

國立中正大學
112 學年度碩士班招生考試
試題

[第 3 節]

科目名稱	有機無機化學
系所組別	化學暨生物化學系

— 作答注意事項 —

※作答前請先核對「試題」、「試卷」與「准考證」之系所組別、科目名稱是否相符。

1. 預備鈴響時即可入場，但至考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。
2. 考試開始鈴響時，即可開始作答；考試結束鈴響畢，應即停止作答。
3. 入場後於考試開始 40 分鐘內不得離場。
4. 全部答題均須在試卷（答案卷）作答區內完成。
5. 試卷作答限用藍色或黑色筆（含鉛筆）書寫。
6. 試題須隨試卷繳還。

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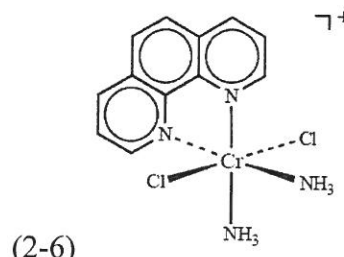
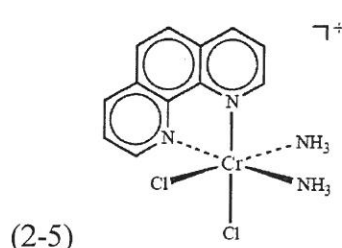
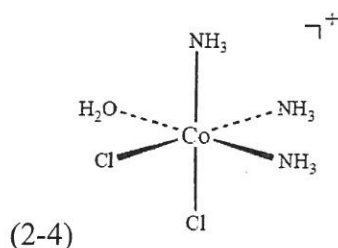
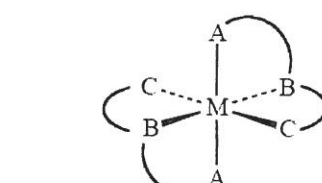
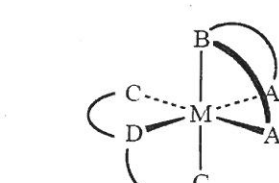
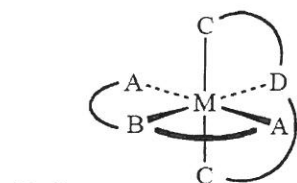
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Inorganic Chemistry (共 50 分):

1) Draw Lewis dot structure, indicating the molecular shape based on reasonable formal charge distribution, and determine the point group for each of the following. (note: show lone pairs, chemical bonds, and give resonance structures if necessary) (8 分)

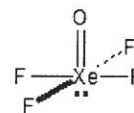
(1-1) I_3^- (1-2) XeO_3F_2 (1-3) $SeOCl_2$ (1-4) NO_2^-

2) Determine whether the following complexes are optical active or not? (6 分)



3) $XeOF_4$ adopts a C_{4v} point group. Answer the following questions.

C_{4v}	E	$2C_4$	C_2	$2\sigma_v$	$2\sigma_d$	
A_1	1	1	1	1	1	z
A_2	1	1	1	-1	-1	R_z
B_1	1	-1	1	1	-1	
B_2	1	-1	1	-1	1	
E	2	0	-2	0	0	$(x, y), (R_x, R_y)$



(3-1) Based on all the motions of the atoms in $XeOF_4$, obtain a reducible representation (Γ). (2 分)

(3-2) Reduce this representation (Γ) to its component irreducible representations. (2 分)

(3-3) Classify these representations, indicating which are for translational, rotational and vibrational motions, respectively. (3 分)

4) Which of the following are paramagnetic? (複選 3 分)

(a) NO^+ (b) NO_2 (c) B_2 (d) C_2^{2-} (e) O_2^{2-} (f) O_2 (g) O_2^+ (h) O_3

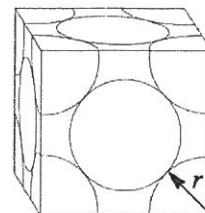
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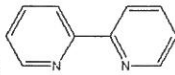
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- 5) The atoms occupy 52.4% of the total volume in a primitive cubic structure in which all the atoms are identical. Calculate the percentage of occupation by the atoms in a face-centered cubic structure. (4分)



