國立臺灣科技大學

114學年度碩士班招生

試題

系所組別：0410材料科學與工程系碩士班甲組

科　　目：物理化學

<<504101>>

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(總分為 100 分；所有試題務必於答案卷內頁依序作答)

1. (40 %) multiple choice question:

(1) (4 %) The Zeroth Law of Thermodynamics states that:

a) Energy can neither be created nor destroyed.

b) If two systems are each in thermal equilibrium with a third system, they are in thermal equilibrium with each other.

c) Entropy of a system always increases.

d) The heat transfer depends on temperature difference.

(2) (4 %) The first law of thermodynamics is a statement of:

a) Conservation of momentum　　b) Conservation of mass

c) Conservation of energy　　d) Conservation of entropy

(3) (4 %) Which of the following processes always has zero work done?

a) Isobaric　b) Isochoric　c) Adiabatic　d) Isothermal

(4) (4 %) For an irreversible process, the total entropy change is:

a) Positive　b) Zero　c) Negative　d) Equal to the heat exchanged

(5) (4 %) The Second Law of Thermodynamics states that:

a) Entropy of an isolated system always decreases

b) Entropy has no relationship with energy

c) Entropy is proportional to temperature

d) Entropy of an isolated system always increases or remains constant

(6) (4 %) When compressibility factor $Z > 1$, it implies that:

a) The gas is ideal　　b) The gas exhibits attractive forces

c) The gas exhibits repulsive forces　　d) The gas is incompressible

(7) (4 %) For a real gas at high pressure, the deviation from ideal gas behavior is primarily due to:

a) Increased molecular attraction　　b) Decreased temperature

c) Negligible interactions　　d) Finite molecular volume

(8) (4 %) For a real solution, a positive deviation from Raoult's Law indicates:

a) Weak interactions between solute and solvent　　b) Ideal solution behavior

c) Strong interactions between solute and solvent　　d) Complete immiscibility

(9) (4 %) The critical point on a phase diagram is the:

a) Point where solid, liquid, and gas phases coexist

b) Point beyond which the liquid and gas phases are indistinguishable

c) Temperature and pressure where all phases exist in equilibrium

d) Lowest temperature at which a substance can exist as a liquid

(10) (4 %) The standard enthalpy of formation (ΔH°_f) of an element in its most stable form is:

a) Always positive　　b) Always negative

c) Always zero　　d) Depends on the reaction

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2. (10 %) Using

$$\left(\frac{\partial H}{\partial P}\right)_T = -C_P\mu_{J-T} = \left[\left(\frac{\partial U}{\partial V}\right)_T + P\right]\left(\frac{\partial V}{\partial P}\right)_T + V$$ and the equation of state for a gas $\mathrm{P(V}-b\mathrm{)}=RT$

show that $\mu_{J\text{-}T} = -\dfrac{b}{C_P}$

Where $\mu_{J\text{-}T}$, H, U, P, T, V, C_P, and b are Joule-Thomson coefficient, enthalpy, internal energy, pressure, temperature, volume, heat capacity at constant pressure, parameters of the finite size of molecules, respectively.

3. (25%) Assuming that silver-gold alloy is a random mixture of gold and silver atoms, please calculate the increase in entropy when 10 gram of gold are mixed with 20 gram of silver to form an ideal homogeneous alloy. The atomic weights of Au and Ag are, respectively, 198 and 107.9.

4. (25 %) Measurement of the saturated vapor pressure of liquid $NdCl_5$ gives 0.3045 atm at 478 K and 0.9310 atm at 520 K. Calculate the normal boiling point temperature of $NdCl_5$.