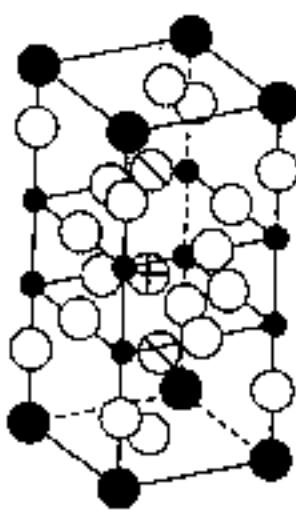
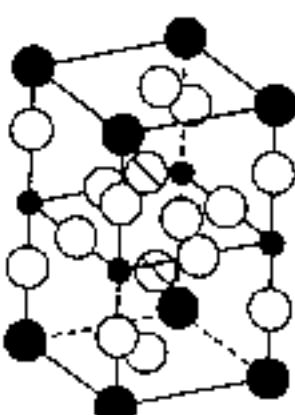
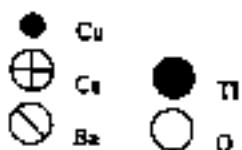


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- The OTeF_5 group is able to stabilize compounds of xenon in formal oxidation state (IV) and (VI). On the basis of VSEPR, predict the structures of $\text{Xe}(\text{OTeF}_5)_4$ and $\text{O} = \text{Xe}(\text{OTeF}_5)_4$. (4%)
- Determine the point groups of the following molecules or atomic orbitals: (6%)
 - (i) borazine, $\text{B}_3\text{N}_3\text{H}_6$
 - (ii) cyclopentadienyl anion
 - (iii) WF_6
 - (iv) d_{xy}
 - (v) $d_{x^2-y^2}$
 - (vi) d_{z^2}
- Baking powder is a mixture of aluminum sulfate and sodium bicarbonate, which generates a gas and makes bubbles in biscuit dough. Explain what the reaction are. (4%)
- An octahedral hole lies at the center of six equidistant spheres whose centers define an octahedral, while a tetrahedral hole lie at the center of four equidistant spheres, respectively. Calculate the radius r of these octahedral and tetrahedral holes with respect to the radius of the packed spheres with radius R . (6%)
- The structure of a class of ceramic, high temperature superconductors are shown below:



