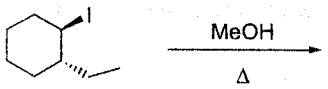
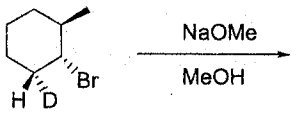
所別：化學學系碩士班 不分組 科目：有機化學與無機化學

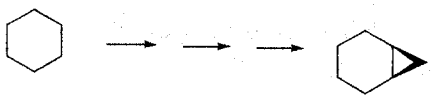
1. Provide the major organic product of the reaction below and a detailed, stepwise mechanism which accounts for its formation. (10 pts)



2. Provide the structure of the major organic product which results in the following reaction. (5 pts)



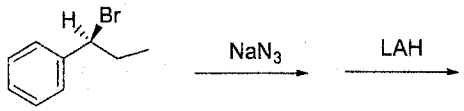
3. Provide the reagents necessary to complete the following transformation. (9 pts)



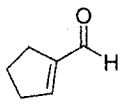
4. Deduce the identity of the following compound from the spectral data given. (5 pts)
$C_9H_{10}O_2$: ^{13}C NMR, δ 18.06 (quartet), 45.40 (doublet), 127.32 (doublet), 127.55 (doublet), 128.61 (doublet), 139.70 (singlet) (ppm), 180.98 (singlet); IR, broad 3500-2800, 1708 cm^{-1}

5. Deduce the identity of the following compound from the spectral data given. (5 pts)
$C_5H_{10}O$: ^1H NMR, δ 1.2 (6H, doublet), 2.1 (3H, singlet), 2.8 (1H, septet) (ppm); IR, 2980, 1710 cm^{-1}; MS, m/z 71, 43

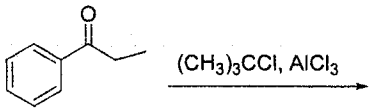
6. Provide the structure of the major organic product in the reaction below. (5 pts)



7. Provide the sequence of steps necessary to synthesize the compound shown below from cyclohexene. (6 pts)



8. Provide the major organic product of the following reaction. (5 pts)
(Hint: The starting material is deactivated. A trick question!)



注意：背面有試題

參考用

所別：化學學系碩士班 不分組 科目：有機化學與無機化學

9. Interhalogens, for example, BrF_5 and I_2Cl_6, undergo autoionization in liquid phases and have been used as nonaqueous solvents. Explain by the equation. (6 pts)

10. Give the preferred molecular shapes of the following molecule. (6 pts)
(a) XeO_3 (b) OIF_3 (c) $O_2IF_2^-$ (d) XeO_2F_2

11. Determine the numbers of electrons for the following compounds: (6 pts)
(a) $Re(PPh_3)_3Cl_2N$ (b) $Os(CO)(CPh)(PPh_3)_2Cl$ (c) $[Ni(lin\text{-}NO)_3(SiMe_3)]^{2+}$ (d) $[CpCr(NO)_2]_2$

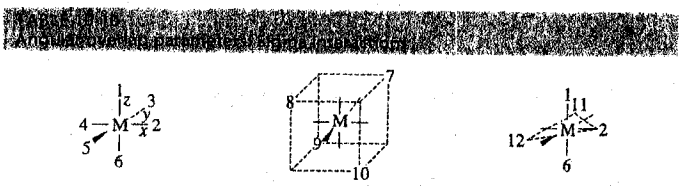
12. Calculate LFAE (Ligand Field Stabilization Energy) values (σ interaction only) for an octahedral d^6 ion undergoing dissociative substitutions with SP as intermediate. (8 pts)
(Table is attached below)

13. Classify the following borane derivatives by structural type. (6 pts)
(a) $C_2B_8H_{10}IrH(PPh_3)_2$ (b) $C_2B_9H_{11}Ru(CO)_3$ (c) $Os_6(CO)_{17}[P(OMe)_3]_3$ (d) $B_{10}H_{18}$

14. Determine the point groups of the following compounds. (6 pts)
(a) $P(C_6H_5)_3$ (b) $OsCp_2$ (eclipsed) (c) HCN (d) $[Co(en)_3]^{3+}$

15. The structure of $Co_2(CO)_8$ is different in solid and solution states, and the symmetry element is C_{2v} and D_{3d}. Draw these two structures. (4 pts)

16. Using the usual d-orbital splitting diagrams, predict the relative strength of the Jahn-Teller effects for a metal ion d^4 and d^7. (8 pts)



Octahedral positions

Square Planar: 2, 3, 4, 5
Linear: 1, 6

Tetrahedral positions

Trigonal bipyramidal positions
Trigonal: 2, 11, 12

Sigma interactions (all in units of e_σ)
metal d orbital

Ligand position	z^2	x^2-y^2	xy	xz	yz
1	1	0	0	0	0
2	1/4	3/4	0	0	0
3	1/4	3/4	0	0	0
4	1/4	3/4	0	0	0
5	1/4	3/4	0	0	0
6	1	0	0	0	0
7	0	0	1/3	1/3	1/3
8	0	0	1/3	1/3	1/3
9	0	0	1/3	1/3	1/3
10	0	0	1/3	1/3	1/3
11	1/4	3/16	9/16	0	0
12	1/4	3/16	9/16	0	0

參考用