1. please prove the following thermodynamic equation (20%)

$$dS = \frac{1}{T}\left(C_P - \frac{TV\alpha^2}{\beta}\right)dT + \frac{\alpha}{\beta}dV$$

where S=entropy V=volume
C_P=heat capacity at constant pressure
α=coefficient of thermal expansion
β= coefficient of compressibility, T=temperature of a system

2. Please use the thermodynamic second law to prove the conditions of thermodynamic equilibrium in a unary system with two phases (α,β)
$T^\alpha=T^\beta$ $P^\alpha=P^\beta$ and $\mu^\alpha=\mu^\beta$
where T= temperature P=pressure and μ=chemical potential of a system (20%)
3. Calculate the pressure required to apply to graphite at 298^0K in order to cause the transformation of graphite to diamond.
Note graphite is the stable form at 298^0K and 1 atm pressure.
Given data
$H_{298\,K(graphite)}-H_{298\,K\,(diamond)}$=-1900 J
$S_{298\,K\,(graphite)}$=5.73 J/K
$S_{298\,K\,(duamond)}$=2.43 J/K
The density of graphite at 298 K is 2.22 g/cm^3
The density of diamond at 298 K is 3.515 g/cm^3 (20%)
4. Copper and fold form solid solutions between 410 and 889^0C, at 600^0C the excess molar Gibb's free energy of formation of the solid solution is given by
G^{xs}=-28280 $X_{Au}X_{Cu}$ J
Calculate the partial pressures of Cu exerted by the solid solution of X_{Cu}=0.5 at 600^0C
Given data $\ln p^0_{Cu}(atm) = -\frac{40920}{T} - 0.86\ln T + 21.67$ (20%)
5. (a)Please write out the expressions for the partial molar free energies of an ideal solution composed of three components, A, B, and C.
(b) Please write out the partial molar free energies and excess free energies of mixing of a non-ideal solution composed of three components, A, B, and C using a model based on activities.
(20%)

試題隨卷繳回