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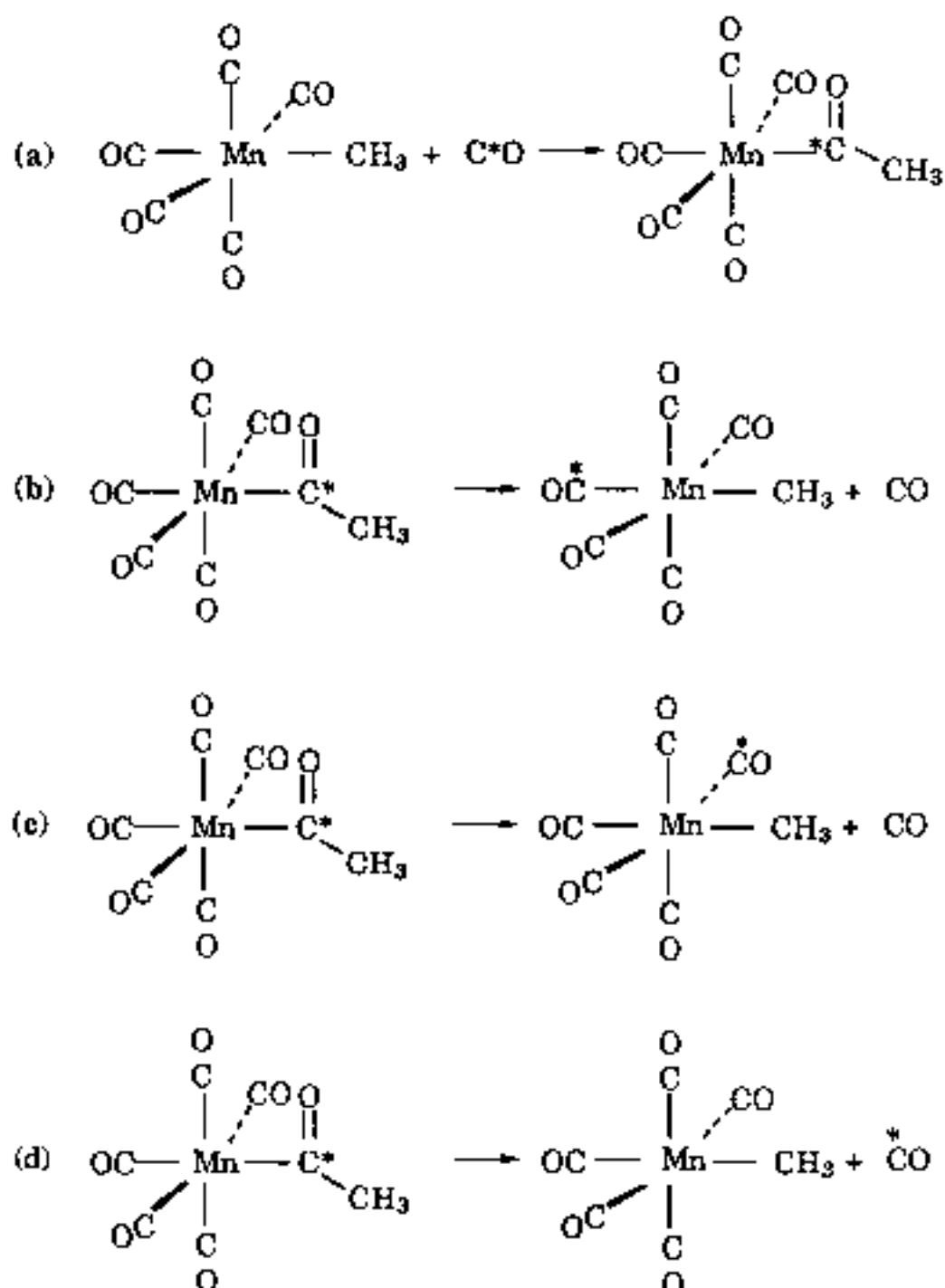
- (i) Determine the formula of these superconductors.
(ii) Assign oxidation states to Cu in each structure assuming Tl exists as Tl^{3+} . The oxidation states of Ca, Ba and O are assumed to be +2, +2, and -2, respectively.
(iii) It also appears that copper must display a mixture of oxidation states for a material to exhibit superconductivity. Explain how this occurs in these materials. (5%)

每題 = 分。仍請在
答案卷上依序作
答。

Choose the correct answer for each question. (6-12 single choice)

6. Predict the magnetic moment of hexaamineiron(II) chloride
(a) 1.82 BM (b) 3.82 BM (c) 2.40 BM (d) 5.45 BM
7. Which of the following is a strong oxidant?
(a) $(C_5H_5)_2Co$ (b) $(C_5H_5)_2Co^+$ (c) $(C_5H_5)_2Fe$ (d) $(C_5H_5)_2Fe^+$
8. How many 1H NMR signals are (is) likely observed for $(C_5H_5)_2Fe(CO)_2$ at low temperature ($-100^\circ C$)?
(a) 4 (b) 2 (c) 1 (d) 3
9. Which of the following oxidation-reduction reactions proceeds through an outer-sphere electron transfer process?
(a) $Co(NH_3)_6Br + Cr(H_2O)_6^{2+} \longrightarrow$
(b) $Co(CN)_6^{3-} + [Co(NH_3)_5OH]^{2+} \longrightarrow$
(c) $[Co(NH_3)_5F]^{2+} + [Cr(bipy)_3]^{2+} \longrightarrow$
(d) $Co(NH_3)_5Br + Eu(H_2O)_6^{2+} \longrightarrow$
10. Which reaction product is correct?

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11. What is the catalyst used for making acetic acid in industry?

