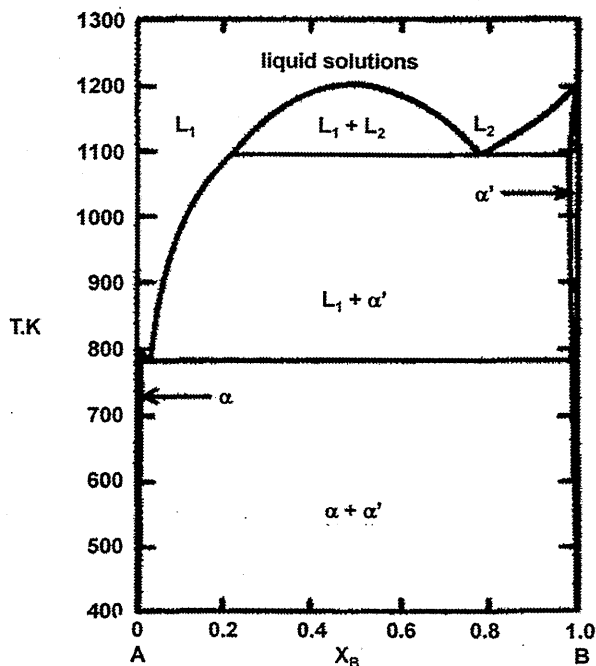


※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。材料熱力學共 20 題選擇題，每題答對得 5 分，答錯倒扣 1 分；滿分 100 分，倒扣至 0 分為止。

