

無機化學 (總計 50 分)

1. Fill in the characters of the irreducible representations in the character table of point group C_{6v} . Give the names of $\Gamma_1, \Gamma_2, \Gamma_3, \Gamma_4, \Gamma_5$ and Γ_6 . (10%)

C_{6v}	E	$2C_6$	$2C_3$	C_2	$3\sigma_v$	$3\sigma_d$	basis function
Γ_1	1	1	1	1	1	1	$z, x^2 + y^2, z^2$
Γ_2							R_z
Γ_3							
Γ_4							
Γ_5							$(x, y)(R_x, R_y) (xz, yz)$
Γ_6							$(x^2 - y^2, xy)$

2. (a) Derive the term symbol for "Nitrogen" atom and identify the ground state?
(b) Show that you have all possible microstates and give the order in the scale of energy. (10%)
3. Determine the point group of the following:
(a) CH_2Cl_2 (b) CH_2BrCl (c) I_3^- (d) BrCl_3 (e) $\text{B}_3\text{N}_3\text{H}_6$ (10%)
4. For the wave function of a hydrogen like atomic orbital,

$$\Psi = K r e^{-Zr/2a_0} (\cos\theta) \quad (K: \text{constant})$$

Please give a proper answer for each question:

- (a) Number of nodal plane for the radial part of the wave function; (2%)
(b) Principal quantum number, n ; (2%)
(c) Number of the nodal planes for the angular part of the wave function; (2%)
(d) Symbol of this atomic orbital (eg. $1s, 2s, 2p, 3d$ ) (4%)
5. Which of the following will exhibit the greater polarizing power? Give the reason for your answer. (10%)
a. K^+ or Ag^+ b. K^+ or Li^+ c. Li^+ or Be^{2+} d. Cu^{2+} or Ca^{2+} e. Ti^{2+} or Ti^{4+} .

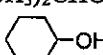
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有機題第一部分：

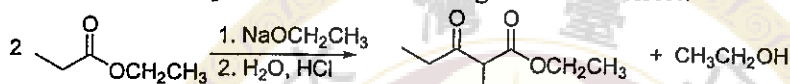
有機單選題（每題 4 分，共 32 分）

Organic Multiple Choices: There is one appropriate answer in each of the following questions. (32 points)

(1) Which of the following alcohols will react most rapidly with the Lucas reagent (HCl, ZnCl₂)?

- (a) CH₃(CH₂)₂CH₂OH
- (b) CH₃CH(OH)CH₂CH₃
- (c) (CH₃)₃COH
- (d) (CH₃)₂CHCH₂OH
- (e) 

(2) Which of the descriptions about the following reaction is correct?

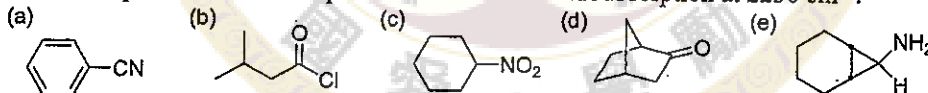


- (a) This reaction is known as aldol condensation.
- (b) Other alkoxides such as NaOCH₃ can also be used to promote the reaction.
- (c) Stoichiometric amount of NaOCH₂CH₃ is required in order to complete the reaction.
- (d) The function of HCl is to neutralize any remaining NaOCH₂CH₃.
- (e) Aldol is the last name of the chemist who discovered this reaction.

