1. Draw qualitatively a temperature-volume diagram for water for two constant pressures 10 MPa and 1 MPa, respectively, showing compressed liquid states, saturated-liquid lines, vaporization processes, saturated-vapor lines, and superheated-vapor states.(15%) What is the concept of a triple point of a pure substance?(4%)

2. Express the first law of thermodynamics for a change in states of a system.(6%) Give explanations for the meanings of the "energy" and "internal energy" of a system.(5%) Give comparisons between heat and work.(6%)

3. Derive $C_p - C_v = R$ for an ideal gas. C_p and C_v are constant-pressure and constant-volume specific heats, respectively.(6%)

4. Derive the "Inequality of Clausius".(16%) Then, explain why "entropy" is a property of a system?(6%)

5. Derive an entropy change relation of an ideal gas(8%), and derive the pressure-volume relation for a reversible adiabatic process of an ideal gas with constant specific heats(8%)

6. Air (R=1715 $ft^2/(s^2 \cdot {}^\circ R)$, $c_p = 6003\, ft \cdot lbf/(slug \cdot {}^\circ R)$ flows steadily, as shown below, through a turbine which produces 700 hp. For the inlet and exit conditions shown below, estimate (a) the exit velocity V_2 and (b) the heat transferred $\dot{Q}$ in Btu/h.(20%)