- (a) PdCl_4^{2-}
- (b) $\text{Rh}(\text{CO})_2\text{I}_2^-$
- (c) $\text{RhH}(\text{CO})(\text{PPh}_3)_3$
- (d) $\text{Co}_2(\text{CO})_8$

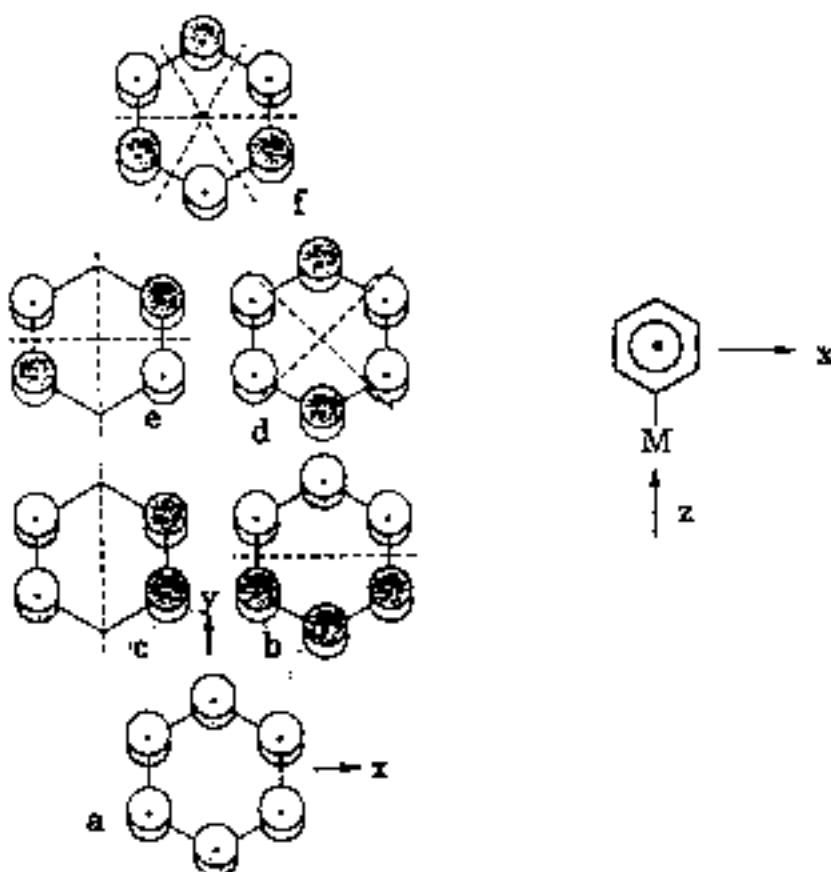
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12. Which compound in the biological systems is involved in the electron transfer reaction of photosynthesis?

- (a) coenzyme B₁₂ (b) ferredoxin (c) cytochrome P-450
(d) myoglobin

13. The π -orbitals of benzene are shown below.



If a benzene molecule is π -bonded to a metal, which of the benzene orbitals shown above form

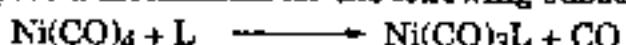
- (i) π -bonding, (ii) δ bonding with the metal center.

If the metal is Cr, which d orbitals in Cr will interact with a and b, respectively? (6%)

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14. Propose a mechanism for the following substitution reaction (3%)



what is the rate law? (2%)

15. When treated with sodium iodide, a solution of (*R*)-2-iodobutane in acetone gradually loses all its optical activity. Explain. Illustrate your explanation with a chemical equation. (4%)

16. 2,3,7,8-Tetrachlorodibenzodioxin (TCDD) is formed as a minor side-product in the synthesis of the herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T).

(a) Write reaction equations showing the synthesis of 2,4,5-T from 1,2,4,5-tetrachlorobenzene. (4%)

(b) Give a mechanism to show how 2,3,7,8-TCDD is formed in the synthesis of 2,4,5-T. (4%)

17. A single monomer **A** having the spectral data shown below is heated with a trace of water to form a polymer **B**. (13%)

(a) Propose a structure of **A** and show how it is consistent with the spectra.

(b) Write reaction equations to show how the polymerization might be accomplished.

