internal energy (kJ) of the system.

4. 5.27 (2 points) Considering a thermodynamic system executing the two reversible processes shown in the sketch (ab and adb) (shown on your textbook). What is the heat transferred to an ideal gas if \( P_2=2P_1 \) and \( v_2=2v_1 \)? Express your answer in terms of the gas constant \( R \) and \( T_1 \).

(Hint: for ideal gas, \( u=5RT/2 \))

Comments (0.5 point)