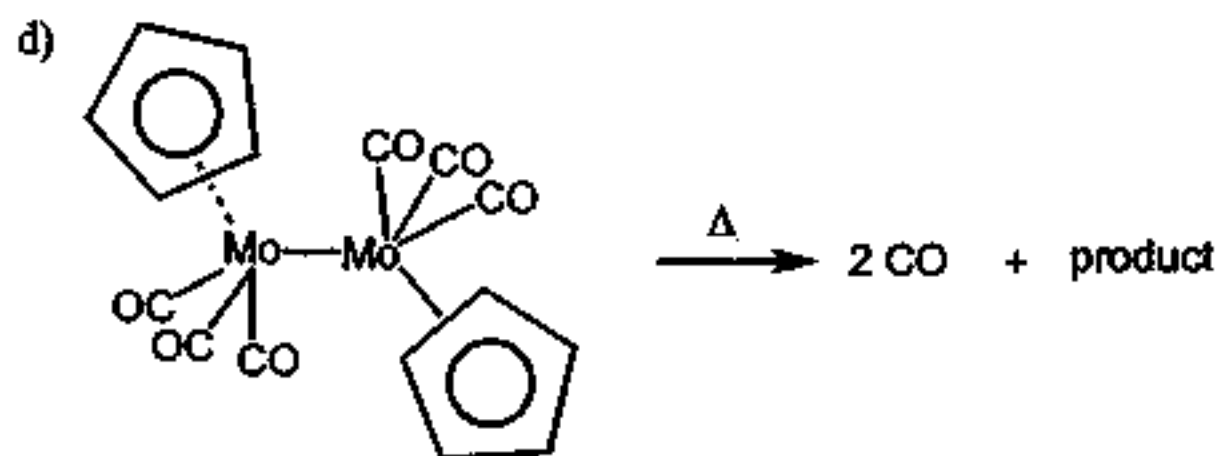
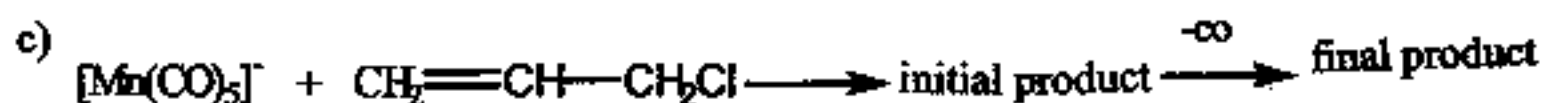
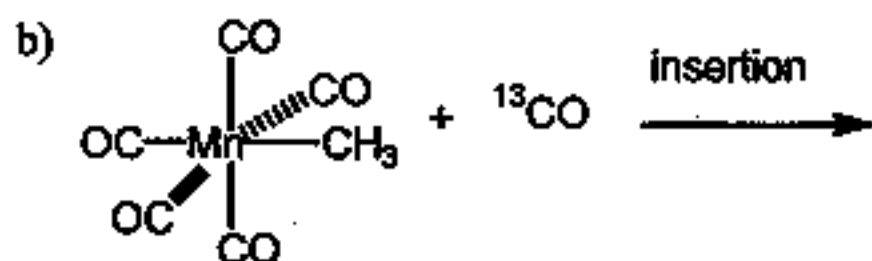
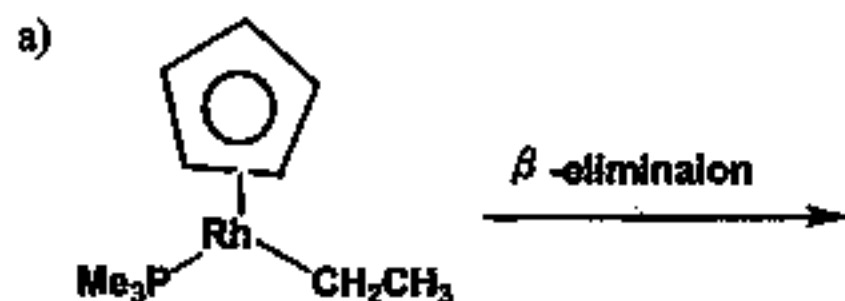
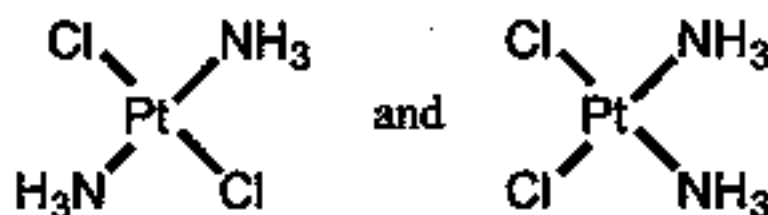


