

國立勤益科技大學九十六學年度研究所一般招生筆試試題卷

所別：化工與材料工程系碩士班 組別：材料、化工組

科目：物理化學

准考證號碼：□□□□□□□□ (考生自填)

考生注意事項：

一、考試時間 100 分鐘。

二、可使用計算機。

1. The composition in volume percent of dry air is 78.084 % N₂, 20.948 O₂, 0.934 % Ar, 0.031 % CO₂ and other gases 2.7X10⁻³ %. What is the partial pressure of each of the first four gases listed at a total pressure of 1 atmosphere? (10 point)
2. One mole of supercooled water at -10°C and 1 atm pressure turns into ice. Calculate the entropy change in the system and in surroundings and the net entropy change? (C_{p,m(water)}=75.3JK⁻¹mol⁻¹, C_{p,m(ice)}=37.7JK⁻¹mol⁻¹, ΔH_{fus(ice)}=6.02JKmol⁻¹) (10 point)
3. Find the osmotic pressure of a solution of 5.00g of glucose in enough water to make 1.000L of solution. (glucose, M=180.16 gmol⁻¹) (10 point)
4. The molar enthalpy change of vaporization of water is 40.67 KJ/mol. (a). Find the boiling point elevation constant for water. (b). Find the boiling temperature at 1.00 atm of a solution of sucrose with 10.00 g of sucrose in 1.000kg of water. (sucrose, C₁₂H₂₂O₁₁, M=342.2 g/mol). (10 point; 5 point/ each 1)
5. (a) Find the height to which water at 20°C rise in a capillary tube of diameter 7.0cm. (b) Assuming a contact angle of 180°, calculate the distance to which the mercury meniscus is depressed in a glass capillary if radius 1.00 mm. (10 point; 5 point/ each 1)

Appendix surface Tension Values Table

Substance	In Contact With	Temperature/°C	Value/NM ⁻¹
Glycerol	air	20	0.0634
Gold	H ₂ , Ar	1120	1.128
Mercury	air	20	0.4355
Water	air	20	0.07275

6. (a) The half-life of the first-order decay of radioactive ¹⁴C is about 5720 years. Calculate the rate constant for the reaction. (b) The natural abundance of ¹⁴C isotope is 1.1 x 10⁻¹³ mol % in living matter. Radiochemical analysis of an object obtained in an archaeological excavation shows that the ¹⁴C isotope content is 0.89 x 10⁻¹⁴ mol %. Calculate the age of the object. State any assumptions. (10 point; 5 point/ each 1)
7. When the concentration of A in the reaction A → B was changed from 1.2 M to 0.60 M, the half-life increased from 2.0 min. to 4.0 min. at 25°C. Calculate (a) the order of the reaction, and (b) the rate constant. (10 point; 5 point/ each 1)
8. Which of the following has a higher chemical potential? If neither, answer "same". (a) H₂O_(s) or H₂O_(l) at water's normal melting point, (b) H₂O_(s) at -5°C and 1 bar or H₂O_(l) at -5°C and 1 bar. (10 point; 5 point/ each 1)
9. Superheated water is water heated above 100°C without boiling. As for supercooled water, superheated water is thermodynamically unstable. Calculate the values of (a) ΔS_{sys}, (b) ΔS_{surr}.

(c) ΔS_{univ} and (d) Q_{surr} when 1.5 moles of superheated water at 110°C and 1.0 atm are converted to steam at the same temperature and pressure. (The molar enthalpy of vaporization of water is 40.79 kJ/mol , and the molar heat capacities of water and steam in the temperature range $100 - 110^\circ\text{C}$ are 75.5 J/K mol and 34.4 J/K mol , respectively.) (10 point; 2.5 point/each 1)

10. Calculate the density of HBr in g/L at 733 mmHg and 46°C . Assume ideal-gas behavior. (H:1.008; Br:79.9) (10 point)