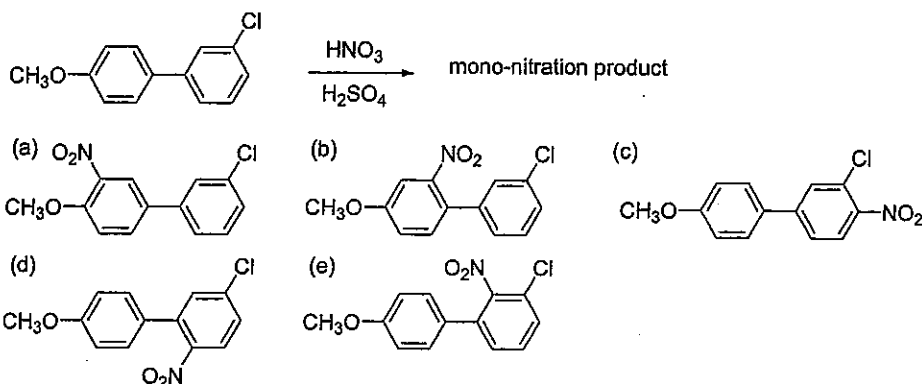
(3) Which of the following reagents is not typically viewed as an oxidizing agent?

- (a) KMnO₄
- (b) Jones reagent
- (c) O₂
- (d) NaBH₄
- (e) HNO₃

(4) Which compound would be expected to show intense IR absorption at 2230 cm⁻¹?

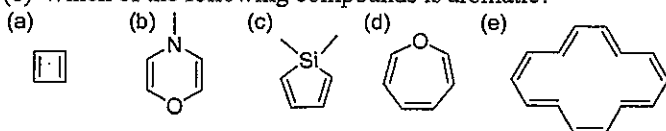


(5) Provide the structure of the major mononitration product in the following reaction.



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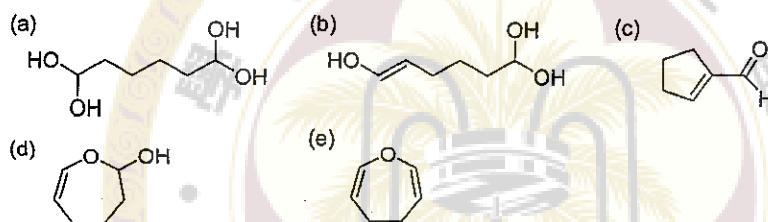
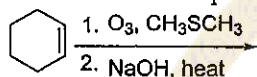
(6) Which of the following compounds is aromatic?



(7) Which of the descriptions about E2 reactions is incorrect?

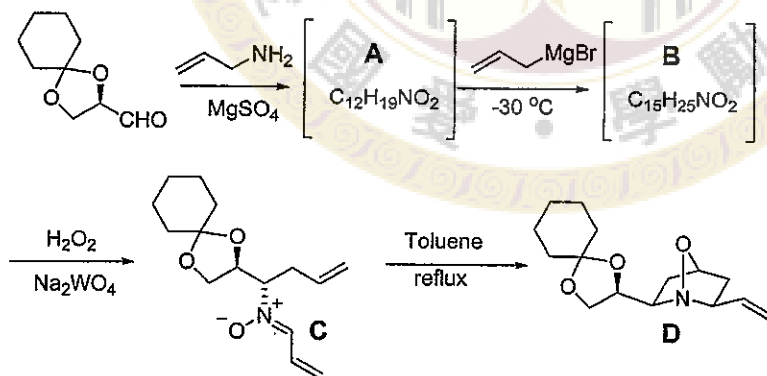
- (a) Elimination requires anti-coplanar or syn-coplanar conformation.
 (b) Elimination requires a strong base for removal of the proton.
 (c) The rate law follows a second order rate equation.
 (d) The orientation of elimination follows Markovnikov's rule.
 (e) Elimination takes place in one step with no intermediates so that no rearrangement is possible in the E₂ reaction.

(8) What would be the product of the following reaction sequence?



