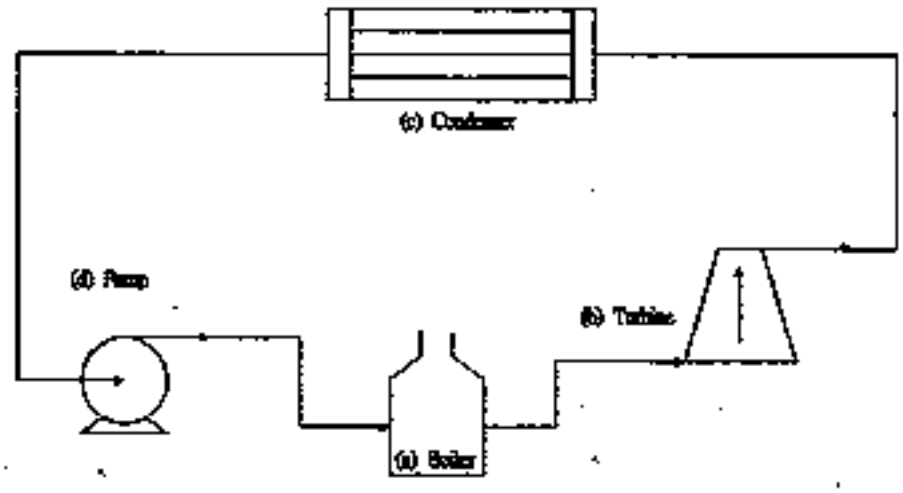
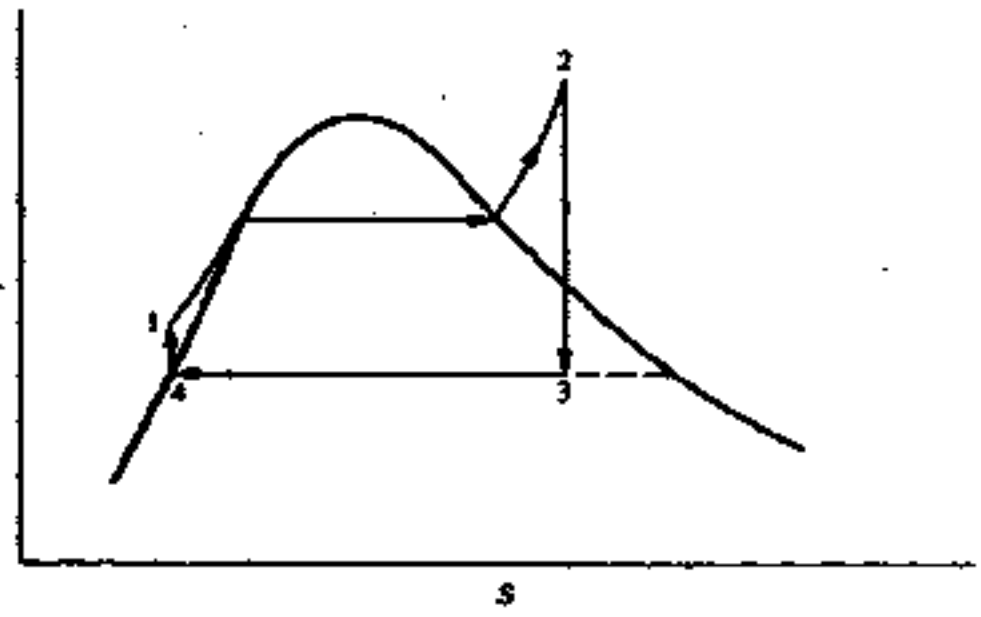
第 1 題(10 分): For an ideal gas, show that the entropy increase when the temperature is increased from T_1 to T_2 at constant pressure is greater than the entropy increase when the temperature is increased from T_1 to T_2 at constant volume.

