

國立中正大學  
110 學年度碩士班招生考試  
試題

[第 4 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。



國立中正大學 110 學年度碩士班招生考試試題

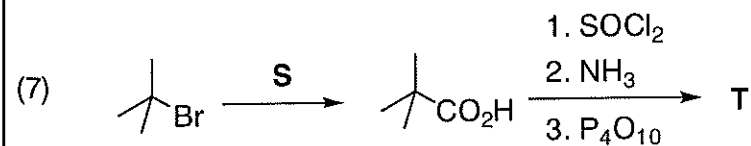
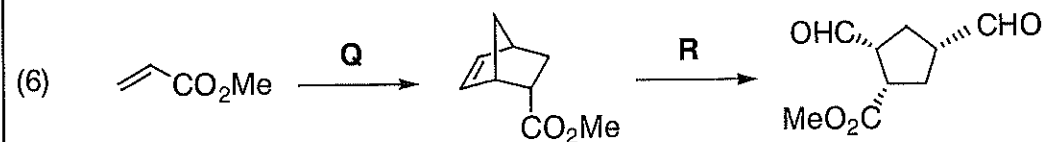
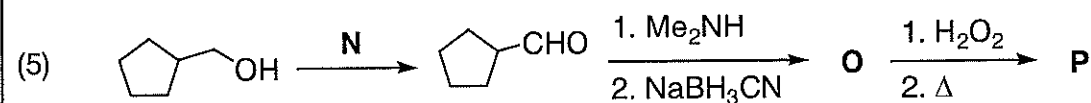
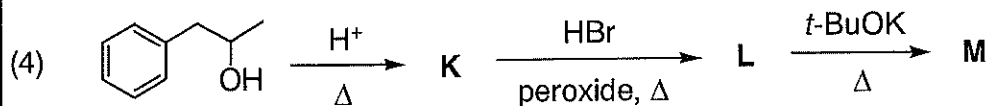
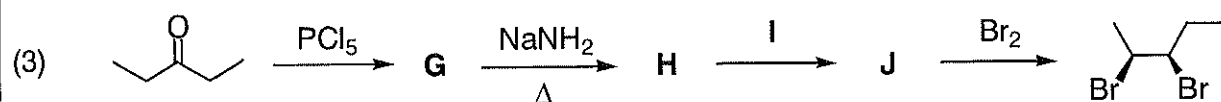
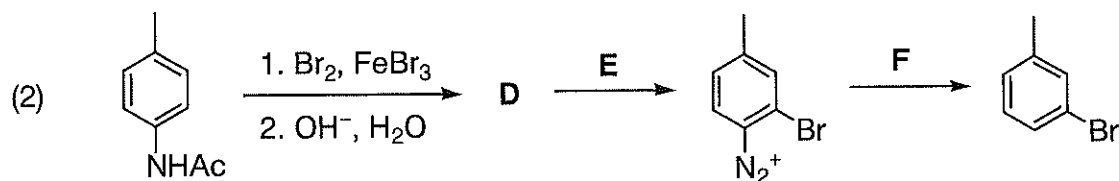
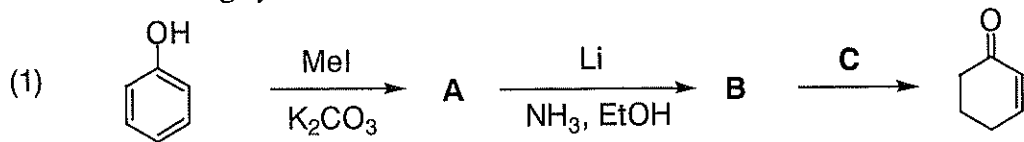
科目名稱：有機無機化學

本科目共 4 頁 第 1 頁

系所組別：化學暨生物化學系

科目：有機化學，總分 50 分

1. Provide the missing reagents and structural formulas for the major organic products (A-T) from each of the following syntheses. More than one reaction may be necessary in some cases. (2 pts each, 40 pts)



國立中正大學 110 學年度碩士班招生考試試題

科目名稱：有機無機化學

本科目共 4 頁 第 2 頁

系所組別：化學暨生物化學系

2. Which reagent in each pair listed here would be the more reactive nucleophile in the indicate solvent.  
(1 pt each, 3 pts)

(1)  $F^-$  or  $I^-$  (in MeOH)

(2)  $Cl^-$  or  $Br^-$  (in DMF)

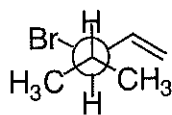
(3)  $HO^-$  or  $CH_3CO_2^-$  (in HMPA)

3. How many chiral centers are there in the following compounds? (1 pt each, 4 pts)

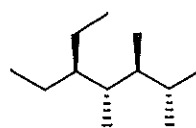
(1)



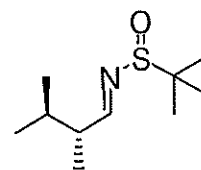
(2)



(3)



(4)



4. What is the structure of the compound in the following  $^1H$  NMR spectral data with the molecular formula  $C_4H_8O_2$ ? (3 pts)

$^1H$  NMR ( $CDCl_3$ , 300 MHz):  $\delta$  3.69 (s, 8H).