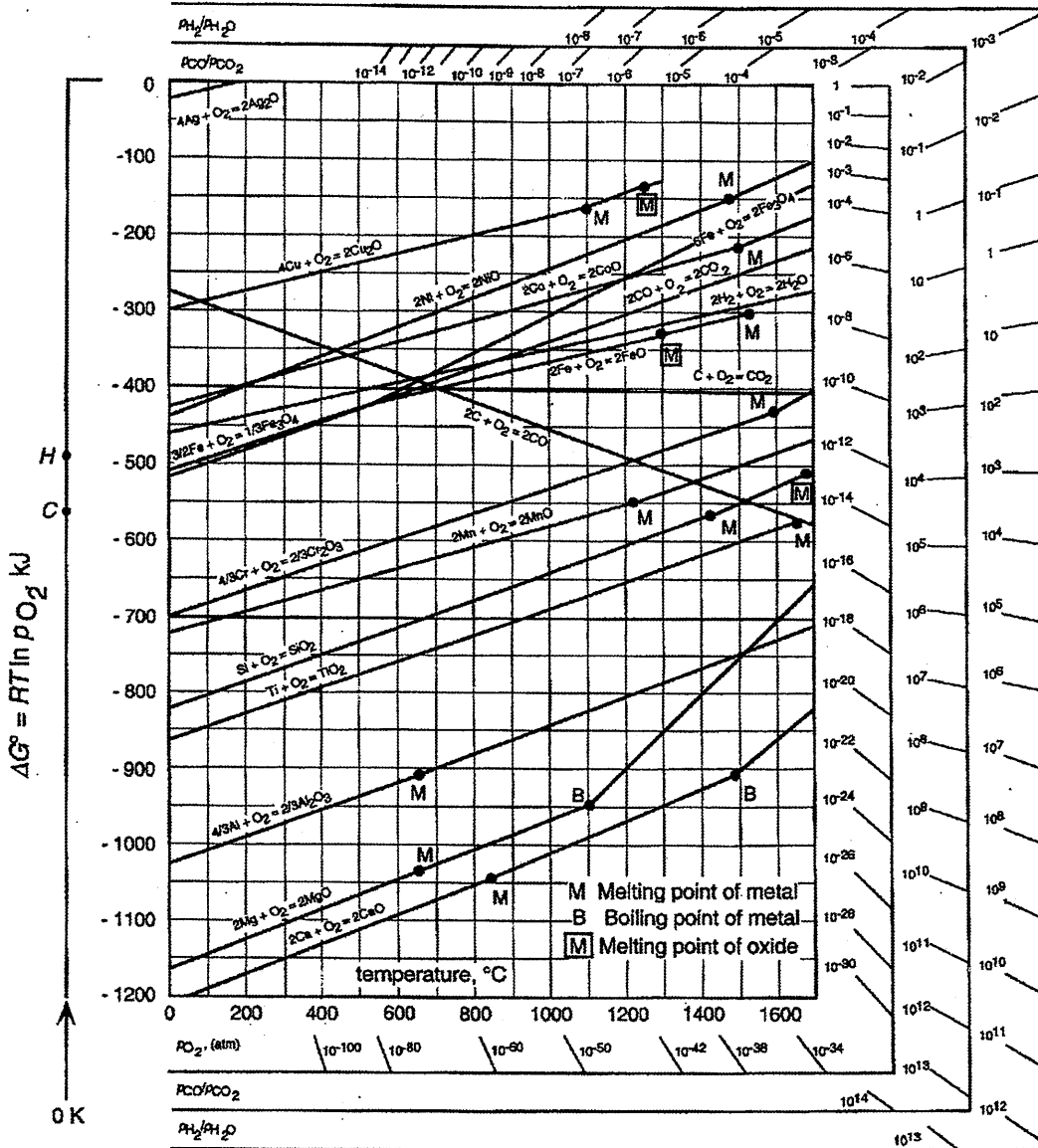
1. Which process is closest to a thermodynamically reversible process? (a) explosion of a bomb (b) forest fire (c) melting of ice cream at room temperature (d) freezing of water at 0°C (e) burning of a candle
2. Which substance has lowest absolute entropy? (a) liquid silver (b) hydrogen gas (c) solid iron (d) diamond (e) gold
3. The infinitesimal variation of Gibbs free energy with temperature at constant pressure defines (a) volume (b) entropy (c) enthalpy (d) internal energy (e) heat capacity
4. To formulate a more realistic gas equation, the ideal gas equation has to be modified based on some facts. Which of the following is NOT one of them? (a) real gas molecules interact with one another (b) real gas molecules has finite volume (c) real gas has internal energy (d) real gas has defects (e) all of the above.
5. About fugacity, f , which of the following is True. (a) $f \rightarrow P$ as $T \rightarrow 0$ (b) $f \rightarrow 0$ as $P \rightarrow 1$ (c) $f \rightarrow 1$ as $P \rightarrow f$ (d) $f \rightarrow P$ as $P \rightarrow 0$ (e) None of the above.
6. In the A-B system of regular solution, the assumption of random mixing is based on the following assumption, which is True? (a) atoms have no interactions (b) A-B bond energy is not far away from the average of A-A and B-B bond energies as in the pure components (c) Raoultian behavior for A, and Henrian behavior for B (d) all of the above (e) none of the above.
7. In a regular solution, the reason that the Gibbs free energy of mixing curve between the spinodal compositions has no physical significance is because (a) spinodal is inconsistent (b) the activity has to be positive (c) the criterion for stability requires that $\frac{\partial a_i}{\partial X_i} > 0$ (d) all of the above (e) none of the above.
8. 'High-entropy' alloys usually involve quinary (5-component) materials systems. What of the following statements on a quinary system is true? (a) Maximum number of co-existing phases is five, (b) a triple point of solid, liquid and vapor phases is invariant, (c) The alloy with equal molar composition possesses the lowest Gibbs free energy, (d) supercritical state may exist, (e) eutectic points with a liquid phase and two solid phases are invariant.
9. What of the followings is true? (a) A binodal curve is equivalent to an immiscible gap. (b) An ideal gas may form a supercritical fluid when the temperature and pressure are both above the critical point. (c) The fugacity of a phase can be directly measured with experiments. (d) An reversible adiabatic process is an isentropic process and vice versa, (e) None of the above is applicable.
10. When the face-centered cubic (fcc) phase is in equilibrium with the body-centered cubic (bcc) phase in

a binary system at constant temperature and pressure, what of the followings is true? (a) $a_A^{fcc} = a_B^{bcc}$, (b) $a_A^{fcc} = a_A^{bcc}$, (c) entropy of the system reaches the maximum, (d) Gibbs free energy of the fcc phase reaches its minimum, (e) none of the above is applicable.

