

M E 227.3 Thermodynamics I
Department of Mechanical Engineering
Midterm Examination
October 27, 2004

Time: 90 minutes
Calculators Allowed
Formula Sheet Supplied

Total Marks: 50
Closed Book
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- (10) 1. Define the following terms.
- (a) Enthalpy
 - (b) Total Energy
 - (c) Ideal Gas
 - (d) Saturated Vapour
 - (e) Isobaric Process
- (20) 2. A piston-cylinder device contains 2 kg of water which is initially a saturated liquid at 300°C . It undergoes three processes to form a cycle. The first process is constant volume, the second is constant pressure at 2 bar and the third is a polytropic process where $Pv^{1.1} = \text{constant}$. Calculate heat transfer and work (both in kJ) for each process. Is the device a heat engine or a refrigerator?
- (20) 3. Air ($R = 286.9 \text{ J}/(\text{kg} \cdot \text{K})$) at 1300 K and 10 bar enters a turbine with a mass flowrate of 5 kg/s. After exiting the turbine, the air enters a heat exchanger where it is cooled to 450 K before discharging to the atmosphere at 1 bar. The heat exchanger warms liquid water flowing at 15 kg/s from 20°C to 40°C . Calculate the power output of the turbine (MW). For the cooling water, you may assume that $c_P = 4.18 \text{ kJ}/(\text{kg} \cdot \text{K})$ is a constant.

