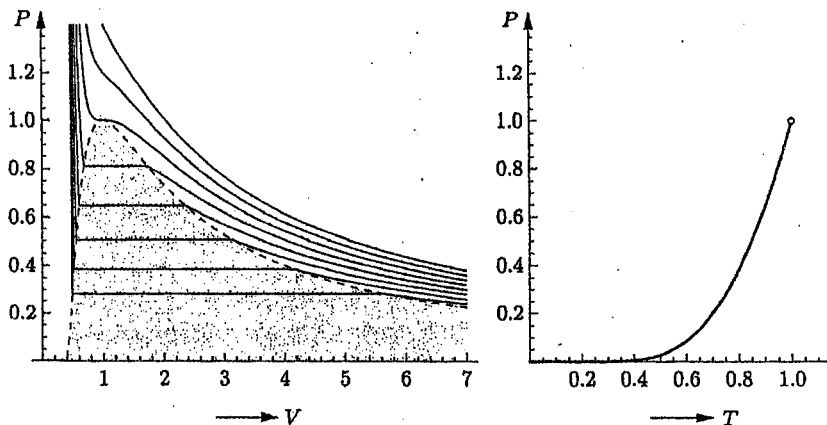




所別：大氣物理研究所碩士班 一般生 科目：熱力學

- 1) Please answer the following questions briefly. (5% each)
  - a) At a pressure of  $P$ , how much of energy is required to create an air parcel of volume  $V$  with energy  $U$ ? What is the specific term for the required energy in thermodynamics?
  - b) State in words the physical definitions of *heat capacity* and *latent heat*, respectively.
  - c) Taking pumping up a bicycle tire as an example, can you compress the air isothermally? Give reasons to support your answer.
  - d) Show an adiabatic expansion process of an ideal gas on a  $P$ - $V$  diagram.
  - e) Show an example of free expansion process. Give at least two thermodynamic properties that will change and will not change during the process, respectively.
  - f) What is an isentropic process? Give an example.
  - g) Describe a thermodynamic process in which enthalpy is conserved.
  - h) In what kinds of conditions the change in Gibbs free energy is zero?
  
- 2) a) How is the efficiency of a heat engine defined? b) The efficiency of a heat engine cannot exceed  $1 - T_c/T_h$  where  $T_c$  and  $T_h$  represent the temperature at the cold and hot reservoirs, respectively. Please explain why. c) Describe an engine cycle which can achieve the maximum possible efficiency. (15%)
  
- 3) On a winter day, the temperatures inside and outside of your home are  $20^\circ\text{C}$  and  $10^\circ\text{C}$ , respectively. Assuming that both the temperatures maintain unchanged while there is a heat loss from your home at a rate of 1000Watts, please estimate the entropy change of the universe in one hour. (You can just show mathematical expressions without calculating the final results.) (15%)
  
- 4) The figure below shows liquid-gas phase diagrams of water with axes labeled in units of the critical values. a) Based on what equation are the diagrams constructed? b) Sketch the diagrams on your answer sheet and, on both diagrams, indicate the critical point and the portions that represent pure liquid water and water vapor. c) From one of the diagrams, explain how to obtain the saturated vapor pressure for a particular temperature. (15%)



- 5) Based on the ideal gas law and the first law of thermodynamics, derive the Poisson's relations for an ideal gas undergoing an adiabatic process. (15%)