1. Predict the product of each of the following reactions (5 分)

2. Based on the definition of isolobal molecular fragments, $\text{Cr}(\text{CO})_6$ is isolobal with CH_4 . Give first-row transition metal carbonyls (or fragments) that are isolobal with CH_3 , CH_2 , and CH , respectively. (3 分)3. Using the reagents PtCl_4^{2-} , $\text{Pt}(\text{NH}_3)_4^{2+}$, NH_3 and Cl^- , design reasonable methods to prepare the following compounds. (4 分)4. Coenzyme B_{12} , cytochrome p-450, chlorophylls, myoglobin and carbonic anhydrase are important bioinorganic molecules. Some of their properties are shown below. Choose a suitable property for each of the above bioinorganic molecules from (a) to (f). (5 分)

- a) containing a Zn^{2+} ion
- b) an O_2 carrier
- c) an important molecule in photosynthesis
- d) helping to detoxify some substances by adding hydroxy groups to the substances.
- e) catalyzing the decomposition of H_2O_2
- f) an organometallic compound in nature

5. Predict the mechanism for the oxidation-reduction reactions: a) $\text{Co}(\text{NH}_3)_6^{3+} + \text{Cr}(\text{H}_2\text{O})_6^{2+}$; b) $\text{Co}(\text{NH}_3)_5\text{OH}^{2+} + \text{Cr}(\text{H}_2\text{O})_6^{2+}$. Which of these reactions is faster? Explain your answer. (5 分)

6. Give structures for: (3 分)

- a) *trans*-triammineaquadichlorocobalt(III) chloride
- b) μ -oxo-bis[pentaamminechromium(III)] ion
- c) potassium diaquabis(oxalato)manganate(III)

7. Apply the group theoretical treatment to obtain the MO description for σ bonding in PF_3 (D_{3h}). Note that the axial σ -bonds are treated as one set and the three σ -bonds in the equatorial plane are in a separate set. (6 分)

8. Give the structural formula and name of a carbon-containing molecule or molecular ion that is isoelectronic and isostructural with (a) NO_3^- , (b) NH_3 , (c) N_2O_4 and (d) N_2 . (4 分)

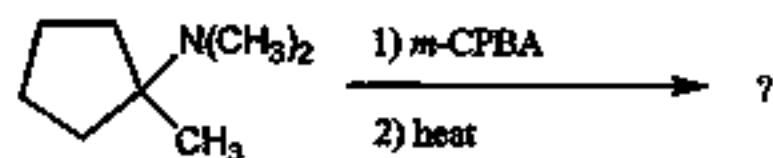
9. If π -bonding between Si and the lone pairs of N is important, what difference in structures between $(\text{H}_3\text{Si})\text{NCS}$ and $(\text{H}_3\text{C})\text{NCS}$ do you expect? Base on the similar argument, draw the molecular structure of $\text{N}_4\text{S}_4\text{F}_4$ and $\text{S}_4\text{N}_4\text{H}_4$ and predict the bonding interaction between S and N atoms. (6 分)

10. Predict the structure for BeCl_2 and PCl_5 in both gaseous phase and solid state. (Hint: these two compounds exist as discrete molecular complexes in gaseous phase but exhibit as either polymeric or ionic structure in solid state). (4 分)

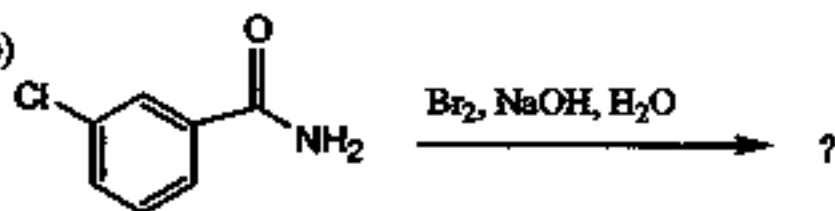
11. Write out the d block of the periodic table. Indicate that (a) the period 5 element that form 18-electron neutral Cp_2M compounds, $\text{Cp} = \text{C}_5\text{H}_5$, (b) the period 4 elements for which the simplest metal carbonyl complexes are dimeric (showing the molecular formula of these carbonyl complexes is required), and (c) the period 6 element that form neutral carbonyls with six carbonyl ligands. (5 分)