11. According to the A-B phase diagram, what of the following is true? (a) Pure A and pure B elements are with the different crystal structures at 600K. (b) The α phase is with a positive mixing enthalpy, that the elements A and B attract each other in the solid solution. (c) The Gibbs free energy of the α phase can be described with a regular solution model with a negative excess energy. (d) The coexistence of the α , L_1 , and L_2 phases is a meta-stable invariant at the given pressure. (e) None of the above is correct.



12. When performing a thermochemical measurement on a binary system, only the data of one component are needed because the other can be derived based which of the followings? (a) Maxwell relations, (b) Henry's law, (c) Gibbs-Duhem equation, (d) Gibbs-Helmholtz equation, (e) Boltzmann equation.
13. If Cu and Ni form a Raoultian solution, which range of value in the following is the activity of Cu, a_{Cu} , at $X_{Cu} = 0.36$? (a) $1 \geq a_{Cu} > 0.5$, (b) $0.5 \geq a_{Cu} > 0$, (c) 0, (d) $0 > a_{Cu} \geq -0.5$, (e) $-0.5 > a_{Cu} \geq -1$.
14. Based on the Ellingham diagram, what of the followings is true? (a) Magnesium (Mg) is more noble against oxidation than calcium (Ca). (b) At the atmosphere pressure, the pure cobalt oxide $CoO_{(s)}$ can be reduced to pure $Co_{(s)}$ via heating. (c) At pure oxygen ($P_{O_2}=1$ atm) atmosphere, the pure silver oxide $Ag_2O_{(s)}$ very stable so it is impossible to be decomposed into $Ag_{(s)}$ and $O_{2(g)}$. (d) Chromium (Cr) can reduce Manganese oxide (MnO) at an appropriate atmosphere and temperature. (e) None of the above is correct.



15. In the phase diagram of H_2O system, pressure is plotted as a function of temperature, the relationship between dP/dT and the volume change/latent heat may be derived from (a) van der Waals equation (b) Laws of thermodynamics (c) Clausius-clapeyron equation (d) Gibbs-Duhem equation (e) Laws of Mass action
16. For solid, liquid and vapor states of H_2O , Gibbs free energies of various states, G , plotted as function of temperature T , at constant pressure, you will find that the vapor phase shows (a) curve with steepest negative slope (b) near horizontal line (c) curve with steepest positive slope (d) with slightly positive slope (e) none of above is correct
17. The number of ways in which the particles can be distributed in space is related to the concept of the thermodynamic property: (a) thermal entropy (b) degree of mixed-up-ness (c) enthalpy (d) configuration entropy (e) formation energy

18. When a piece of steel A with temperature of 30°C and a piece of aluminum B with temperature of 50°C were put in contact side by side, which of the following is true (a) the Al atom will diffuse into steel A (b) configuration entropy will not increase (c) total entropy will not be affected (d) thermal entropy will not increase. (e) the equilibrium temperature will definitely be 40°C
19. If the pressure of a system remains unchanged during a heating process, the product of heat capacity and temperature difference is equal to (a) the change of internal energy (b) entropy change (c) enthalpy change (d) volume change (e) weight change
20. During the phase change of one-component system, G may be plotted as a function of pressure, or function of temperature, if there is one curve with a straight line with positive slope, which one in the following is **NOT TRUE**: (a) this curve may represent a solid phase (b) this curve may represent a liquid phase (c) this curve should be G vs T curve (d) this curve should be G vs P curve (e) slope has physical meaning of volume