國立臺北科技大學 112 學年度碩士班招生考試

系所組別：3401 資源工程研究所

第一節　基礎熱力學　試題（選考）

注意事項：

1. 本試題共 20 題，每題 5 分，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Which statement is NOT true?
   (a) The heat capacity is used when the addition of heat to or withdrawal of heat from the system produces a temperature change.
   (b) The concept of heat capacity can be used when a phase change is involved.
   (c) The heat capacity is an extensive property.
   (d) If the process is carried out at constant volume, all of the heat added is used to raise the temperature of the system.
   (e) If the process is carried out at constant pressure, in addition to raising the temperature, the heat added is required to provide the work.

2. Which statement is true?
   (a) No work is needed for free expansion.
   (b) The internal energy of a gas is independent of volume.
   (c) The internal energy of a gas is function only of temperature.
   (d) The difference of heat capacities at constant pressure and constant volume is always equal to R.
   (e) For solids, the internal energy is independent of volume.

Two mole of an ideal gas (Cv=3/2R) are contained adiabatically at 30 atm pressure and 298K. The pressure is suddenly released to 10 atm, and the gas undergoes an irreversible adiabatic expansion as a result of which 2000 joule of work are performed.

3. What is the final temperature of the gas after the irreversible expansion?
   (a) 192K　(b) 350K　(c) 218K　(d) 396K　(e)　77K

4. What is the created entropy due to the irreversible process (unit: joules/degree)?
   (a) +3.7　(b) -7.8　(c) +16.3　(d) -27.9　(e) +5.2　(note: ln0.73=-0.31;ln2.19=0.78)

5. Consider the heat entering the constant-temperature heat reservoir at 590K and 1 atm for the freezing process. The enthalpy changes in the lead for the 1 mole of supercooled liquid lead, which spontaneously freezes at 590K and 1 atm, is -4799 joules. What is the entropy changes for the heat reservoir at 590K. (unit: joules/degree)
   (a) 23.55　(b) -23.55　(c) -8.13　(d) 8.13　(e) 0

6. Which statement is NOT correct?
   (a) The equilibrium state of a system is simply the most probable of all its possible states.
   (b) Configuration entropy is related to the number of ways in which the particles themselves can be mixed over the available position in space.
   (c) The relationship between the number of microstates available to the system, Ω, and the entropy of the system is given by $S=k\ln\Omega$.
   (d) The total entropy of a system comprises two contributions: the thermal entropy and the configuration entropy.
   (e) When a system undergoes a change of state during which it performs work and absorb heat, the magnitudes of the quantities work and heat are minimized when the change of state occurs reversibly.

7. Which equation is not equal to Cp-Cv (difference of heat capacities at constant pressure and volume)?
   (a) $V\left(\frac{\partial P}{\partial T}\right)_V + \left(\frac{\partial H}{\partial V}\right)_T \left(\frac{\partial V}{\partial T}\right)_P$　(b) $\left[V - \left(\frac{\partial H}{\partial P}\right)_T\right]\left(\frac{\partial P}{\partial T}\right)_V$　(c) $T\left(\frac{\partial V}{\partial T}\right)_P \left(\frac{\partial P}{\partial T}\right)_V$
   (d) $\left(\frac{\partial H}{\partial T}\right)_P + \left(\frac{\partial H}{\partial T}\right)_V + V\left(\frac{\partial P}{\partial T}\right)_V$　(e) $\left(\frac{\partial H}{\partial T}\right)_P - \left(\frac{\partial U}{\partial T}\right)_V$

The molar volume of Fe is 7.1 cm^3. The isobaric coefficient of thermal expansion is 3×10^{-5} K^{-1}. Assume the volume and the isobaric coefficient of thermal expansion are independent of pressure.

8. What is the increase in the molar enthalpy of Fe resulting from an increase in pressure form 1 to 100 atm at 298K?
   (a)18　(b)27　(c)5　(d)38　(e)71 joules

9. What is the change in the molar Gibbs free energy of Fe resulting from an increase in pressure from 1 to 100 atm at 298K?
   (a)81.5　(b)71.2　(c)65.9　(d)36.2　(e)19.5 joules

注意：背面尚有試題

10. Which of following value is the most close to ΔG^M(T=300K) for the solution with $x_A = 0.3$?
(a) 0 kJ (b) -1.5 kJ (c) -3 kJ (d) -15 kJ (e) -30 kJ

11. By raising the temperature from 300K to 600K, which of the following value is the most close to the change of molar entropy for the solution with $x_A = 0.3$?
(a) 16 J/K (b) 8 J/K (c) 0 kJ/K (d) -8 J/K (e) -16 J/K

12. When an ideal gas undergoes a reversible adiabatic process, which one in the following is correct? ($\gamma = C_p/C_v$, R is the gas constant)
(a)$PV^{\gamma-1}$ =constant (b)TV^{γ}=constant (c)PV^{R}=constant
(d)TV^{R}=constant (e)None of the above

13. When an ideal gas undergoes a reversible isothermal process from V_1 to V_2, which is the work done by the system?
(a)$RTln\frac{V_1}{V_2}$ (b) $RTln\frac{V_2}{V_1}$ (c) $RTln\frac{P_2}{P_1}$ (d) $RTln\frac{P_1V_2}{P_2V_1}$ (e)None of the above

14. In a closed system of constant temperature and constant volume the criterion for equilibrium is:
(a) The Gibbs free energy (G) has its minimum value.
(b) The entropy (S) has its maximum value.
(c) The enthalpy (H) has its minimum value.
(d) The Helmholtz free energy (A) has its minimum value.
(e) None of the above.

15. Which relationship is NOT correct?
(a)$\left(\frac{\partial U}{\partial S}\right)_V = \left(\frac{\partial H}{\partial S}\right)_P$ (b) $\left(\frac{\partial U}{\partial V}\right)_S = \left(\frac{\partial A}{\partial V}\right)_T$
(c) $\left(\frac{\partial H}{\partial P}\right)_S = \left(\frac{\partial G}{\partial P}\right)_T$ (d) $\left(\frac{\partial A}{\partial T}\right)_V = \left(\frac{\partial G}{\partial T}\right)_P$
(e)None of the above.

16. Which relationship is correct?
(a)$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$ (b) $\left(\frac{\partial T}{\partial P}\right)_S = -\left(\frac{\partial V}{\partial S}\right)_P$
(c) $\left(\frac{\partial S}{\partial V}\right)_T = -\left(\frac{\partial P}{\partial T}\right)_V$ (d) $\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$
(e)None of the above.

17. Which one is the van der Waals equation? (a and b positive values.)
(a)$\left(P + \frac{a}{V^2}\right)(V - b) = RT$ (b) $\left(P - \frac{a}{V^2}\right)(V + b) = RT$
(c) $\left(P + \frac{a}{V^2}\right)(V + b) = RT$ (d) $\left(P - \frac{a}{V^2}\right)(V - b) = RT$
(e) None of the above.

18. The melting temperature of ice is 0°C at 1 atm. When the pressure changes to 10 atm, the melting temperature of ice is:
(a) 0°C (b) < 0°C (c) > 0°C (d)Depending on other parameters
(e) None of the above.

19. When a three-component system is in equilibrium (pressure is fixed at 1 atm) with zero degree of freedom, there must coexist
(a) one phase (b) two phases (c) three phases (d) four phases (e) None of the above.

20. At constant temperature, the change of molar Gibbs free energy (G) of a nonideal gas can be described as
(a) dG = RTd(lnP) (P is pressure) (b) dG = RTd(lnV) (V is volume)
(c) dG = VdP (d) dG = PdV (e) None of the above.