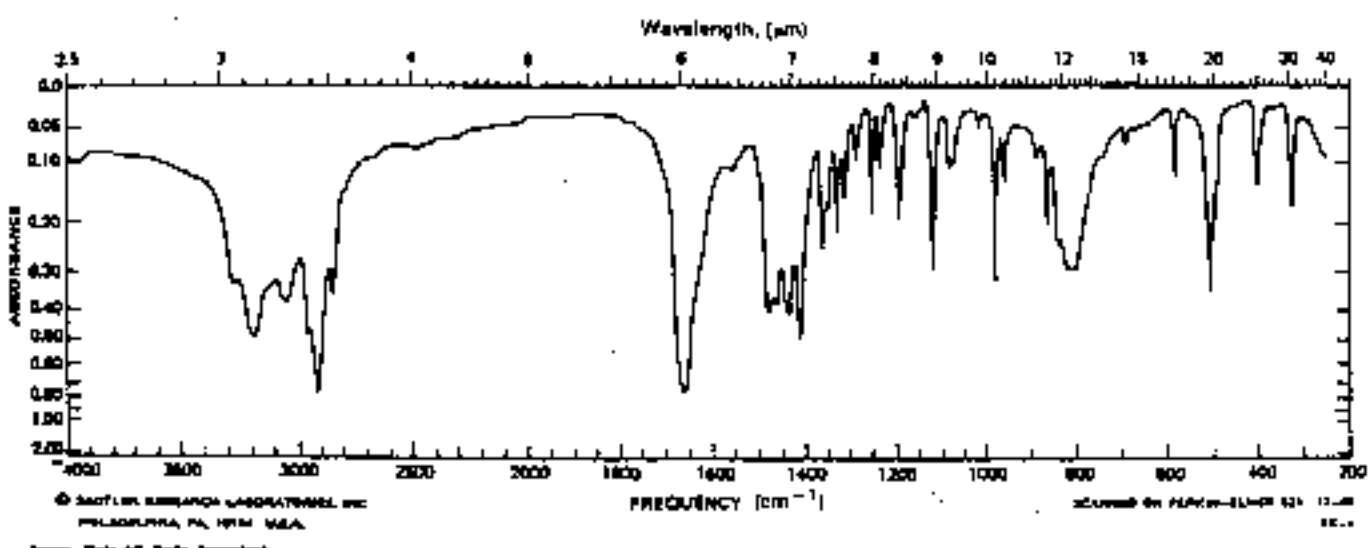
(c) Give appropriate names for monomer **A** and polymer **B**.

