

東吳大學 108 學年度碩士班研究生招生考試試題

第 1 頁，共 3 頁

系級	化學系碩士班	考試時間	100 分鐘
科目	綜合化學	本科總分	100 分

※請標明題號後，依序作答於答案卷上。

Part A:

1. Determine the point groups for the following molecules: (a) B₂H₆ (b) ClF₃ (c) SF₄ (d) XeF₂ (e) TeF₄²⁻
(5 Points, each 1point)
2. What are the possible numbers of unpaired electrons of Co(II) in tetrahedral, octahedral (high-spin and low-spin) and square-planar complexes by using crystal field theory?. (4 Points, each 1point)
3. Describe the differences between the Fischer and Schrock Carbene. (6 Points, each 1point)
4. Present qualitative crystal field splitting patterns for five *d* orbitals for the following geometric structures:
(a) square planar (b) octahedral (c) trigonal bipyramidal (d) tetrahedral (e) square pyramidal.
(10 Points, each 2point)
5. A 3.5 mole sample of an ideal gas, for which $C_{V,m} = 3R/2$, initially at 25°C and 1.6x10⁶ Pa, under goes a two-stage transformation. For each of the stages described in the following list, calculate the final pressure, as well as *q*, *w*, ΔU , and ΔH . Also calculate *q*, *w*, ΔU , and ΔH for the complete process.
(a) The gas is expanded isothermally and reversibly until the volume triples.
(b) Beginning at the end of the first stage, the temperature is raised to 105°C at constant volume.
(8 Points)
6. What is the maximum number of electrons that can be emitted if a potassium surface of work function 3.20 eV absorbs 5.00×10^{-3} J of radiation at a wavelength of 335 nm? What is the kinetic energy and velocity of the electrons emitted? (6 Points)
7. Show (a) that $\psi(x) = e^{-x^2/2}$ is an eigenfunction of $\hat{A} = x^2 - \partial^2 / \partial x^2$; and (b) that $\hat{B}\psi(x)$ (where $B = x - \partial / \partial x$) is another eigenfunction of \hat{A} . (4 Points)
8. A standard rotary pump is capable of producing a vacuum on the order of 10⁻³ Torr. What is the single-particle collisional frequency and mean free path for N₂ at this pressure and 300 K? (7 Points)

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Part B:

1. Define the following terms: (20 分)

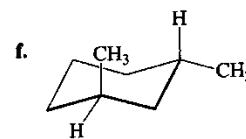
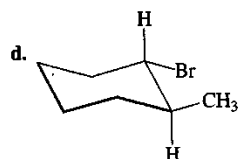
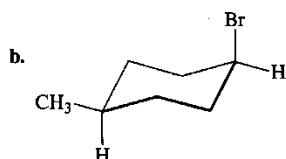
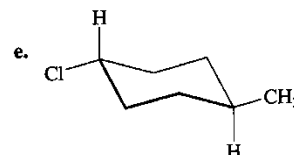
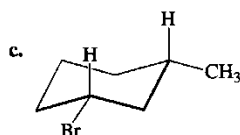
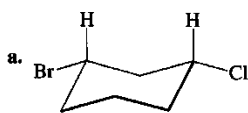
- (1) Matrix assisted laser desorption ionization (MALDI)
- (2) Inductively coupled plasma
- (3) Attenuated Total internal Reflectance FTIR
- (4) Mass-transport in the electrochemistry

2. Calculate the pH of a buffer solution that is 0.050 M in benzoic acid ($\text{HC}_7\text{H}_5\text{O}_2$) and 0.150 M in sodium benzoate ($\text{NaC}_7\text{H}_5\text{O}_2$). For benzoic acid, $K_a = 6.5 \times 10^{-5}$. (5 分)

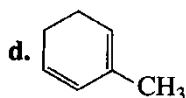
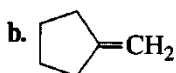
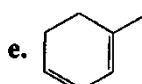
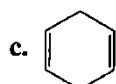
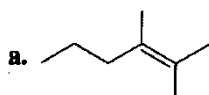
3. Which is a stronger base? (6 分)

- | | | |
|--|--|---|
| a. HS^- or HO^- | c. CH_3OH or CH_3O^- | e. CH_3COO^- or CF_3COO^- |
| b. CH_3O^- or CH_3NH^- | d. Cl^- or Br^- | f. $\text{CH}_3\text{CHClCOO}^-$ or $\text{CH}_3\text{CHBrCOO}^-$ |

4. Is each of the following a cis isomer or a trans isomer? (6 分)

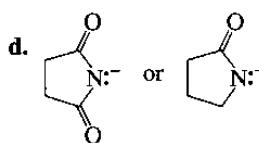
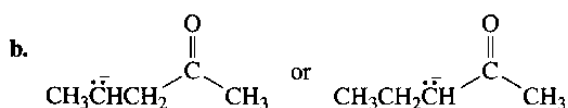
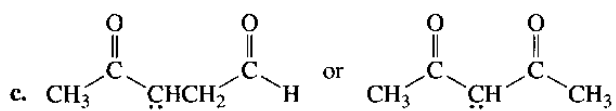
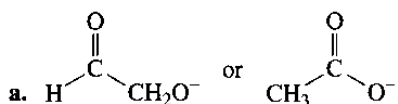


5. What products are formed when the following compound react with ozone and then dimethyl sulfide? (5 分)



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6. Which species in each pair is more stable? (4 分)



7. Which reaction in each of the following pairs will take place more rapidly? (4 分)

