

所別：機械工程學系碩士班 戊組(生醫) 科目：熱力學  
能源工程研究所碩士班

1. (10 %) What is heat engine? Please explain its purpose, efficiency and give a sketch to show its operating character.
2. (6 %) What is the Kelvin-Planck statement of the second law of thermodynamics?
3. (14 %) The general expression of a boundary work is  $W_b = \int PdV$ .  
Consider the polytropic process ( $PV^n = \text{constant}$ )
  - (a) Plot the  $P$ - $V$  diagram for this process. (4%)
  - (b) Derive the work done during a polytropic process in terms of  $P_1$ ,  $V_1$ ,  $P_2$ ,  $V_2$  and  $n$ , where 1 and 2 are the initial and final state of the polytropic process. (6%)
  - (c) Calculate the boundary work for  $P_1=100$  kPa,  $V_1=0.1$  m<sup>3</sup>,  $P_2=10$  kPa,  $V_2=0.5$  m<sup>3</sup>, and  $n=1.4$ . (4%)
4. (5%) Briefly describe the purpose of the Kyoto Protocol?
5. (5%) Is it possible to have water vapor at 10°C? Give a brief explanation.
6. (10%) Briefly explain the greenhouse effect. Why is it important to regulate the greenhouse effect?
7. (10%) A simple ideal Brayton cycle is modified to incorporate multistage compression with intercooling, multistage expansion with reheating, and regeneration without changing the pressure limits of the cycle. As a result of these modifications,
  - (a) Does the net work output increase, decrease, or remain the same?
  - (b) Does the back work ratio increase, decrease, or remain the same?
  - (c) Does the heat rejected increase, decrease, or remain the same?
8. (a) Can the enthalpy values determined from a psychrometric chart at sea level be used at higher elevations? Why? (5 %)  
(b) What is the value of the Clapeyron equation in thermodynamics? (5%)
9. (a) Express the increase of entropy principle for chemically reacting systems. (5 %)  
(b) How are the absolute entropy values of ideal gases at pressures different from 1 atm determined? (5 %)
10. (10%) What is cogeneration? Sketch a cogeneration plant and describe its operation.
11. (5 %) If the equilibrium constant for the reaction  $\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}$  is  $K$ , what is the equilibrium constant for the reaction  $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$  at the same temperature?
12. (5 %) What is the importance of the van't Hoff equation?