

國立臺北科技大學 102 學年度碩士班招生考試

系所組別：3711 有機高分子研究所甲組

第二節 分析化學 試題 (選考)

第一頁 共一頁

注意事項：

1. 本試題共 9 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. Calculate the absolute standard deviation for the results of the following calculations. Round each result to include only significant figures. The numbers in the parentheses are absolute standard deviations. (10 points total, 5 points each)
(a) $y = [1.73(\pm 0.03) \times 10^{-14}] \div [1.63(\pm 0.04) \times 10^{-16}] = 106.1349693$
(b) $y = [2.145(\pm 0.002)]^{1/4} = 1.210199$
2. Generate equilibrium constant expression for the following reaction. Calculate numerical value for K_{eq} . (10 points)
 $2 \text{Ce}^{4+} + \text{H}_3\text{AsO}_3 + \text{H}_2\text{O} \rightleftharpoons 2 \text{Ce}^{3+} + \text{H}_3\text{AsO}_4 + 2 \text{H}^+ \quad (1\text{M HClO}_4)$
 $(\text{Ce}^{4+} + \text{e}^- \rightleftharpoons \text{Ce}^{3+} \quad E^0 = 1.70 \text{ V})$
 $\text{H}_3\text{AsO}_4 + 2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_3\text{AsO}_3 + \text{H}_2\text{O} \quad E^0 = 0.577 \text{ V})$
3. Determine the transition ranges for Eriochrome Black T in titration of Mg^{2+} at pH 10.0 given (a) that the second acid dissociation constant for the indicator is
 $\text{HIn}^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{In}^{3-} + \text{H}_3\text{O}^+ \quad K_2 = 2.8 \times 10^{-12}$
(b) that the formation constant for MgIn^- is
 $\text{Mg}^{2+} + \text{In}^{3-} \rightleftharpoons \text{MgIn}^- \quad K_f = 1.0 \times 10^7$
, and a detectable color change is observed when $[\text{MgIn}^-]/[\text{HIn}^{2-}]$ changes from 10 to 0.10. (10 points)
4. Calculate the pH of the isoelectric point for $\text{NH}_2\text{CH}_2\text{COOH}$. (10 points)
($K_a = 2 \times 10^{-10}$, $K_b = 2 \times 10^{-12}$ for $\text{NH}_3^+\text{CH}_2\text{COO}^-$, $K_w = 1 \times 10^{-14}$)

5. Define the following terms. (20 points total, 5 points each)
(a) Reversed-phase packing
(b) Doppler broadening
(c) Thermogravimetric analysis (TGA)
(d) Chromophores
6. The wavelength of the fundamental N-H stretching is about $3.0 \mu\text{m}$. What is the force constant for this bond? (10 points)
($N = 14$, $H = 1$, $c = 3 \times 10^{10} \text{ cm/s}$)
7. What is the absorption frequency in a 4.69-T magnetic field of (a) ^{19}F , (b) ^{31}P ? (10 points total, 5 points each)
(magnetogyric ratio $^{19}\text{F} = 2.52 \times 10^8 \text{ radian T}^{-1}\text{s}^{-1}$, $^{31}\text{P} = 1.08 \times 10^8 \text{ radian T}^{-1}\text{s}^{-1}$)
8. Calculate the goniometer setting, in terms of 2θ , required to observe the $L_{\alpha 1}$ line for W at 1.476 \AA when the diffracting crystal is (a) NaCl ($d = 2.820 \text{ \AA}$) (b) Topaz ($d = 1.356 \text{ \AA}$) (10 points total, 5 point each)
9. Discuss the differences between quadrupole ion-trap mass spectrometers and Fourier transform ion cyclone resonance (ICR) mass spectrometers. (10 points)