國立成功大學 105 學年度碩士班招生考試試題

系　　所：材料科學及工程學系

考試科目：材料熱力學　　考試日期：0227，節次：2

※ 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。

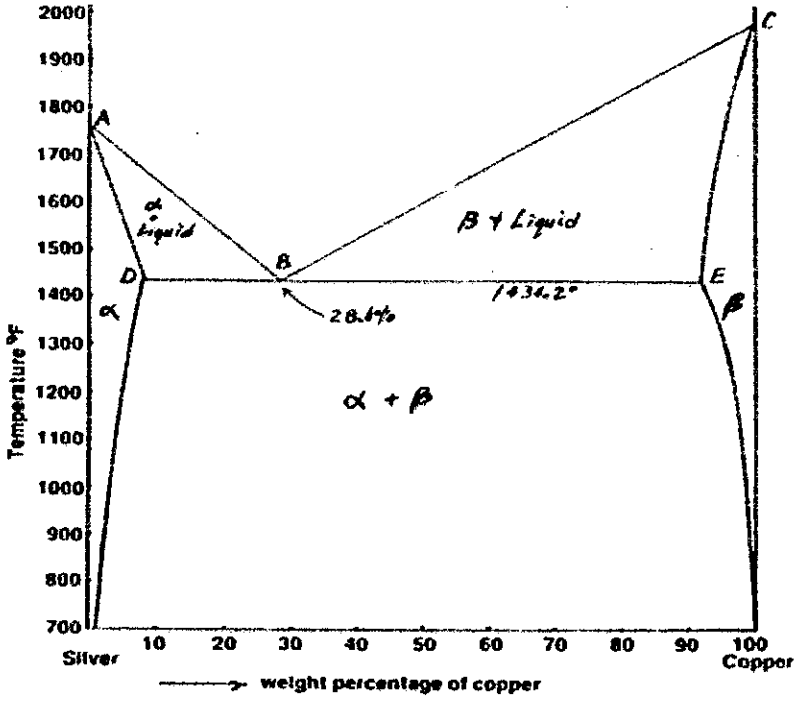
1. For a gas following the van der Waals equation of state (as given below), the value of ΔH_{evap} (molar heat of evaporation) as the temperature approaches T_{cr} will be, $\left(P + \frac{a}{V^2}\right)(V - b) = RT$

(a) 0　　(b) >0　　(c) <0　　(d) varying according to the quantity　　(e) unpredictable

2. Which of the following expression is correct?

(a) $d\bar{G} = \bar{V}_i\, dP$　　(b) $d\bar{G}_i = \bar{V}_i\, dP$　　(c) $d\bar{G}_i = \bar{V}\, dP$　　(d) $\bar{G}_i = \bar{V}_i\, dP$　　(e) $dG = \bar{V}_i\, dP$

3. The following is the binary phase diagram of Cu and Ag. Which statement is correct?



(a) B has three phases co-existing　　(b) C is the boiling point of Cu　　(c) α phase is 100% Ag

(d) D is eutectic point　　(e) Cu and Ag are completely miscible.

4. Continue from Question 3, what is (are) the phase(s) of 70Cu-30Ag at 1450°F, 1 atm?

(a)α, β　　(b) liquid　　(c) liquid, vapor　　(d) liquid,β　　(e) solid.

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5. A Carnot heat engine operates between reservoirs at 1200°C and 200°C. The isothermal process at the hotter reservoir consists of an expansion (reversible) from an initial pressure of 5 x 105 N/m^2 to 4 x 104 N/m^2. Assuming that the working substance is a kilomole of ideal gas. What is the efficiency of the heat engine?

(a) 98%　(b) 88%　(c) 78%　(d) 68%　(e) 58%

6. For a system at constant T and V, which of the following is the criterion of equilibrium?

(a) Minimum Helmholtz free energy,　(b) maximum entropy,　(c) minimum internal energy,

(d) enthalpy is equal to zero,　(e) Gibbs free energy is equal to zero.

7. The infinitesimal variation of internal energy with entropy at constant volume defines

(a) enthalpy,　(b) temperature,　(c) internal energy,　(d) heat capacity,　(e) entropy.