12. Give the structure of the major product with appropriate stereochemistry, if necessary, for each of the following reactions. (15%)

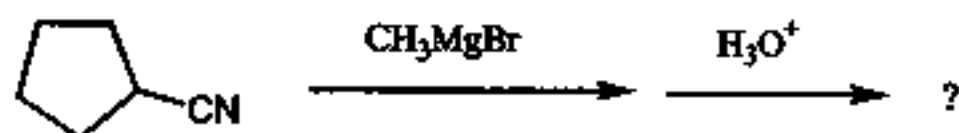
(a)



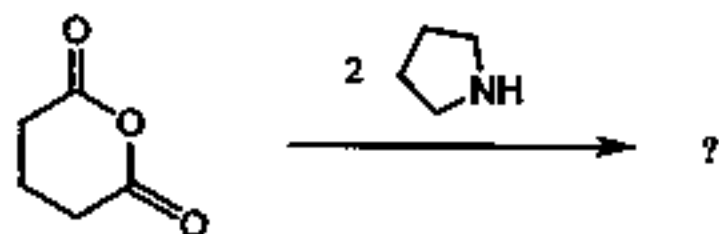
(b)



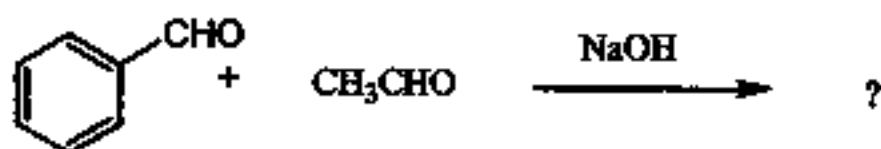
(c)



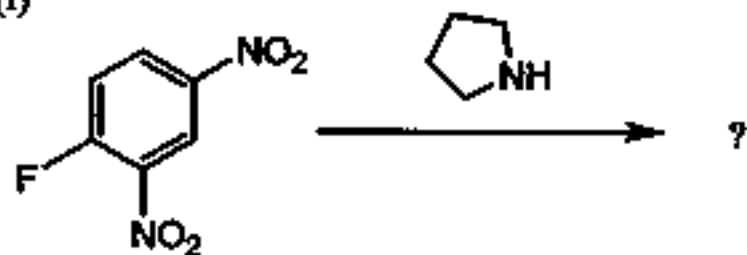
(d)



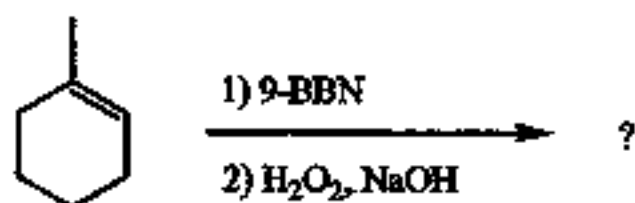
(e)



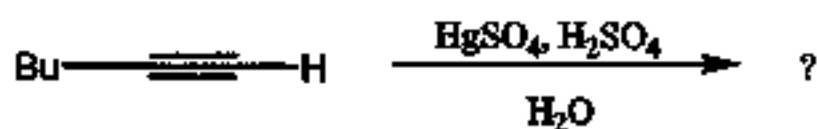
(f)



