

國立臺北科技大學 105 學年度碩士班招生考試

系所組別：3520 化學工程與生物科技系化學工程碩士班乙組

第二節 物理化學 試題

第一頁 共一頁

注意事項：

1. 本試題共[7]題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
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. From the data given in the following table construct a complete temperature-composition diagram for the system ethanol-ethyl acetate for 101.3 kPa. A solution containing 0.8 mole fraction of ethanol, EtOH, is distilled completely at 101.3 kPa. (diagram 10%)

x_{EtOH}	y_{EtOH}	B.P., °C	x_{EtOH}	y_{EtOH}	B.P., °C
0	0	77.15	0.563	0.507	72.0
0.025	0.070	76.7	0.710	0.600	72.8
0.100	0.164	75.0	0.833	0.735	74.2
0.240	0.295	72.6	0.942	0.880	76.4
0.360	0.398	71.8	0.982	0.965	77.7
0.462	0.462	71.6	1.000	1.000	78.3

- (a) What is the composition of the first vapor to come off? (3%)
 - (b) That of the last drop of liquid to evaporate? (3%)
 - (c) What would be the values of these quantities if the distillation were carried out in a cylinder provided with a piston so that none of the vapor escapes? (3%)
2. For the reaction: $\text{Fe}_2\text{O}_3(\text{s}) + 3 \text{CO}(\text{g}) \rightleftharpoons 2 \text{Fe}(\text{s}) + 3 \text{CO}_2(\text{g})$
the following values of equilibrium constant K are known.

$T / ^\circ\text{C}$	250	1000
K	100	0.0721

At 1120°C for the reaction $2 \text{CO}_2(\text{g}) \rightleftharpoons 2 \text{CO}(\text{g}) + \text{O}_2(\text{g})$, $K = 1.4 \times 10^{-12}$.
What equilibrium partial pressure of O_2 would have to be supplied to a vessel at 1120°C containing solid Fe_2O_3 just to prevent the formation of Fe? (15%)

3. Three moles of an ideal gas ($C_{V,m} = 3/2 R$) expand isothermally and reversibly from 0.1 to 0.3 m³ at 25°C.

(a) Calculate ΔU , ΔH , ΔS , ΔG , ΔA , w , and q for this system. (7%)

(b) If the expansion is carried out irreversibly by allowing the gas to expand into an evacuated container, what are the values of ΔU , ΔH , ΔS , ΔG , ΔA , w , and q ? (7%)

4. Given $\Delta G^\circ = 49.4 \text{ kJ mol}^{-1}$ for



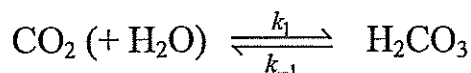
calculate corresponding $\Delta G'^\circ$ at pH 7 and 25°C and 0.2 mol dm⁻³ ionic strength. The pK values that are needed are: for ATP, pK₁ = 6.95; for ADP, pK₁ = 6.88; for AMP, pK₁ = 6.45; for pyrophosphate, pK₁ = 8.95 and pK₂ = 6.12. (10%)

5. Electrons are accelerated by a 1000-V potential drop.

(a) Calculate the de Broglie wavelength. (6%)

(b) Calculate the wavelength of the X-rays that could be produced when these electrons strike a solid. (6%)

6. For the reaction



where the parentheses indicate that H₂O is not included in the equilibrium constant expression or in the rate equation, the following data were obtained: $\Delta H^\circ = 4730 \text{ J mol}^{-1}$ and $\Delta S^\circ = -33.5 \text{ J K}^{-1} \text{ mol}^{-1}$. At 25°C, $k_1 = 0.0375 \text{ s}^{-1}$ and at 0°C, $k_1 = 0.0021 \text{ s}^{-1}$. Assuming that ΔH° and ΔS° are independent of temperature in this range.

(a) calculate the equilibrium constant and k_{-1} values at 25°C and 0°C. (9%)

(b) calculate the activation energies for the forward and backward reactions. (6%)

7. A fatty acid was spread on the surface of water in a Langmuir film balance at 15°C, and the following results obtained:

Area / dm ² μg ⁻¹	0.057	0.282	5.07	10.7	22	111
Surface pressure / N km ⁻¹	30	0.3	0.2	0.1	0.05	0.01

Estimate the molecular weight of the acid and the area per molecule when the film was fully compressed. (15%)