

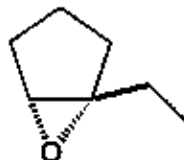
# 國立中央大學九十一學年度碩士班研究生入學試題卷

所別: 化學學系 不分組 科目: 有機與無機化學 共 1 頁 第 1 頁

1. What is Jahn-Teller effect? Which electronic configuration states of the first 3d transition metals are expected to have this effect and explain. (8 pts)
2. List all the possible products (including the optical isomers) for complexes *trans*-[Cr(en)<sub>2</sub>Cl<sub>2</sub>]<sup>+</sup> undergoing dissociative substitution reaction. (8 pts)
3. Predict the correct structures and point groups for compounds, XeF<sub>2</sub>O<sub>2</sub>, XeO<sub>3</sub>F<sub>2</sub> and XeO(OTeF<sub>5</sub>)<sub>4</sub> by VSEPR theory. (9 pts)
4. Formula N<sub>3</sub>CO have three known isomer; ONCN, ONNC and NOCN. Determine their relative stability. (8 pts)
5. Are the two non-18e-compounds; Zn(en)<sub>3</sub><sup>2+</sup> and TiF<sub>6</sub><sup>2-</sup> stable or not, and why? (8 pt)
6. Except in cases where ligand geometry requires, square-planar geometry occurs with d<sup>7</sup>, d<sup>8</sup>, and d<sup>9</sup> ions and with strong field, π-acceptor ligand. Explain why these restrictions apply. (9 points)
7. A compound U (C<sub>9</sub>H<sub>10</sub>O) gives a positive iodoform test; its IR spectrum shows a strong peak at 1705 cm<sup>-1</sup>. The <sup>1</sup>H NMR spectrum of U gives the following: (8 pts)  
 Singlet d 2.0 (3H)  
 Singlet d 3.5 (2H)  
 Multiplet d 7.1 (5H)  
 Give a structure for compound U and make assignments for each of the NMR peaks.
8. Unlike most other electrophilic aromatic substitutions, sulfonation is often reversible. When one sample of toluene is sulfonated at 0°C and another sample is sulfonated at 100°C, different ratios of substitution products result.

Isomer of the product	Reaction temperature	
	0°C	100°C
<i>o</i> -toluenesulfonic acid	43%	13%
<i>m</i> -toluenesulfonic acid	4%	8%
<i>p</i> -toluenesulfonic acid	53%	79%

- (a) Give a curved-arrow mechanism to account for formation of all the products. (5 pts)
  - (b) Explain the change in the product ratios when the temperature is increased. (3 pts)
  - (c) Draw a potential energy diagram to show your explanation. (4 pts)
  - (d) Predict what happens when the product mixture from the reaction at 0°C is heated to 100°C. (5 pts)
  - (e) Write a curved-arrow mechanism for the conversion of *p*-toluenesulfonic acid to toluene and H<sub>2</sub>SO<sub>4</sub> with hot water (steam). (5 pts)
9. Given the starting material 1-ethyl-1,2-epoxycyclopentane, of the absolute configuration as shown, decide which chiral product would you expect to be formed



- (a) when it is allowed to stand in methanol containing a few drops of sulfuric acid? (5 pts) Explain how you arrived at your answer, using curved-arrow formalism. (5 pts)
- (b) when it is treated with sodium methoxide in methanol. (5 pts) Explain how you arrived at your answer, using curved-arrow formalism. (5 pts)

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