1. One mole of an ideal gas, in an initial state P=10 atm, V=5L, is taken, reversibly, in a clockwise direction, around a circular path given by $(V-10)^2+(P-10)^2=25$. Calculate the amount of work done by the gas as a result of this process, the change in internal energy of the gas, and the maximum and minimum temperature attained by the gas during the cycle. How do these answers change if the number of moles of gas double for the same P-V cycle? (30%)

2. The ice skating field contains ice at -10 °C. Upon exerting a high enough pressure P on the ice skate blade, a thin layer of ice melts and provides lubrication for ice skating. The heat of fusion for ice is $\Delta H_f=3.34\times10^2$ kJ/kg. The densities of water and ice are $\rho=10^3$ kg/m^3 and $\rho=0.917\times10^3$ kg/m^3, respectively.
   (a) Calculate the pressure P in the unit of (N/m^2). (10%)
   (b) Why the blade for ice skating is very sharp? (10%)

3. For a binary mixture at T= 298 K, the activity coefficient for component 1 is:
   $\ln \gamma_1 = x_2^2(2-3x_2)$
   (a) What is the activity coefficient γ_2 at $x_2=0.3$? (10%)
   (b) What is the molar Gibbs free energy change on mixing ($\Delta G/RT$) for this mixture at $x_2=0.3$? (10%)

4. Two cylinders A and B; each with a volume of 0.01m^3, are connected and are immersed in a water bath so that their contents are always at 300 K. Initially, cylinder A contains an ideal gas at a pressure of 5 bar and the other is evacuated. A valve is open and the pressure is allowed to equalize. For this change please calculate
   (a) the total heat exchange between the bath and the cylinder resulting from this change. (8%)
   (b) the heat exchange between cylinder A and the bath. (12%)

5. Show that when the van der Waals equation of state is written in the virial form, $\frac{PV}{RT}=1+\frac{B}{V}+\frac{C}{V^2}+\cdots\cdots$ the second virial coefficient is given by $B=b-\frac{a}{RT}$. (10%)

試題隨卷繳回