NAME:
ME 327
Examination 3
Prof. J. M. Powers
April 21, 1995

1. Efficiency Problem (30)

A adiabatic turbine uses air as a working fluid. The inlet pressure is 10 MPa and inlet temperature is 1500°C. The turbine efficiency is $\eta_t = 0.7$. It is desired to generate 9 kW of work. What is the required mass flow rate to achieve this effect? Neglect kinetic and potential energy effects; assume air is an ideal gas with a constant specific heat (you can evaluate the specific heat at 300 K) [correction, 5-9-2013: Take the pressure ratio to be 10.]

2. Carnot Engine (30)

A Carnot heat engine receives energy from a solar collector at a temperature of 80°C, and rejects a heat transfer to the surroundings at 25°C. The solar collector converts 50 percent of the incident solar energy into usable thermal energy . If 1 kW of solar energy strikes each 1 m^2 of the collectors, what collecter area is necessary to provide 5 kW of power output from the heat engine?

3. Rankine Cycle (40)

Consider an ideal Rankine cycle in which all components operate at peak efficiency. Steam enters the turbine at 10 MPa, 800°C. It is expanded through the turbine till it is a saturated vapor. At the end of the condensor it is a saturated liquid. It is then pumped to 10 MPa. What is the mass flow rate necessary to generate 100 MW of net power? What is the cycle efficiency?