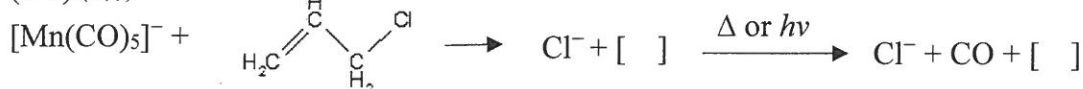
- 6) Determine the number of unpaired electrons, effective magnetic moment ($\mu_{\text{eff}} = g\sqrt{S(S+1)}$), and ligand field stabilization energy (LFSE, in Δ_0) for $[\text{Cr}(\text{CN})_6]^{4-}$ and $[\text{Co}(\text{NO}_2)_6]^{4-}$, respectively. Both cyanide- and nitro-ligands are strong field. (6分)
- 7) For p^3 electronic configuration, there are 20 microstates and the lowest-energy term is $^4S_{3/2}$. What is the number of microstates and the lowest-energy term of p^1d^1 configuration? (4分)

- 8) Which of the following does not obey 18-electron rule? (2,2'-bipy: ) (單選 2分)

- (a) $(\eta^3\text{-C}_5\text{H}_5)(\eta^5\text{-C}_5\text{H}_5)\text{Fe}(\text{CO})$ (b) $(\eta^5\text{-C}_5\text{H}_5)\text{Ir}(\text{C}_2\text{H}_4)_2$ (c) $[\text{Rh}(2,2'\text{-bipy})_2\text{Cl}]^+$
 (d) $\text{Co}_2(\mu_2\text{-CO})_2(\text{CO})_6$ (e) $[(\eta^3\text{-C}_3\text{H}_5)(\eta^5\text{-C}_5\text{H}_5)\text{Mn}(\text{CO})]^-$

- 9) Draw the structures of the products in the brackets [].

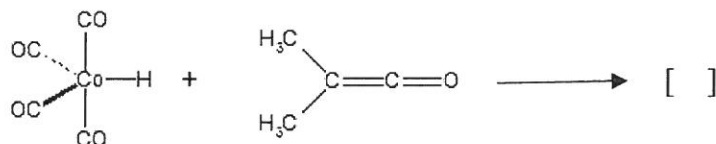
(9-1) (4分)



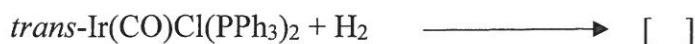
(9-2) (2分)



(9-3) 1,2 insertion (2分)



(9-4) oxidative addition (2分)



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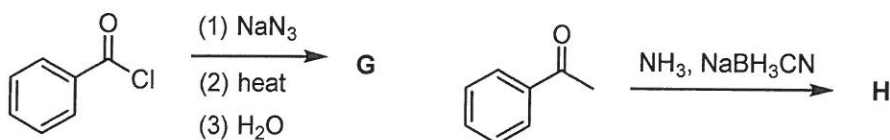
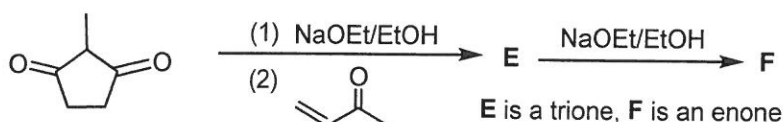
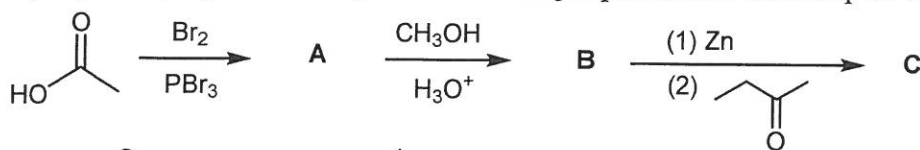
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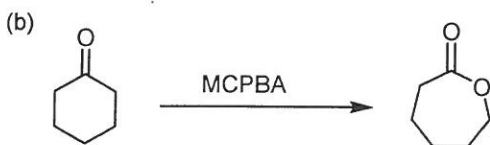
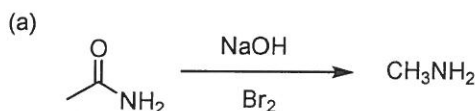
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有機化學 (共 50 分):

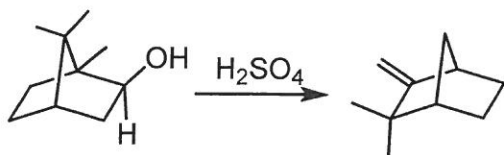
1. (20 points, 2 points each) Predict the major product of each step in the following reactions:



2. (12 points, 4 points each) Please provide the reasonable mechanism for the following reactions:

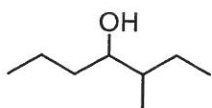


(c) Isoborneol is converted into camphene on treatment with dilute sulfuric acid. Propose a mechanism for the reaction, which involves a carbocation rearrangement.



