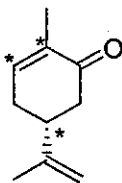


※ 注意：請於試卷內之「非選擇題作答區」依序作答，並應註明作答之部份及題號。

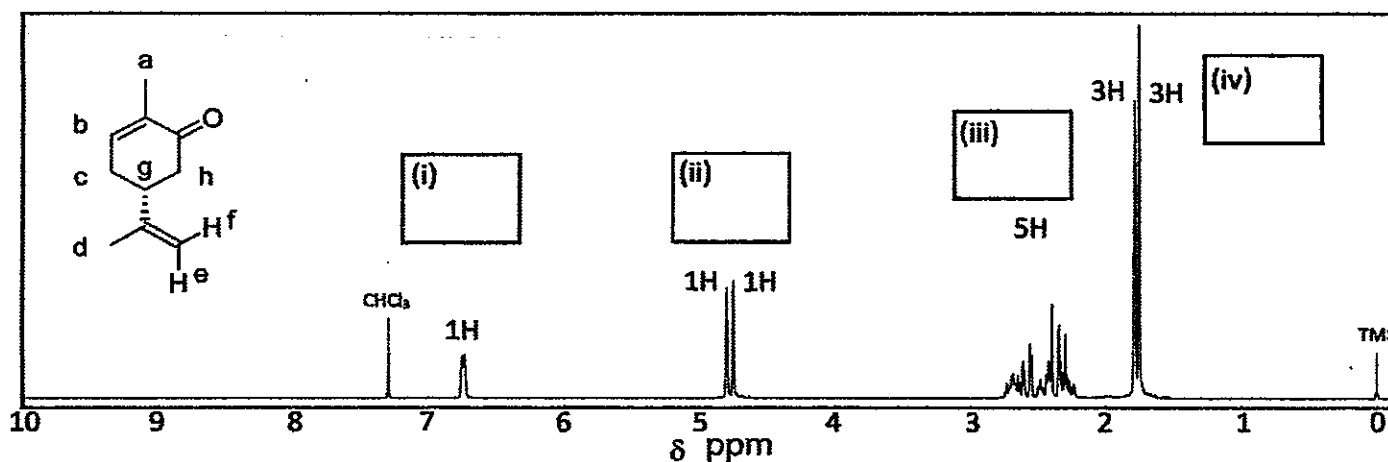
第一題 (共 16 分) (Problem 1 (total 16 pts))

回答以下關於(L)-(-)-香芹酮的問題，香芹酮常用於天然產有機合成。(Answer the following questions about (L)-(-)-carvone, a natural product that can be used in organic synthesis (total 16 pts)).

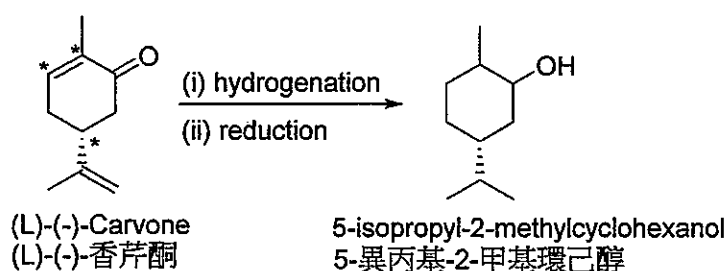


(L)-(-)-Carvone  
(L)-(-)-香芹酮

- 寫出有星號標記 $\pi$  鍵之(E)- or (Z)-命名。(2 分) (Assign the (E)- or (Z)- designation to the  $\pi$ -bond being starred. (2 pts))
- 按 CIP 規定，寫出有星號標記的不對稱碳中心之(R)- or (S)- 命名。(2 分) (Assign the (R)- or (S)- designation to the asymmetric center being starred according to the CIP rules. (2 pts))
- (L)-(-)-香芹酮的  $^1\text{H}$  NMR 共顯示了 4 組共振信號(i)-(iv)。指認香芹酮上(a)-(h)質子的相應信號。(8 分) ((L)-(-)-Carvone shows 4 groups of resonance signals (i)-(iv) in the  $^1\text{H}$  NMR spectrum below. Assign the protons (a)-(h) to the corresponding signals. (8 pts))



- 如果將(L)-(-)-香芹酮氫化後再還原成醇，共應可以獲得多少種 5-異丙基-2-甲基環己醇非對映異構體？(2 分) (How many possible diastereomers of 5-isopropyl-2-methylcyclohexanol can be identified if (L)-(-)-carvone is first hydrogenated, followed by reduction to alcohol? (2 pts))