第 2 題(10 分): Associate actual operations (a) boiler, (b) turbine, and (c) condenser, and (d) pump with steps 1 to 2, 2 to 3, 3 to 4, and 4 to 1 on the T-S diagram.





第 3 題(15 分): A gas cylinder well insulated inside with a volume of V_T contains methane at temperature T_1 and pressure P_1. The methane is withdrawn from the cylinder until the pressure drop to $P_2=P_1/2$. The withdrawal process is slow enough that there is no temperature or velocity gradient inside the cylinder. Find the final temperature and the number of moles of methane withdrawn. Assume that methane is an ideal gas with isobaric heat capacity C_p and heat capacity ratio γ.

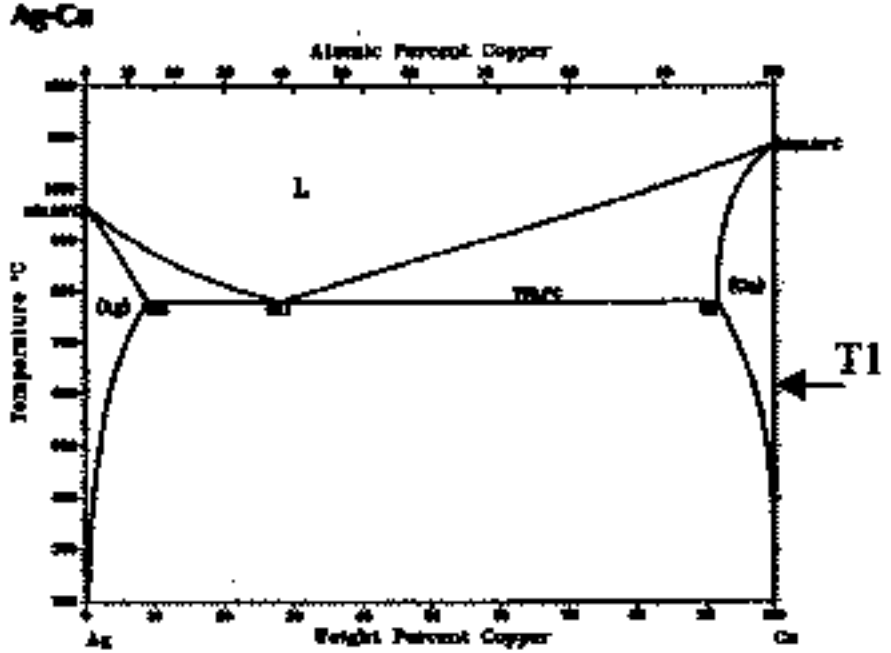
第 4 題(15 分): The excess Gibbs free energy of a binary mixture is given by

$$\frac{G^{ex}}{RT} = x_1 x_2 [A + B(x_1 - x_2)]$$

Find the expression of activity coefficient for component 1 if B is not 0

第 5 題(10 分): Please write down the mathematical definition of the partial molar property $\overline{M_i}$ of species i in solution. Is chemical potential of species i, μ_i, a partial property ?

第 6 題(10 分): Please plot an x-y diagram showing the value of activity of Cu, a_{Cu} (y-axis), versus composition, wt%Cu (x-axis), at T_1 from the following Ag-Cu binary phase diagram.



第 7 題(10 分): What is Gibbs phase rule ? Please explain by following the phase rule why a binary eutectic reaction at a constant pressure must occur isothermally.

第 8 題(10 分): Please draw a binary schematic T-x (temperature-composition) phase diagram which shows a miscibility gap, and please indicate on the diagram the binodal curves, tie-line and spinodal curves.

第 9 題(10 分): A and B gases react to form C and D gases at T_1. Reaction coordinate ε characterizes the extent to which the A+B=C+D reaction has taken place. Please plot a x-y diagram showing the total Gibbs energy of the system in relation to the reaction coordinate ε. Please also indicate on the diagram the criteria of the system at its equilibrium state.