

國立高雄大學 104 學年度研究所碩士班招生考試試題

科目：綜合化學(I)  
考試時間：100 分鐘

系所：應用化學系  
本科原始成績：100 分

是否使用計算機：是

Section I: 無機化學 (Inorganic Chemistry) (50 points)

1. Provide a concise but thorough explanation of the following: (10 points) (名詞解釋, 請勿只翻譯)  
(a)  $\pi$  back-bonding      (b) Inorganic chemistry      (c)  $\delta$ -bonding  
(d) trans effect      (e) Lewis base
2. Based on the VSEPR model, please sketch the shape of  $\text{BrF}_3$ . (5 points)
3. Please give a detailed mechanism for olefin metathesis reaction. Please also give an example of the Grubbs catalysts. (8 points)
4. Predict the number of unpaired electrons for a tetrahedral  $d^5$  ion and an octahedral  $d^7$  ion. Explain your answer by sketching crystal field splitting of d-orbitals in the geometric arrangements. (8 points)
5. What is an organometallic compound? Please give an example. (6 points)
6. Prepare a molecular orbital (MO) energy level diagram for  $\text{B}_2$ , showing clearly how the atomic orbitals interact to form molecular orbitals. (8 points)
7. Determine the point groups for the following: (4 points total)  
(i)  $\text{O}_2$       (ii)  $\text{CHCl}_3$
8. Write the ground state electron configurations of Be. (1 point total)

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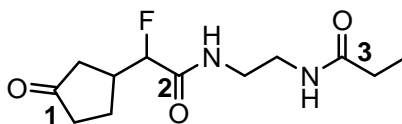
Section II: 有機化學(Organic Chemistry), 50 points

1. Select a best choice for the following questions: (15 points, 3 pts each)

i. Which of the following alkyl halides yields the most stable carbocation intermediate during solvolysis in hot ethanol?

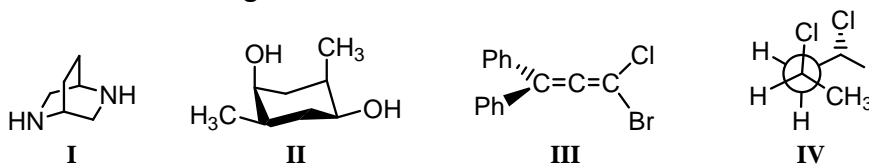
- A) methyl iodide                      B) (S)-2-bromopentane  
 C) (R)-2-bromopentane              D) (S)-3-bromopent-1-ene  
 E) 1-chlorobutane

ii. Which sequence ranks the following carbonyl compounds in order of increasing rate of nucleophilic addition?



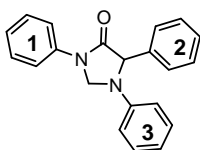
- A) 1 < 2 < 3                      B) 3 < 2 < 1                      C) 2 < 1 < 3                      D) 1 < 3 < 2

iii. Which of the following structures are achiral and meso?



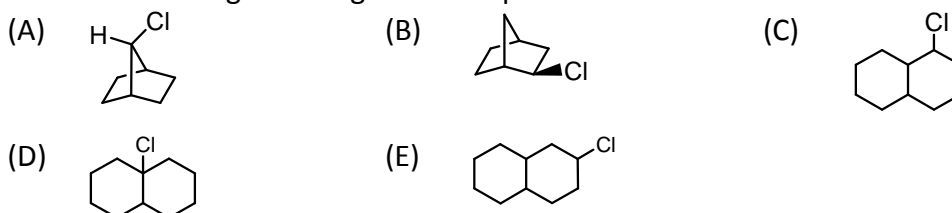
- A) I and II                      B) I and III                      C) II and IV                      D) all of above

iv. Which sequence ranks the following aromatic rings of this compound in order of increasing reactivity in an electrophilic aromatic substitution reaction (slowest to fastest reacting)?



- A) 1 < 2 < 3                      B) 2 < 3 < 1                      C) 3 < 2 < 1                      D) 3 < 1 < 2                      E) 2 < 1 < 3

v. Which of the following compounds **cannot** undergo dehydrohalogenation in the presence of a strong base to give alkene product?



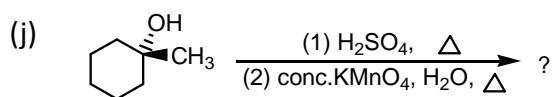
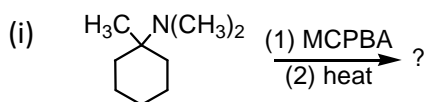
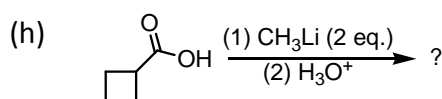
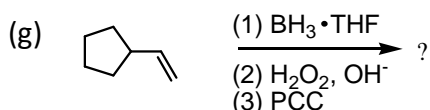
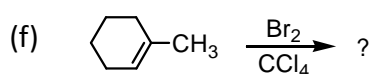
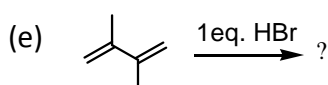
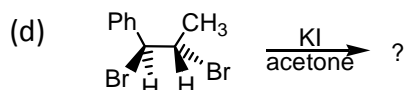
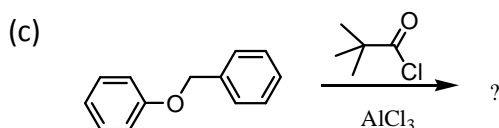
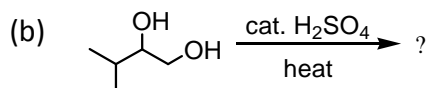
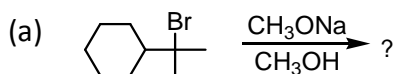
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2. Give the structure of the major product, clearly indicate the stereochemistry if necessary. (30 points, 3 points each)



3. Beta-keto acids are unusually unstable and will lose the carboxylate group under certain conditions where both a general acid and base are involved. During this process, CO<sub>2</sub> is lost and the original beta-keto acid is converted into a ketone. For the following reaction, show a stepwise mechanism, with electron pushing arrows, in the formation of the products. Make special note of any resonance stabilized intermediates in this reaction. (5 points)