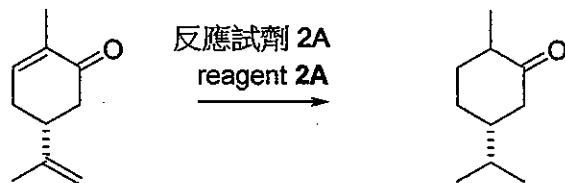
- 由(L)-(-)-香芹酮所衍生的 5-異丙基-2-甲基環己醇同分異構體中，其中有一異構體的取代基都在赤道位置，繪出這異構體的最穩定椅形構型。(2 分) (Draw the more stable chair form of the isomer of 5-isopropyl-2-methylcyclohexanol, derived from (L)-(-)-carvone, with all substituents at equatorial positions. (2 pts))

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第二題 (共 10 分) (Problem 2 (total 10 pts))

提供以下的反應試劑 2A-2E (Provide reagents 2A-2E for the following transformations)

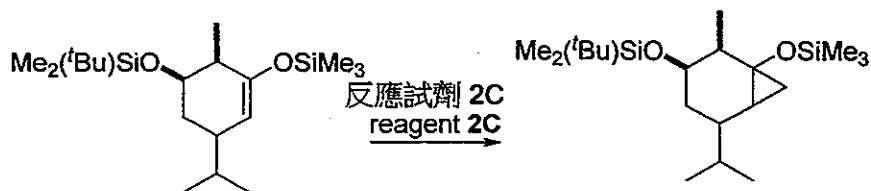
A. (2 分) (2 pts)



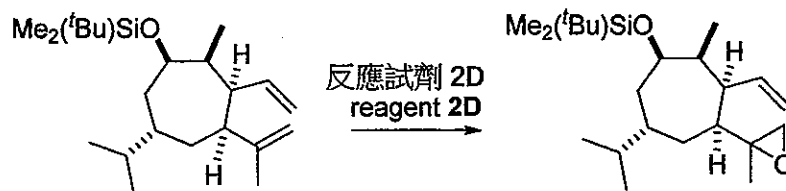
B. (2 分) (2 pts)



C. (2 分) (2 pts)



D. (2 分) (2 pts)



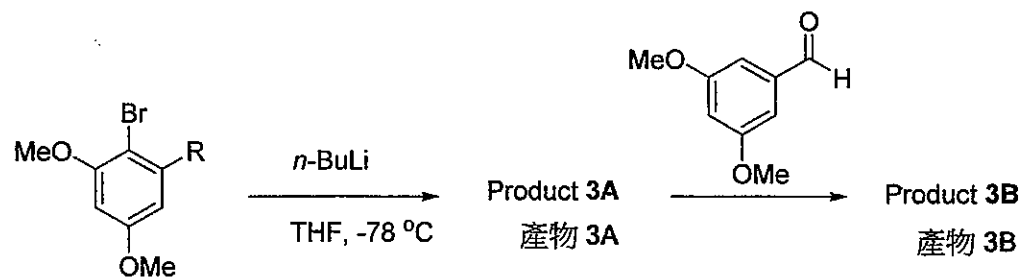
E. (2 分) (2 pts)



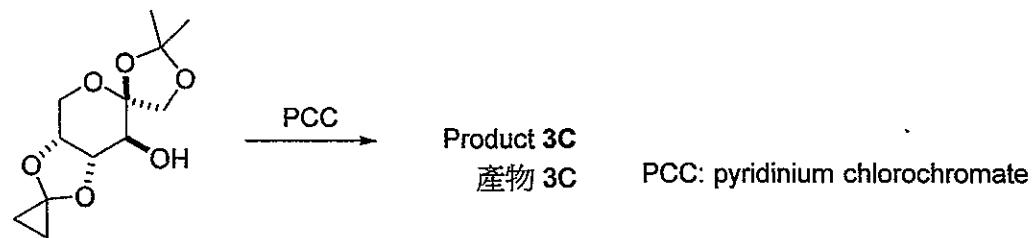
第三題 (共 6 分) (Problem 3 (total 6 pts))

預測以下反應中的產物 3A-3F。(Predict the products 3A-3F in the following reactions)

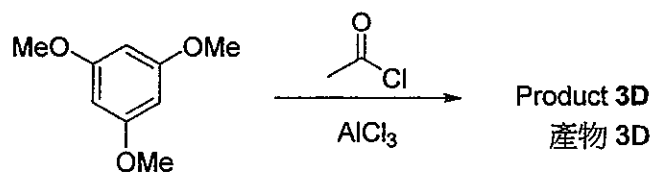
A. (2 分) (2 pts)



B. (1 分) (1 pt)



C. (1 分) (1 pt)



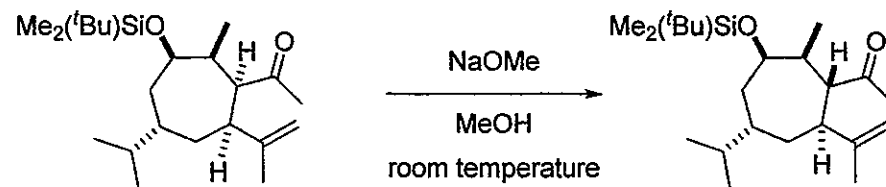
D. (2 分) (2 pts)