科目：無機化學

共 19 題，1 - 13 題每題 2 分，14 及 15 題每題 3 分，16 及 17 題每題 4 分，18 及 19 題每題 5 分，合計 50 分。

1. What are the values of quantum numbers  $n$  and  $l$  for a  $5d$  electron?
2. Which one of the following atoms, Na, Mg, Al, has the highest ionization energy?
3. Which one of the molecules,  $\text{OCl}_2$ ,  $\text{O}(\text{CH}_3)_2$ , and  $\text{O}(\text{SiH}_3)_2$  has the largest bond angle at the O atom?
4. For  $\text{NO}^-$ ,  $\text{NO}$ ,  $\text{NO}^+$ , (A) which one has the weakest bond, (B) which one has the most unpaired electrons, on the basis of molecular orbitals?
5. List the following acids in order of their acid strength when reacting with  $\text{NH}_3$ :  
 $\text{BMe}_3$ ,  $\text{B}(\text{C}_6\text{H}_2\text{Me}_3)_3$ ,  $\text{BF}_3$
6. Using appropriate chemical equation explain that the conductivity of  $\text{BrF}_3$  is increased by adding  $\text{KF}$ .
7. Give an example of  $p$ -type semiconductor?
8. Determine the formula of the silicate shown below.

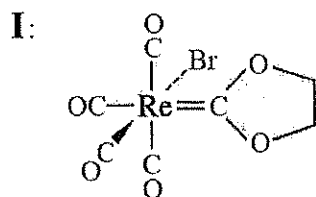


9. List all the possible first-row transition metals which form complexes  $[\text{MCl}_6]^{4-}$  having two unpaired Electrons.
10. Which one of the following ions,  $\text{CrO}_4^{4-}$ ,  $\text{MnO}_4^{3-}$ ,  $\text{FeO}_4^{2-}$ , has the largest value of  $\Delta_t$ ?
11. Predict the product of the mixing equimolar  $[\text{Pt}(\text{CO})\text{Cl}_3]^-$  and  $\text{NH}_3$ .
12. On the basis of the 18-electron rule, determine the second-row transition metal for  $[\text{M}(\text{PE}_3)_2(\text{NO})_2]^+$  (contains linear  $\text{M}-\text{N}-\text{O}$ ).
13. The tungsten alkylidyne complex  $\text{W}(\equiv\text{CCMe}_3)(\text{OCMe}_3)_3$  has been used to catalyze the ring-closing metathesis reaction for alkynes. Predict the structure of the cyclic product for metathesis of  $\text{MeC}\equiv\text{C}(\text{CH}_2)_8\text{COO}(\text{CH}_2)_9\text{C}\equiv\text{CMe}$ .
14. (A) Give the Lewis structure, (B) predict the geometry on the basis of VSEPR and (C) determine the point group of  $\text{TeF}_4^{2-}$ .
15. Sketch all the isomers of  $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$  (en:  $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$ ).

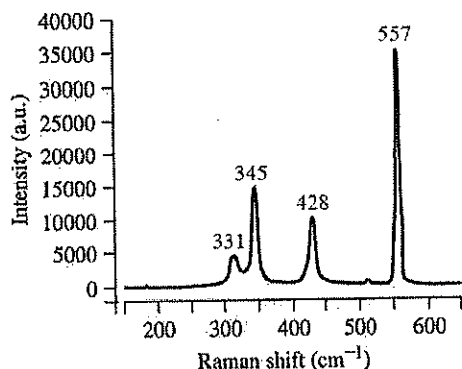
16. When a toluene solution containing the carbene complex **I** shown below and excess triphenylphosphine ( $\text{PPh}_3$ ) is heated to reflux, compound **II** is formed first, and then compound **III**. The IR and  $^1\text{H}$  NMR data for **II** and **III** are as follows:

	IR $\nu(\text{CO})$ ( $\text{cm}^{-1}$ )	$^1\text{H}$ NMR $\delta$ (ppm)
<b>II</b>	2038, 1958, 1906	7.62 ~ 7.41 multiplets (15), 4.19 multiplet (4)
<b>III</b>	1944, 1860	7.70 ~ 7.32 multiplets (15), 3.39 singlet (2)

Propose the structures of **II** and **III**.



17. Copper, silver and gold crystalize in face-centered cubic (fcc) structure. (A) Sketch the fcc unit cell. (B) Calculate the packing efficiency of the fcc structure.
18. The Raman spectrum of  $\text{AsP}_3$  shown below, exhibits four absorptions.



- (A) Sketch the structure of  $\text{AsP}_3$ . (B) Is the Raman spectrum consistent with the proposed structure? Support your answer by determining the number of Raman-active stretching modes for  $\text{AsP}_3$ .

Character table

$C_{3v}$	$E$	$2C_3$	$3\sigma_v$		
$A_1$	1	1	1	$z$	$x^2 + y^2, z^2$
$A_2$	1	1	-1	$R_z$	
$E$	2	-1	0	$(x, y), (R_x, R_y)$	$(x^2 - y^2, xy), (xz, yz)$

19. The nitrogen atom is an example of a valence  $p^3$  configuration. There are five levels associated with this configuration, with the energies shown below.

Energy ( $\text{cm}^{-1}$ )	28839.31	28838.92	19233.18	19224.46	0
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Using Russell-Saunders term, assign these five energy levels.