有機題第二部分：問答題（共 18 分）

Problem 1. Answer the questions according to the following reaction scheme. (9 pts)



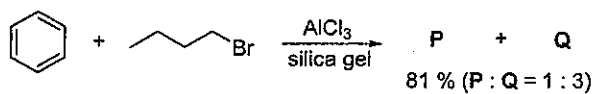
Nemai Saha and Shital K Chattopadhyay, 2012, JOC

- (a) What is the structure of A? (2 pts)
 (b) What is the structure of B? (2 pts)
 (c) Propose reaction mechanisms for the conversion of C to D. (5 pts)

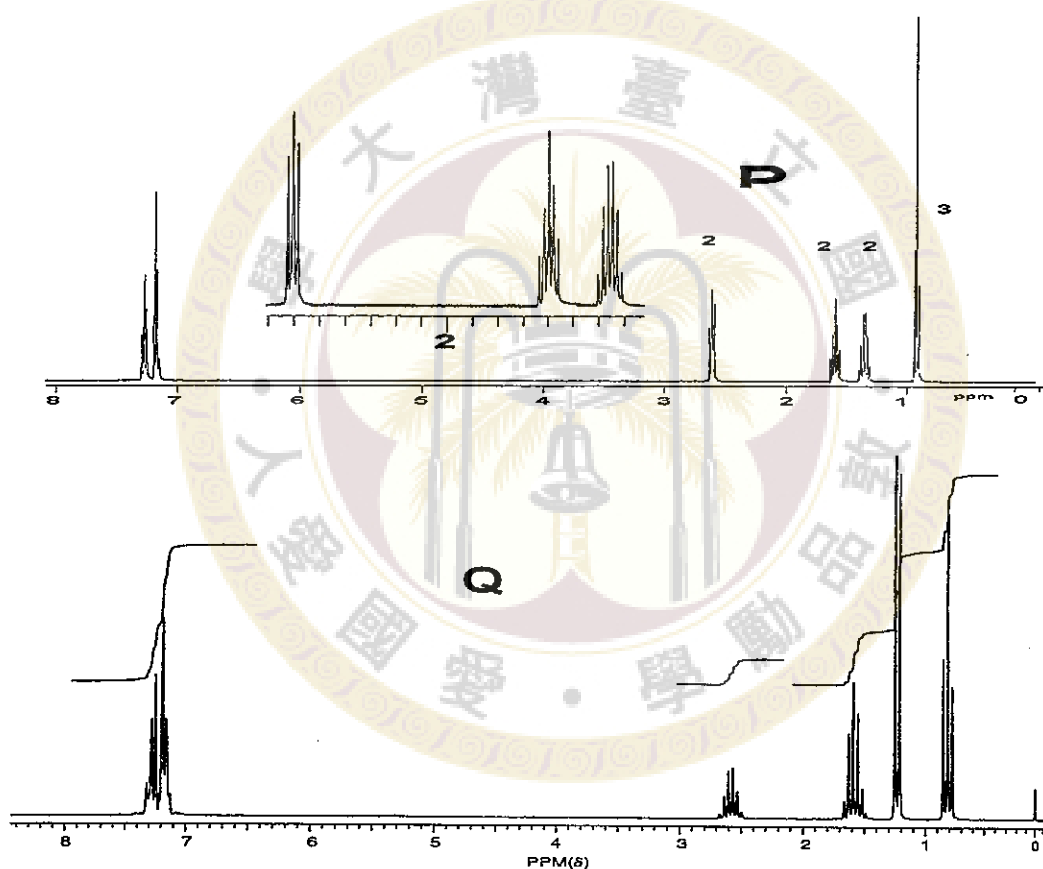
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Problem 2. Answer the questions according to the following reaction scheme and the NMR spectrum. (9 pts)

Reaction of benzene and bromobutane in the presence of AlCl_3 on silica gel solid support gives two products: **P** is the minor one and **Q** is the major one.



Tetrahedron Letters, 53(39), 5343-5346; 2012



- What is the structure of **P**? (2 pts)
- What is the structure of **Q**? (2 pts)
- Propose reaction mechanisms for the formation of **Q**. (3 pts)
- Use a tree-diagram to explain the NMR splitting pattern of **Q** at 2.6 ppm (2 pts).

試題隨卷繳回