# 國立成功大學
# 111學年度碩士班招生考試試題

編　號：92

系　所：材料科學及工程學系

科　目：材料熱力學

日　期：0219

節　次：第 2 節

備　註：可使用計算機

編號： 92

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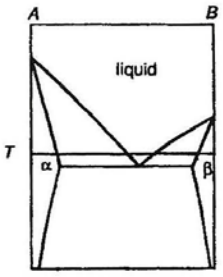
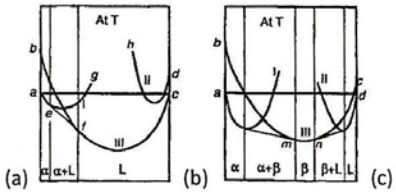
※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

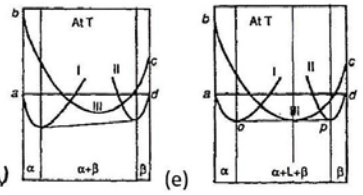
材料熱力學共 20 題選擇題，每題答對得 5 分，答錯倒扣 1 分；滿分 100 分，倒扣至 0 分為止。

1. The chemical potential of an element in a solution is usually a measurement of the partial molar (a) volume; (b) entropy; (c) free energy; (d) heat capacity; (e) density of the element in the solution.
2. When two same chambers are separated by a partition, each chamber has 1 mole of A, after removing the partition, what will happen to the change anything. Thus, the total entropy change is (a) $\Delta S = 0$; (b) $\Delta S = R \text{ Log } [2]$; (c) $\Delta S = 2 R \text{ Log } [2]$; (d) $\Delta S = 0.5 R \text{ Log } [2]$; (e) none of above is correct.
3. Which of the following expressions is correct? (a) $\Delta H^{M,ideal} > 0$ (b) $\Delta V^{M,ideal} = 0$ (c) $\Delta H^{M,ideal} < 0$ (d) $\Delta G^{M,ideal} = 0$ (e) $\frac{\Delta G^{M,ideal}}{\Delta H^{M,ideal}} = \Delta S^{M,ideal}$.
4. The enthalpy of PbO is -219 kJ/mole at 298 K. $\Delta c_p$ of the reaction $Pb+0.5O_2 \rightarrow PbO$ is 10 J/mol-K for T=298 –500 K. What is $\Delta H$ for the reaction at 398 K? (a) $-10 ln(398/298)$ J; (b) 1000 J; (c) -218 kJ; (d) -220 kJ; (e) not available from the provided data.
5. Gibbs-Duhem equation is often used to determine (a) activation energy; (b) activity; (c) heat conductivity; (d) diffusivity; (e) work.
6. For which of the following conditions, the system would reach equilibrium at its maximal entropy? (a) Constant temperature and pressure, (b) constant internal energy and volume, (c) constant temperature and volume, (d) constant volume and pressure, (e) constant Gibbs free energy and temperature.
7. The maximum work that can be done by a reversible heat engine operating between 350 and 300K if 1000J is absorbed at 350K is (a) 143 J (b) 1430 J (c) 14300J (d) 143 kJ (e) 1430 kJ.
8. Consider the phase diagram of a binary system A-B on the right. Which of the following is the corresponding molar Gibbs free energies of mixing?




(a) (b) (c)




(d) (e)

9. Which substance has lowest absolute entropy? (a) liquid silver; (b) hydrogen gas; (c) solid iron; (d) diamond; (e) solid gold.

10. For the melting process of most materials, the volume will increase after melting. For these materials, if the ambient pressure increases, the melting point would (a) increase (b) decreases (c) no change (d) be all possible for the above answer (e) none of above is correct.