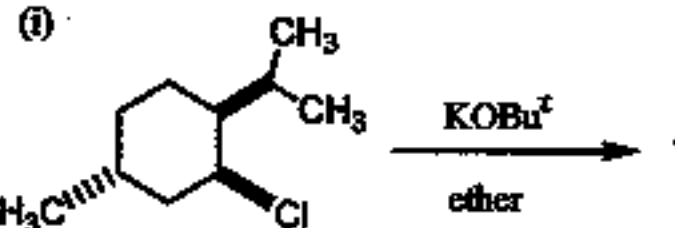
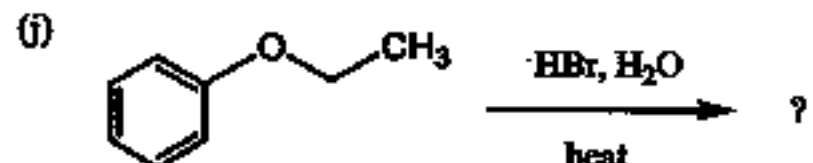
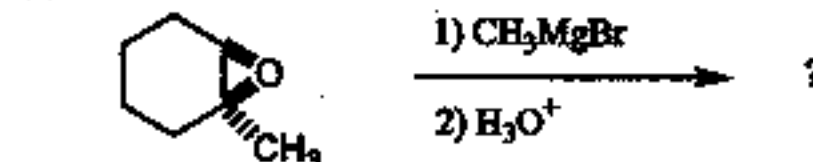
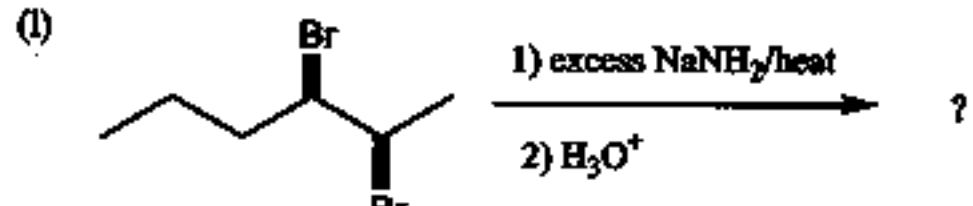
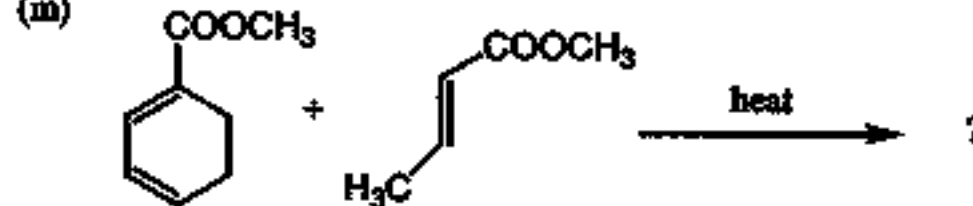
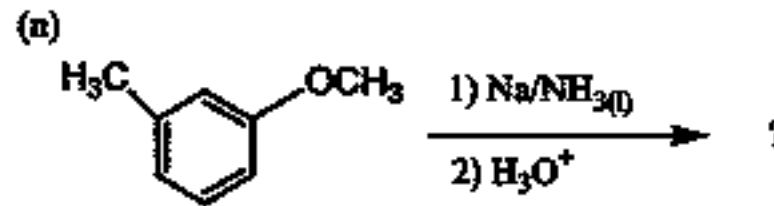
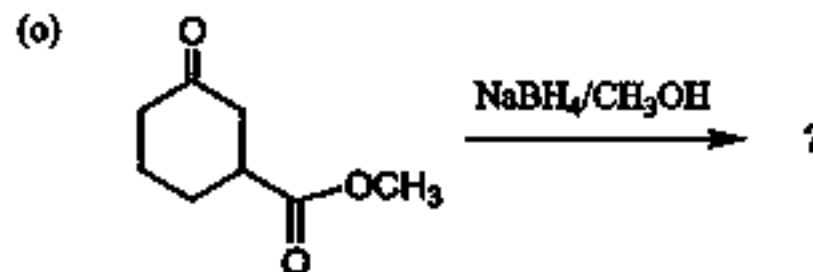
(g)



(h)