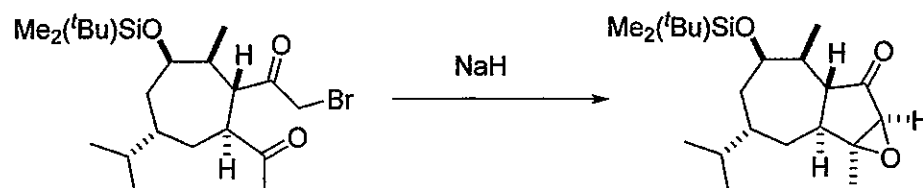
第四題 (共 18 分) (Problem 4 (total 18 pts))

提供以下反應的反應機理 (Provide reaction mechanisms for the following transformations)

A. (3 分) (3 pts)

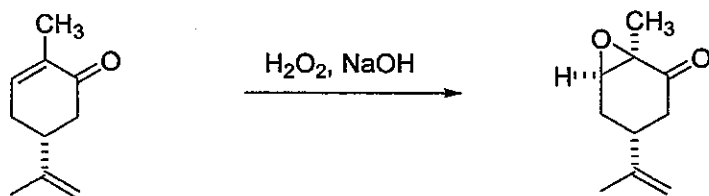


B. (3 分) (3 pts)

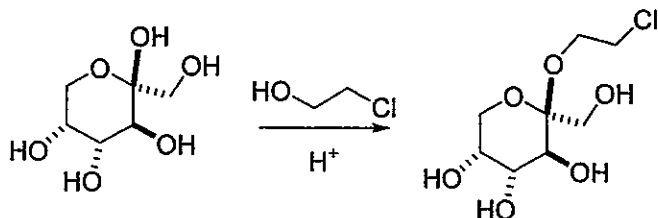


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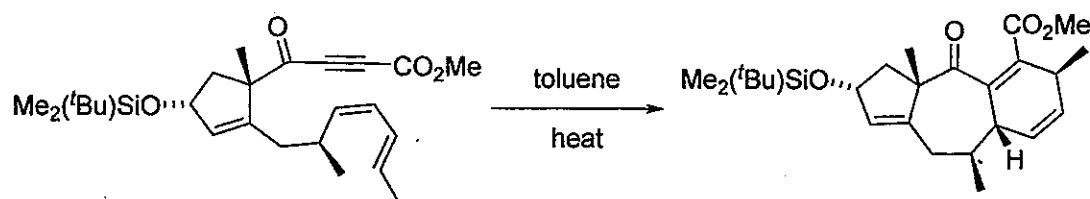
C. (3 分) (3 pts)



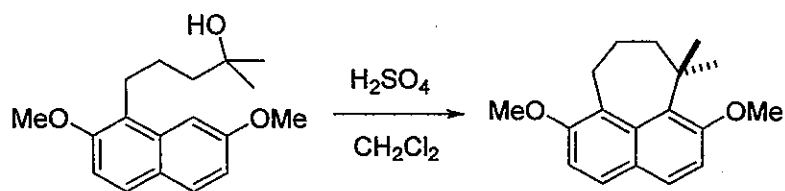
D. (3 分) (3 pts)



E. (3 分) (3 pts)



F. (3 分) (3 pts)



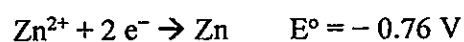
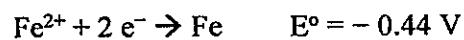
—有機部分完— (end of the organic part)

接次頁

無機化學 (50 分) ※ 注意：請於試卷內之「非選擇題作答區」依序作答，並應註明作答之部份及題號。

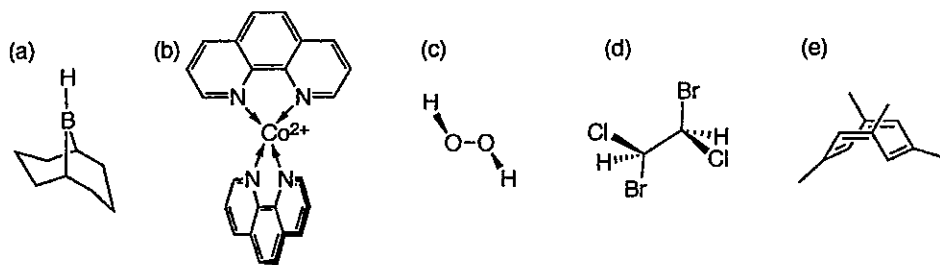
Multiple choice: 20 points (There is at least one correct choice)

1. Consider a cell based on the following half-reactions:



- The cell can be expressed as  $\text{Fe}|\text{Fe}^{2+}(\text{sol})||\text{Zn}^{2+}(\text{sol})|\text{Zn}$
- The standard cell potential is  $+0.32 \text{ V}$
- The  $\Delta G^{\circ}$  of the cell reaction at  $298 \text{ K}$  is  $-31 \text{ kJ}$  per mole of  $\text{Fe}$ .
- If the  $[\text{Fe}^{2+}] = [\text{Zn}^{2+}] = 0.1 \text{ M}$ , the cell potential become  $0.032 \text{ V}$ .
- None of the above.

