國立成功大學

110學年度碩士班招生考試試題

編　號：78

系　所：化學工程學系

科　目：無機化學及分析化學

日　期：0203

節　次：第 2 節

備　註：可使用計算機

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※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

Inorganic Chemistry and Analytical Chemistry (total points: 100)

Part I: Inorganic Chemistry (total points: 50)

1. Based on the electronegativity values of elements in periodic table, please use the Pauling equation to calculate the % ionic character of (a) CsCl; (b) KF; (c)MgS; and (d)LiBr (10 pts)

2. NaCl has the AX crystal structure: anions form the face-centered cubic (FCC) crystal structure with cations occupied all the octahedral site of FCC structure. Please calculate the density of NaCl based on this crystal structure. (lattice constant of NaCl = 5.638 Å) (8 pts)

3. Give the ground-state electron configurations of the oxygen molecule, O_2, the superoxide ion, O_2^-, and the peroxide ion, O_2^{-2} (6 pts)

4. Draw the models of the following molecules and determine the point group of the following molecules: (a) Phenanthrene; (b) $Fe(CN)_6$; (c) 1-Chloronaphthalene; (d) $PtCl_4^-$ (10 pts)

5. Give the valence electron count at the meal center for the following metal complexes, and indicate whether they obey the Effective atomic number (EAN) rule or not? (a) $Ni(NH_3)_6^{2+}$; (b) $Ni(CO)_6$; (c) $Co(NH_3)_6^{3+}$; (d) $Fe(CN)_6^{4-}$ (10 pts)

6. The rate of reaction of O2 with trans-IrX(CO)(PPh3)2 in benzene decreasing in the order of $X= NO_2 > I > ONO_2 > Br > Cl > N_3 > F$ explain this observation. (6pts)

Part II: Analytical Chemistry (total points: 50)

7. when highly concentrated silver nitrate solution is added drop by drop into a solution mixture with 0.05M Cl^-, 0.04 M Br^-, and 0.03 M I^-, which type of ions will precipitate first? Why? Show all calculation if necessary. (K_{sp} of AgCl = 1.8×10^{-10} AgBr = 5.0×10^{-13} AgI = 8.3×10^{-17}. (10 pts)

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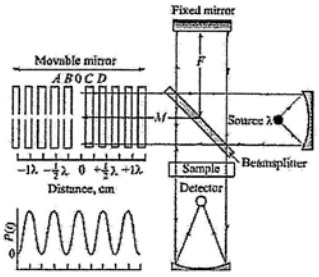
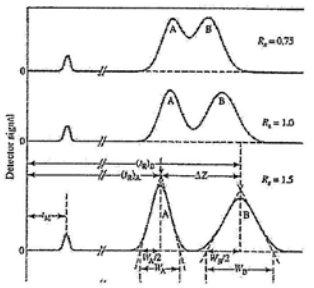
8. (a) the right hand side figure show the schematic representation of a Michelson interferometer. Please show the relationship between the optical frequency of the radiation (υ) and the interferogram (f) is $f = \frac{2V_m}{c}\upsilon$ (5 pts)



Here V_m: the constant velocity of the mirror and c is the velocity of light. 2(M-F) in the figure is termed the retardation δ, and λ is the wavelength of the source light.

(b) Calculate the frequency range of a modulated signal from a Michelson interferometer with a mirror velocity of 0.15 cm/s for visible radiation of 700 nm and infrared radiation of 16μm. (5 pts)

9. The resolution of a chromatographic column is a quantitative measure of its ability to separate analytes A and B. On the basis of the terms given in the right hand side of figure, (a) define the resolution of a column (4 pts); (b) if substance A and B have retention times of 16.32 and 17.58 min, respectively, on a 30.0-cm column. The peak widths (at base for A and B are 1.10 and 1.25 min), respectively. Calculate (i) the column resolution and (ii) length of column required to achieve a resolution of 1.9 . (6 pts)



10. A chemist performs a colorimetric assay that selectively measures copper. A 10.0 mL portion of the original sample gives an absorbance reading of 0.450 and a 10.0 mL portion of the same sample that has been spiked with 10.00 mL of 2.00×10^{-2} M copper solution gives an absorbance of 0.650. What is the concentration of copper in the original sample? (10 pts)

11. Briefly describe or define: (a) resonance fluorescence; (b) Vibrational relaxation; (c) quantum yield; (d) Stokes shift; (e) internal conversion. (10 pts)

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