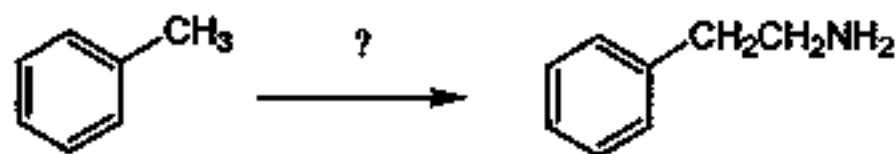


科目 無機化學及有機化學 科號 0602 0702 共 6 頁第 4 頁 *請在試卷【答案卷】內作答

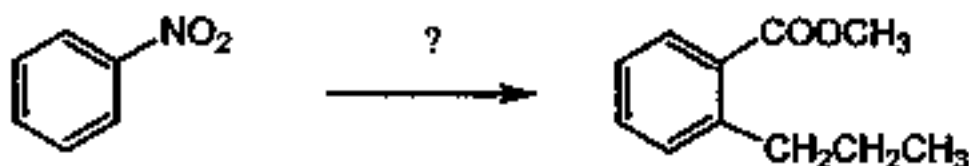
- (i)  CC(C)[C@H]1CC[C@@H](C)[C@H]1Cl >> ?
 $\xrightarrow[\text{ether}]{\text{KOBu}^t}$
- (j)  CCOC1=CC=CC=C1 >> ?
 $\xrightarrow[\text{heat}]{\text{HBr, H}_2\text{O}}$
- (k)  CC12CCC(CC1)O2 >> ?
 $\xrightarrow[2) \text{H}_3\text{O}^+]{1) \text{CH}_3\text{MgBr}}$
- (l)  CC[C@H](Br)[C@H](Br)C >> ?
 $\xrightarrow[2) \text{H}_3\text{O}^+]{1) \text{excess NaNH}_2/\text{heat}}$
- (m)  COC(=O)C1=CC=CC=C1 + CC(=C)C(=O)OC >> ?
 $\xrightarrow{\text{heat}}$
- (n)  COc1cccc(C)c1 >> ?
 $\xrightarrow[2) \text{H}_3\text{O}^+]{1) \text{Na/NH}_3(l)}$
- (o)  COC(=O)C1CCC(=O)CC1 >> ?
 $\xrightarrow{\text{NaBH}_4/\text{CH}_3\text{OH}}$

13. Show how one would accomplish the following multistep syntheses using the indicated starting material and any necessary reagents. (10%)

(a)



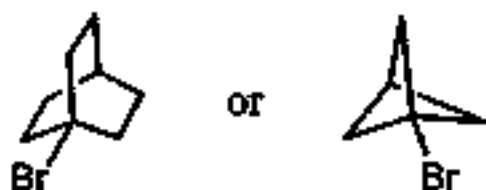
(b)



14. Draw the chemical structure for (2*R*,3*S*)-2-bromo-3-hydroxypentane in Fisher projection. (2%)

15. Draw the most stable conformation in Newman projection for 2-fluoroethan-1-ol. (2%)

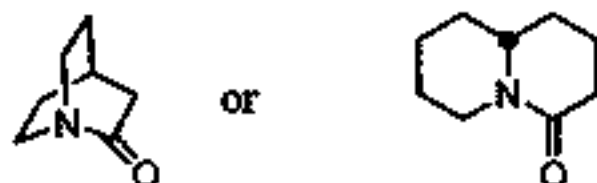
16. Which of the following compounds will undergo the S_N1 reaction faster? Explain your prediction. (2%)



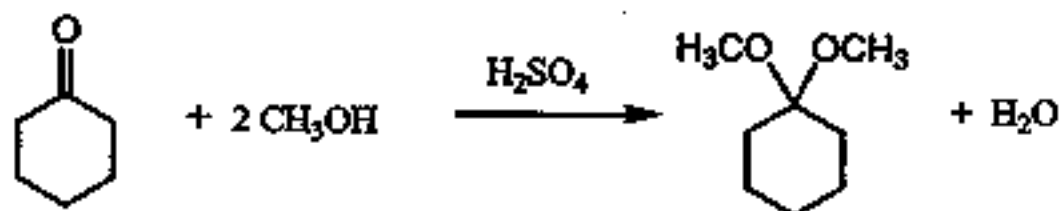
17. Arrange the following nitrogen containing compounds in an order of increasing basicity, and give a brief explanation of your arrangement. (2%)



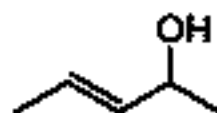
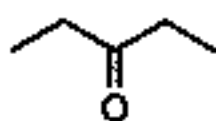
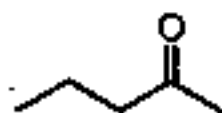
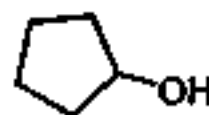
18. Which of the following compounds will show a higher carbonyl stretching frequency? Give a brief explanation. (2%)



19. Provide a plausible stepwise reaction mechanism for the following transformation. (4%)



20. Provide a sequence of simple chemical tests that would allow one to distinguish one of the following compounds from the others. (5%)



21. Deduce the molecular structure for compound that consists with the following spectral data. (6%)

IR: 1602(m), 1690(s) cm^{-1} .

^1H NMR: δ 4.71(s, 2H), 7.49(dd, 2H, $J = 8.0, 7.8$ Hz), 7.60(t, 1H, $J = 7.8$ Hz), 7.94(d, 2H, $J = 8.0$ Hz).

^{13}C NMR: δ 46.1, 128.4, 129.0, 139.2, 141.0, 191.0.

Mass(m/z): 156(5.0%), 154(15.1%), 105(100%).