ME 312 Thermodynamics Name _____
D. Abata please print!

First Hour Exam

This is a closed book examination. You may use your Properties Booklet.

Warm-Ups (5 pts each)

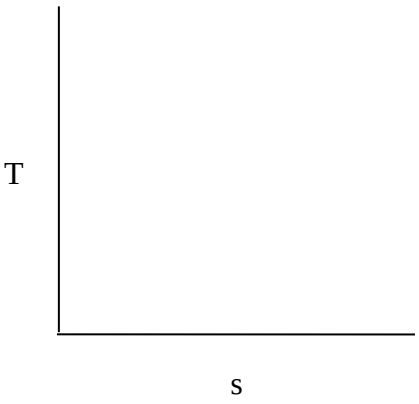
1. Determine the mass of air in a room measuring 3m x 5m x 2m. The temperature and pressure are 20 ºC and 100 kPa respectively.

2. Heat is added to Helium at constant temperature. The temperature of Helium is 30 ºC and the entropy change of this process is 0.10 kJ/K. Determine the amount of heat added in kJ.

3. A closed system undergoes an expansion process while producing 200 kJ of useful work. The exergy at the beginning and end of the process is 450 kJ and 200 kJ respectively. Determine the lost work in kJ and the second law efficiency of this process.

4. Briefly describe the primary difference between the Diesel cycle and the Otto cycle.

5. (40 pts) Steam enters an adiabatic turbine at 8 MPa and 500°C with a mass flow rate of 3 kg/s and leaves at 30 kPa and 70 °C. Kinetic and potential energy is negligible.



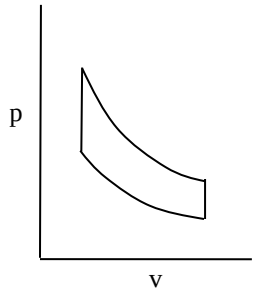
(a) Calculate the work produced by the turbine in kW.

(b) Determine the exergy change of the steam in kW.

(c) Determine the irreversibility of this process in kW.

(d) Determine the second law efficiency of this process.

6. (40 pts) An ideal Otto cycle has a compression ratio of 8. The temperature and pressure at the beginning of the compression process is 95 kPa and 27 C. Heat added to the constant-volume heat-addition process is 750 kJ/kg. (Use constant specific heats of air for your analysis.)



(a) Determine the temperature in K at the end of the heat addition process.

(b) Determine the net work output, in kJ/kg.

(c) Determine the thermal efficiency.

(d) What is the Carnot efficiency for a heat engine with the same maximum and minimum temperatures as the above cycle?