2. Which of the following compound is chiral?

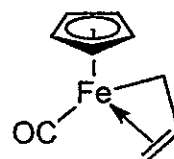
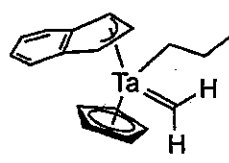
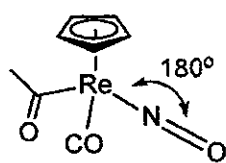


3. Which of the following statement is correct?

- The ground term of free  $\text{Co}^{2+}$  ion is  ${}^4F_{3/2}$
  - The calculated spin only effective magnetic moment of  $\text{Cu}^{2+}$  is  $1.73 \mu_B$ .
  - In an octahedral field, S and P terms will not split.
  - The ground state of a high-spin  $[\text{Cr}(\text{L})_6]^{3+}$  complex is non-degenerate.
  - None of the above.
4. Which of the following statement is correct?
- The acidity of  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$  is lower than that of  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ .
  - The crystal field strength of  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$  is higher than that of  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ .
  - Fluoride has a stronger nephelauxetic effect than iodide ligand.
  - In the same group, the M-M bond of transition metals becomes stronger as M becomes heavier.
  - None of the above.

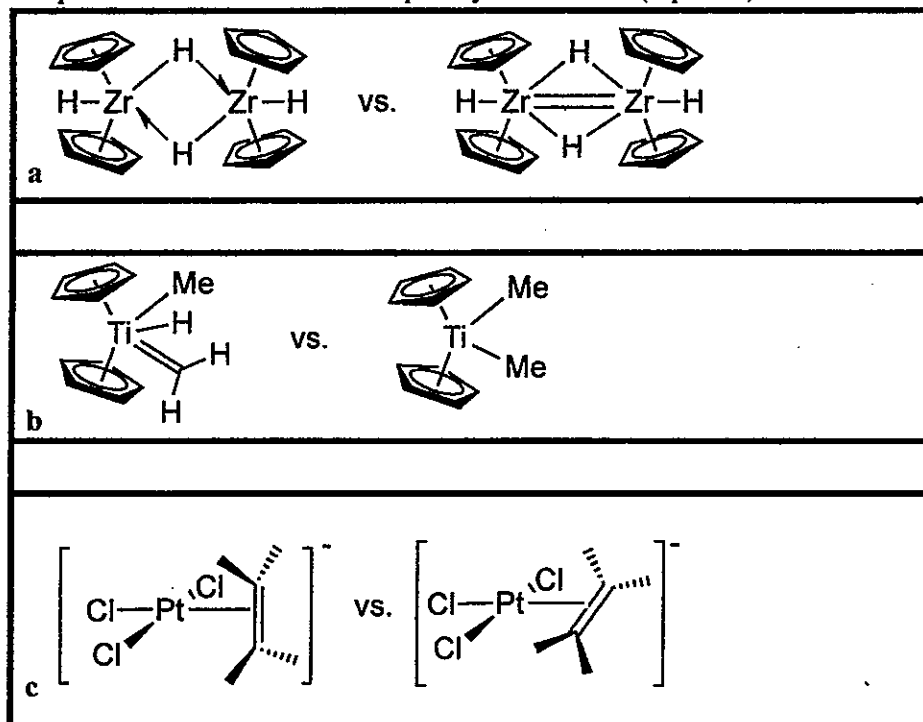
Q&A section: 30 points

5. For the following complexes, please give the *CBC assignment*, *d<sup>n</sup> configuration of the metal center*, and the *total electron count*. (9 points)



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6. Which expression of the complex is more reasonable? Explain your answer. (9 points)



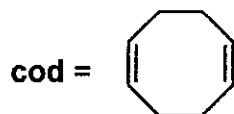
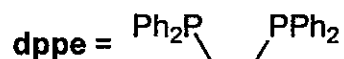
7. Order the following complexes according to their reactivity towards oxidative addition of  $H_2$ . Explain your answer. (6 points)

A:  $Cp_2TiCl_2$

B:  $[Co(cod)(dppe)]^+$

C:  $[Co(dppe)_2]^+$

D:  $[Ir(dppe)_2]^+$



8. Please explain the observed water exchange reaction rate of 3d transition metals. (6 points)



試題隨卷繳回