ENSC 388

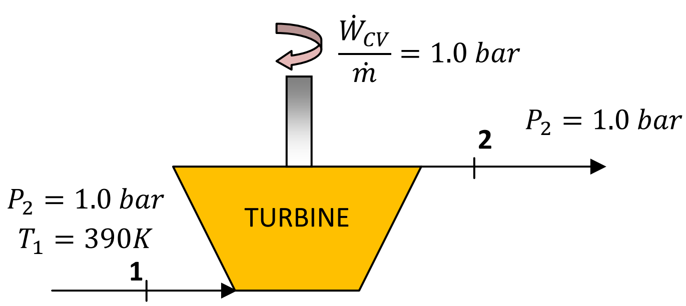
Assignment #6

Assignment date: Wednesday Oct. 21, 2009

Due date: Wednesday Oct. 28, 2009

Problem 1

A turbine operating at steady state receives air at a pressure of $P_1 = 3.0\ bar$ and a temperature of $T_1 = 390K$. Air exits the turbine at a pressure of $P_2 = 1.0\ bar$. The work developed is measured as $74\ kJ$ per kg of air flowing through the turbine. The turbine operates adiabatically, and changes in kinetic and potential energy between inlet and exit can be neglected. Using the ideal gas model for air, determine the turbine efficiency.



Problem 2

Components of a heat pump for supplying heated air to a dwelling are shown in the schematic below. At steady state, Refrigerant 134a enters the compressor at 6 ℃, 3.2 bar and is compressed adiabatically to 75 ℃, 14 bar. From the compressor, the refrigerant passes through the condenser, where it condenses to liquid at 28 ℃, 14 bar. The refrigerant then expands through a throttling valve to 3.2 bar. The states of the refrigerant are shown on the accompanying T-s diagram. Return air from the dwelling enters the condenser at $20\ ^\circ C$, $1\ bar$ with a volumetric flow rate of $0.42\ m^3/s$ and exits at $50\ ^\circ C$ with a negligible change in pressure. Using the ideal gas model for the air and neglecting kinetic and potential energy effects, (a) determine the rates of entropy production, in kW/K, for control volumes enclosing the condenser, compressor, and expansion valve, respectively. (b) Discuss the sources of irreversibility in the components considered in part (a).