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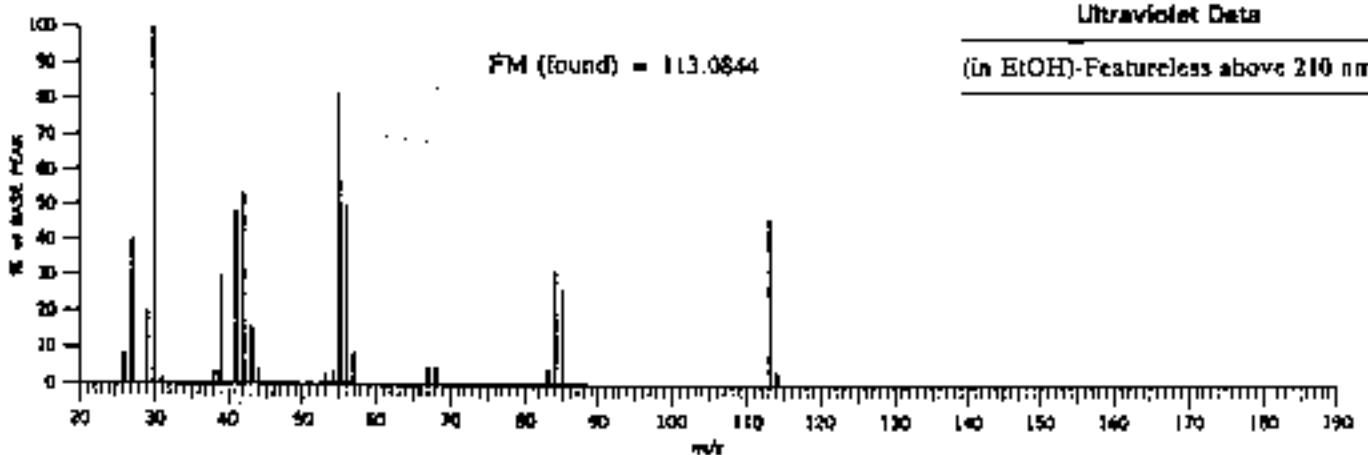
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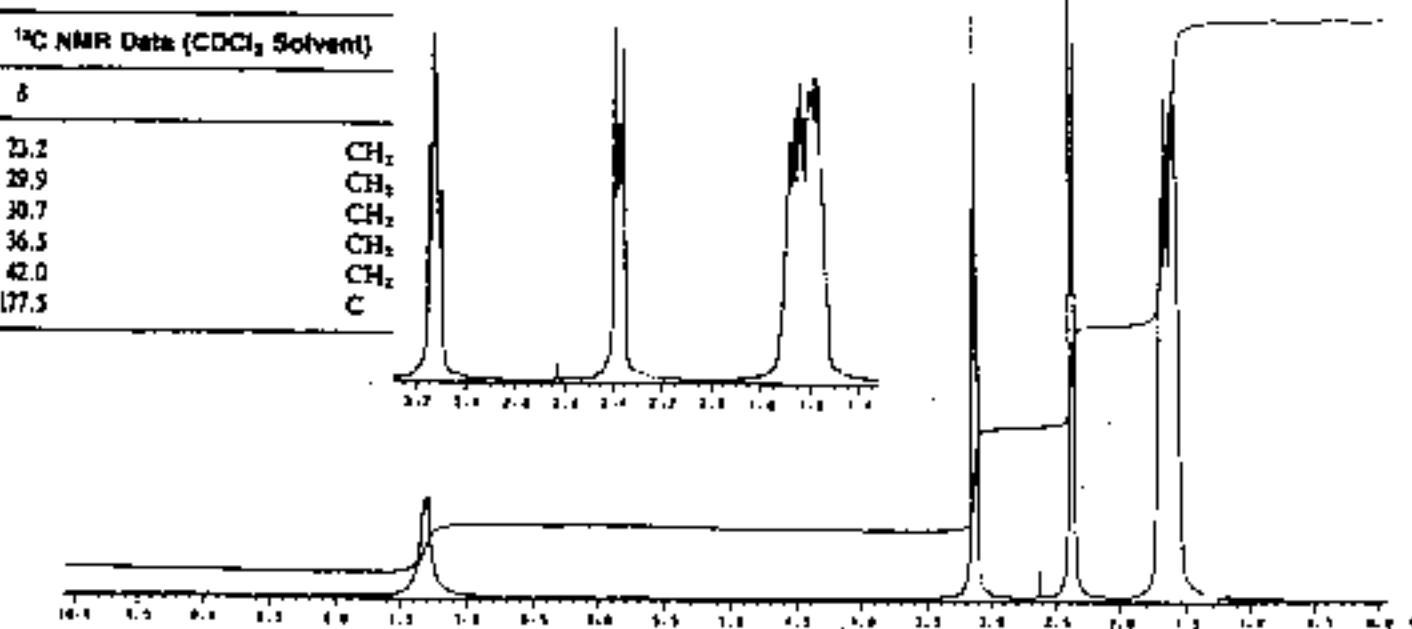
INFRARED SPECTRUM



MASS SPECTRAL DATA (Relative Intensities)



^1H NMR SPECTRUM (Solvent CDCl_3 , 300 MHz)



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18. Provide necessary reagents to complete each of the following multistep syntheses and show all intermediates. (12%)

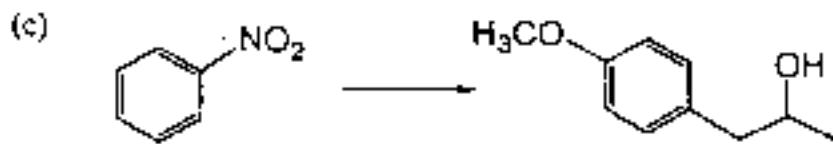
(a)