11. $CO_2$ has the following vibrational degrees of freedom: 1388, 667.4 (doubly degenerate), and 2349 $cm^{-1}$. The total vibrational partition function for this molecule at 1000 K is? Hint:

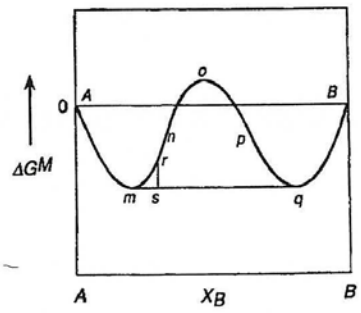
$q = \sum_n e^{-\beta \varepsilon_n} = 1 + e^{-\beta hc\bar{\nu}} + e^{-2\beta hc\bar{\nu}} + e^{-3\beta hc\bar{\nu}} \ldots = \frac{1}{1 - e^{-\beta hc\bar{\nu}}}$, k = Boltzmann's constant $1.381 \times 10^{23}$ J $K^{-1}$. h = $6.62607004 \times 10^{-34}$ $m^2$ kg / s. c= $3 \times 10^8$ m / s. (a) 3.17 (b) 8.56 (c) 13.63 (d) 17.45 (e) 22.06

12. In the phase diagram of $H_2O$ plotting as pressure vs temperature, the slope for solid and liquid two-phase line is different from many other materials, the reason is simply because (a) the water has high surface energy (b) the water is polar molecule (c) the density of water is larger than ice (d) the volume of water is larger than that of ice having the same weight (e) none of above is correct.

13. An ideal gas at 300 K has a volume of 15 liters at a pressure of 15 atm. What is the work done by the system when the gas undergoes a reversible adiabatic expansion to a pressure of 10 atm? The constant volume heat capacity of the gas, $c_v$, has the value of 1.5R (R=gas constant). (a) 9244 J; (b) 1011 J; (c) 5130 J; (d) 561 J; (e) -561 J.

14. The 1wt% standard state was established basing on (a) Raoultian's law (b)Gibbs-Duhem equation (c) Henry's law (d)Regular solution (e)Ellingham diagram.

15. Considering the molar Gibbs free energies of missing of binary system A-B (see figure on the right), we know this system: (a) has eutectic composition at point O. (b) has no stable phases because $\alpha > \alpha_{critical}$. (c) exhibits a miscibility gap. (d) is a Raoultian solution. (e) causes spinodal decomposition between curves **Amn** and **pqB.**




16. At the normal boiling temperature of iron, $T_b$=3330 K, the rate of change of the vapor pressure of liquid iron with temperature is $3.72 \times 10^{-3}$ atm/K. Calculate the molar latent heat of boiling of iron at 3330 K. [Assuming that the iron vapor behaves as an ideal gas] (a) 12.38 kJ; (b) 12.38 J; (c) 3378 liter-atm; (d) 3378 J; (e) 245 kJ.

17. In the pressure- temperature phase diagram for all one component, what are the values of slope solid-vapor and liquid- vapor two-phase lines; and what is the main reason (a) negative; the volume changing from liquid or solid to vapor is always positive (b) positive; the volume changing from liquid or solid to vapor is always positive (c) negative; the volume changing from liquid or solid to vapor is always negative (d) positive; the volume changing from liquid or solid to vapor is always negative (e) none of above is correct.

18. Enthalpy is equivalent to heat when (a) pressure is constant; (b) volume is constant; (c) temperature is constant; (d) entropy is constant; (e) activation energy is constant.

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19. Consider a collection of 10,000 particles with each particle capable of populating one of three energy levels having energies, 0, ε, and 2ε with a total available energy of 5000 ε. Treat the number of particles in the highest energy level ($N_3$) as the independent variable, the number of particles in the intermediate ($N_2$) and lowest ($N_1$) energy levels. Under the constraint that the total number of particles and total energy be constant, configurational entropy has a maximum value at $N_3$ = (a) 1200 (b) 1600 (c) 2000 (d) 2400 (e) 2800.

20. Silver is more noble against oxidation than copper. Which of the followings is true? (a) At atmosphere pressure, the critical temperature at which pure $Ag_2O_{(s)}$ decomposes to $Ag_{(s)}$ and $O_{2(g)}$ is higher than that pure $Cu_2O_{(s)}$ decomposes to $Cu_{(s)}$ and $O_{2(g)}$. (b) The slopes of the Ellingham line for Ag and Cu are in the same order of magnitude. (c) The intercept of the Ellingham line for Ag is more negative than that for Cu. (d) Raising temperature would promote oxidation of Cu. (e) Partial pressure of oxygen gas does not affect the reduction temperature of Ag.