8. Which of the following is not a state function?

(a) PV work　(b) entropy　(c) angular moment　(d) internal energy　(e) temperature

9. The EMF of the cell $Ag_{(s)} \mid AgCl_{(s)} \mid Cl_{2(g,1atm)}, Pt$ is found to be

$\varepsilon(volts) = 0.977 + 5.7\times10^{-4}(350-t) - 4.8\times10^{-7}(350-t)^2$ in the temperature range t = 100°C to t = 450°C. The value of ΔCp for the cell reaction is _____ J K-1mole-1.

(a) 0.145　(b) -2.361　(c) 63.25　(d) 1.562　(e) -0.093

10. When compressing a liter of an Van der Waals gas to 0.5 liter by the three different reversible processes (1) isothermally, (2) adiabatically, and (3) isobarically, the work needed would be

(a) W1>W2>W3,　(b) W2>W1>W3,　(c) W3>W1>W2,　(d) W1>W3>W2,　(e) W2>W3>W1.

11. Assuming A and B forms Henrian solution behavior with very strong negative deviation, which one of the following statement is correct:

(a) there is strong attractive force between A and B

(b) there is strong repulsion force between A and B

(c) the partial pressure of each component is much higher than the Raoultian solution

(d) there is attraction force between A and B is same as A-A and B-B

(e) none of above is correct.

12. From, Co(s) + (1/2) O2(g) = CoO(s) , DG° = -233,900 + 71.85 T J (298K-2000K), when the mixture of Co and CoO equilibrates at 800℃, what would you do if you need to obtain more CoO,
(a) lower the temperature to below 800℃ (b) increase the temperature to above 800℃
(c) added NiO into the mixture enthalpy (d) remove some oxygen (e) decrease the oxygen pressure

13. When you plot a P-T phase diagram for a unique substance, the slope for liquid solid boundary on its P-T diagram is negative, it indicates
(a) the density of solid is higher than liquid (b) there is volume increase when it melts
(c) the solid will sink in liquid (d) it needs heat to solidify
(e) there is volume expansion when it solidifies.

14. Which of the following relations is incorrect?
(a) $C_p = T\left(\frac{\partial S}{\partial T}\right)_P$ (b) $C_p = \left(\frac{\partial H}{\partial T}\right)_P$ (c) $C_V = T\left(\frac{\partial S}{\partial T}\right)_V$ (d) $C_V = \left(\frac{\partial H}{\partial T}\right)_V$ (e) $C_V = \left(\frac{\partial U}{\partial T}\right)_V$

15. For most of non-metallic solids, the specific heat C_v at extremely low temperature (i.e. $T \rightarrow 0$ K) is proportional to:
(a) T (b) T^2 (c) T^3 (d) T^4 (e) T^5

16. A 1-dimensional classic harmonic oscillator at temperature T has an average energy equal to:
(a) $kT/2$ (b) kT (c) $3kT/2$ (d) $2kT$ (e) $5kT/2$

17. Which of the following statement is correct for constant-volume heat capacity (C_v)?
(a) C_v of one mole gas equals 3R/2
(b) the internal energy of a material is proportional to its C_v
(c) the enthalpy of a material is proportional to its C_v
(d) C_v is proportional to the change of entropy to temperature
(e) C_v is a constant value for all elemental solids (e. g. Cu, Au, Al, Fe ...)

18. A binary *A-B* solution behaves ideally both in liquid and solid and exhibits complete mutual solid/liquid solubility. At a temperature which is between melting point of *A* and melting point of *B*, the activities of component *B* will be
(a) $a_B = X_A$ (b) $a_B = X_B$ (c) $a_B = X_B/X_A$ (d) a_B =constant (e) a_B may have two values for each of X_B.

19. An ideal gas at 300 K has a volume of 15 liters at a pressure of 15 atm. When the gas undergoes a reversible isothermal expansion to a pressure of 10 atm, the change in internal energy of the system is
(a) 0 (b) 980 J (c) 9244 J (d) 273 J (e) 1033 J

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20. What is a thermodynamic parameter?

(a) heat conductivity　(b) diffusivity　(c) activation energy　(d) dislocation　(e) heat capacity