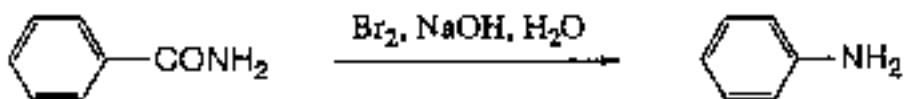
(b)



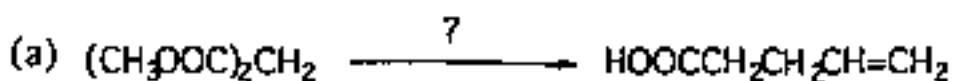
(c)



19. Give a stepwise arrow pushing mechanism for the following transformation. (3%)

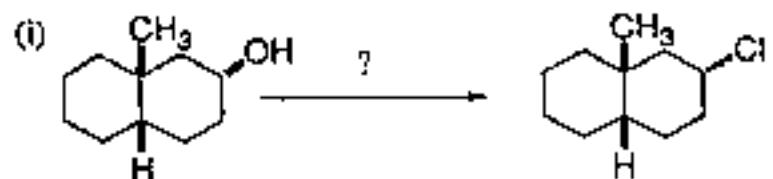
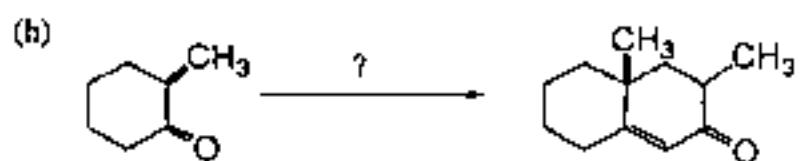
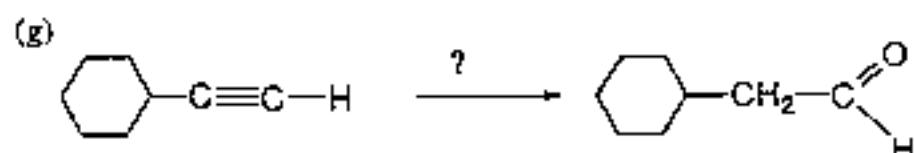
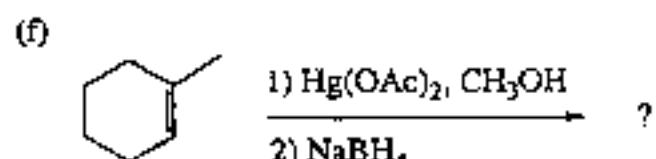
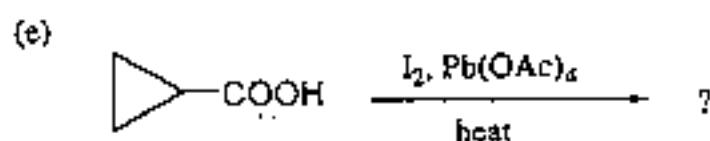
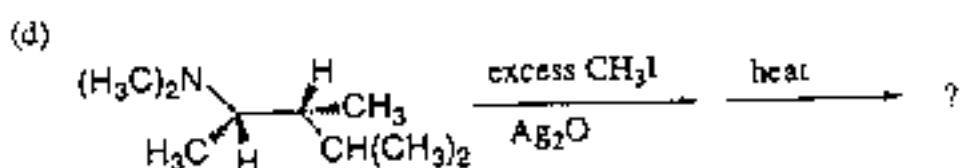
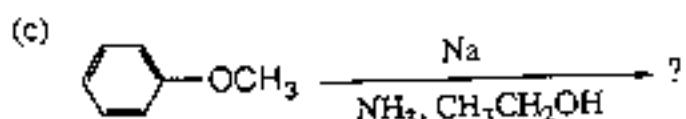
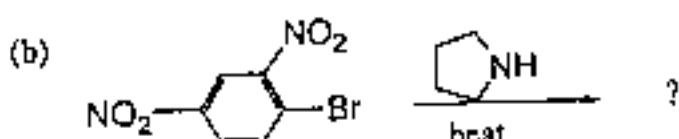


20. Give the structure of major product(s), clearly indicate the stereochemistry if necessary, or provide necessary reagent(s) to complete each of the following transformations. (10%)



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(j)