3. (12 points, 4 points each)

(a) Suggest an efficient route for the synthesis of the following compound from any starting material containing four or fewer carbons, an acetoacetic ester, a malonic ester, and any inorganic reagents.



(b) Show how *p*-chlorotoluene could be converted to *p*-ClC₆H₄CH(OH)CO₂H.

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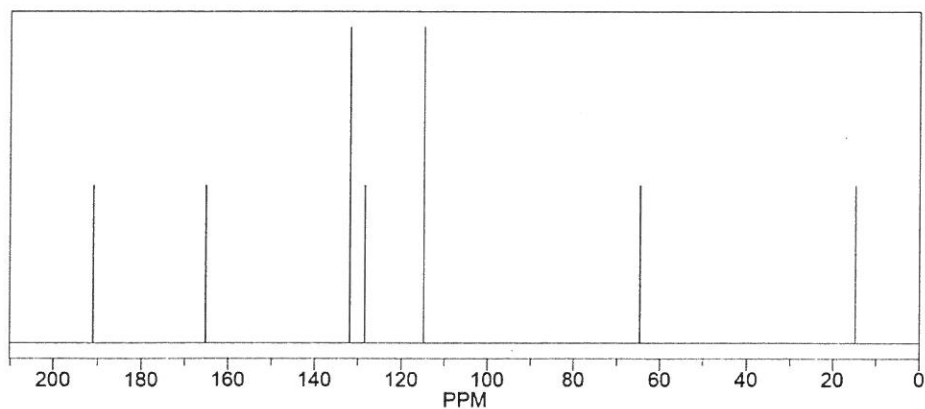
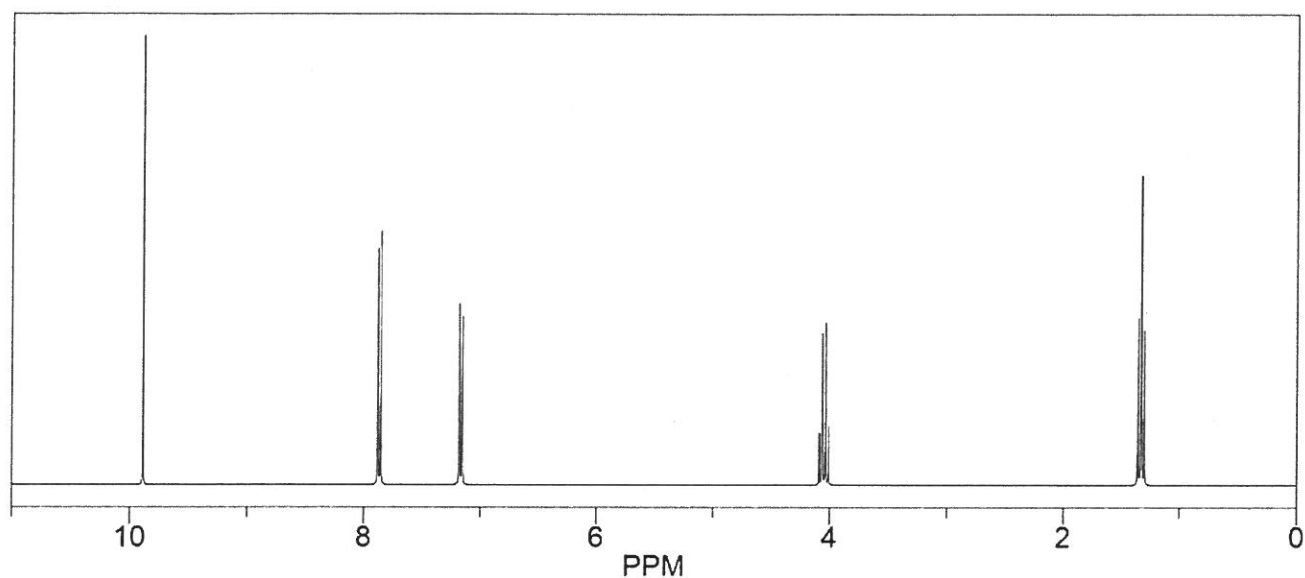
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(c) Starting with benzyl bromide, show how you would synthesize the following compound: $C_6H_5CH=CH-CH=CHC_6H_5$

4. (6 points, 3 points each) please provide the structure of the compound based on the following spectra.

(a) $C_9H_{10}O_2$



(b) $C_4H_8O_2$

