

系所組別： 化學工程學系乙組

考試科目： 無機化學及分析化學

考試日期： 0307，節次： 2

※ 考生請注意：本試題 可 不可 使用計算機**Part I: Inorganic Chemistry (total points: 50)**

- (1) Indicate which of the following ligands should show ambidentate character, and indicate for such ligands the hard and soft ends: NO_3^- , SO_3^- , $\text{S}_2\text{O}_3^{2-}$, $\text{S}_2\text{O}_7^{2-}$, NO_2^- , $(\text{CH}_3)_2\text{SO}$, CN^- , SeCN^- . Why is glycine not classified as an ambidentate ligand? (10 points)
- (2) Give an example of (a) an acidic oxide of a metal, (b) an amphoteric oxide of a transition metal, (c) a compound of a metal in the +8 oxidation state, (d) a liquid metal chloride, and (e) a compound of a transition metal in a negative oxidation state. (10 points)
- (3) What is the cytochrom chain? What are the advantages of such a complex system? (10 points)
- (4) Instead of using Cartesian coordinates x and y , the position of a point in the xy plan can be specified by the polar coordinates r and ϕ . (a) What is the mathematical relation between x , y and r , ϕ ? (b) Rotation around the z axis through an angle θ takes the point (x,y) into (x',y') . The new polar coordinates are $(r,(\phi-\theta))$. Express mathematically the relation between (x',y') and the polar coordinates $(r,(\phi-\theta))$. Convert the relationship into one between (x',y') and (x,y) . (c) Express the results of (b) in matrix notation. (10 points)
- (5) Identify the symmetry type of the orbital, $\psi = \phi - \phi'$, in a C_{2v} NO_2 molecule, where is a $2p_x$ orbital on one O atom and that on the other. (10 points)

Part II: Analytical Chemistry (Total points: 50)

- (6) Consider an infrared grating with 72.0 lines per millimeter and 10.0 mm of illuminated area. Calculate the first order resolution ($\lambda/\Delta\lambda$) of this grating. How far apart (in cm^{-1}) must two lines centered at 1000 cm^{-1} be if they are to be resolved? (10 points)
- (7) Explain the following term: (a) fluorescence, (b) phosphorescence, (c) resonance fluorescence, (d) singlet state, and (e) triplet state. (10 points)

(背面仍有題目,請繼續作答)

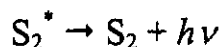
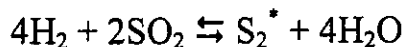
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- (8) An important method for determining sulfur-bearing pollutants, such as SO_2 , H_2S and CH_3SH , in the atmosphere involves heating the gas sample in a hydrogen-rich flame and measuring the resulting chemiluminescence. The overall reaction for SO_2 is



Here, the radiation intensity is proportional to the concentration of the excited sulfur dimer. Derive an expression for the relationship between the concentration of SO_2 in the sample, the luminescent intensity, and the equilibrium constant for the first reaction. (10 points)

- (9)(a) Describe the difference between power compensators and heat flux DSC instruments. (b) Why does the glass transition for a polymer sample yield no exothermic or endothermic peak? (10 points)

- (10) A band from a column eluted at a rate of 1.50 mL/min has a width at half-height of 18.3 s. The sample was applied as a sharp plug with a volume of 0.30 mL, and the detector volume is 0.20 mL. Find the variances introduced by injection and detection. What would be the width at half-height if broadening occurred only on the column? (10 points)