

國立彰化師範大學 98 學年度碩士班招生考試試題

系所：化學系

科目：無機化學與分析化學

☆☆請在答案紙上作答☆☆

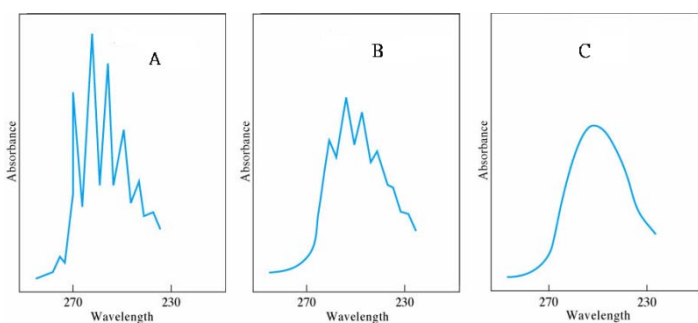
共 2 頁，第 1 頁

PART.1

1. Prepare a molecular orbital energy diagram for O_2^{2-} , showing clearly how the atomic orbital interact to form MOs and filling the electrons in the diagram. (8%)
2. Anhydrous H_2SO_4 and anhydrous H_3PO_4 both gave high electrical conductivities. Why? (5%)
3. When *cis*- OsO_2F_4 is dissolved in SbF_5 , the cation $OsO_2F_3^+$ is formed. The ^{19}F NMR spectrum of this cation shows two resonances, a doublet and a triplet having relative intensities of 2:1. What is the most likely structure of this cation? What is its point group? (8%)
4. On the basis of molecular orbitals, explain why the Mn-O length in $[MnO_4]^{2-}$ is longer than in $[MnO_4]^-$. (5%)
5. A 2.00×10^{-4} M solution of $Fe(S_2CNET_2)_3$ ($Et = C_2H_5$) in $CHCl_3$ at 25 °C has absorption bands at 350 nm ($A = 2.34$), 514 nm ($A = 0.532$), 590 nm ($A = 0.370$), and 1540 nm ($A = 0.0016$). (a) calculate the molar absorptivity for this compound at each wavelength (b) are these bands due to *d-d* transitions or charge transition? (10%)
6. Why are there two separate water exchange rates for $[Cu(H_2O)_6]^{2+}$ in aqueous solution? (6%)
7. The $RhCl(PPh_3)_3$ is an active catalyst for alkene hydrogenation; however, the $RhCl(PEt_3)_3$ is inactive. Why? (8%)

PART.2

1. For UV-Visible absorbance measurement, the effect of bandwidth on spectral detail for a sample of benzene vapor can be seen from the following spectra. Three different bandwidths (10 nm, 4 nm and 1.6 nm) are selected to test the effect. Please match each spectrum with a suitable band width. (9%)



國立彰化師範大學 98 學年度碩士班招生考試試題

系所：化學系

科目：無機化學與分析化學

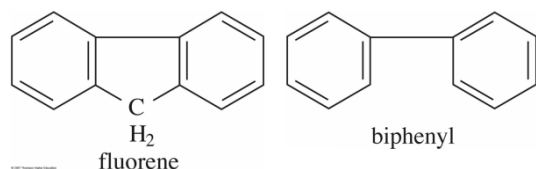
☆☆請在答案紙上作答☆☆

共 2 頁，第 2 頁

2. Two light sources (deuterium and tungsten lamps) are frequently used in spectrophotometers for absorbance measurement. Which one is for Visible and near-IR region? Which one is for UV region? (6%)
3. The following table describes fluorescence properties for Aniline and Anilinium ion. Explain the differences of wavelength and relative intensity seen for these two compounds. (10%)

Compound	Formula	Wavelength of Fluorescence, nm	Relative Intensity of Fluorescence
Aniline	$C_6H_5NH_2$	310–405	20
Anilinium ion	$C_6H_5NH_3^+$	—	0

4. Effect of structure can be seen from the fluorescence quantum efficiency of the following two compounds. Which one has a quantum efficiency of 0.2? Which one has a quantum efficiency of 1.0? (6%)



5. Absorbance, fluorescence and mass spectrometry are three frequently chosen detectors for HPLC. However, the typical Mass LOD (limit of detection) are different for these three detectors. Please match each detector with a possible LOD: (a) less than 1 pg, (b) 10 pg and (c) 10 fg. (9%)
6. Calculate the concentrations of Ca^{2+} in solution at the following volumes of added EDTA (ethylenediamine tetraacetic acid) if 30 mL of 0.02 M Ca^{2+} is titrated by (a) 10 mL and (b) 20 mL of 0.04 M EDTA. (10%)