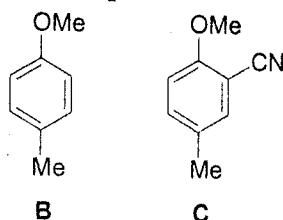
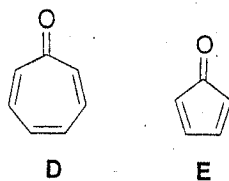


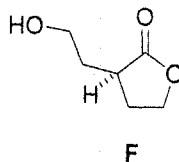
1. 2-Bromopropane can undergo S_N2 , S_N1 , E2, or E1 reaction as the major reaction pathway, depending on the reaction conditions. Give one example for each of these four types of reactions for 2-bromopropane with reaction conditions (reagents, solvents, and temperature) and the structure of products. (10 pts)
2. When acetone is treated with anhydrous ammonia in the presence of anhydrous calcium chloride (a common drying agent), crystalline product **A** is obtained on concentration of the organic liquid phase of the reaction mixture. These are spectral data for product **A**:
MS (m/z): 155 (M^+), 140
IR (cm^{-1}): 3350 (sharp), 2850-2960, 1705
 1H NMR (δ): 2.3 (s, 4H), 1.7 (1H; disappears in D_2O), and 1.2 (s, 12H)
(a) What is the structure of **A** (assign the peaks for IR and NMR)? (5 pts)
(b) Propose a mechanism for formation of **A** (use curved arrows). (5 pts)
3. How would you convert compound **B** to compound **C**? (10 pts)



4. Explain the following observations.
(a) Cycloheptatrienone (**D**) is very stable. Cyclopentadienone (**E**) by contrast is quite unstable. (5 pts)



- (b) The C-H bond dissociation energy in ethane, ethene, and ethyne is ethane < ethene < ethyne. (5 pts)

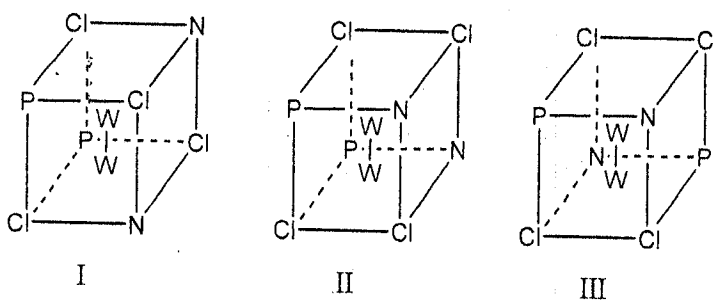


- (c) Compound **F** racemizes in base. (5 pts)
(d) The order of basicity of these amines in aqueous solution is $Me_2NH > MeNH_2 > Me_3N$. (5 pts)

注意：背面有試題

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5. Predict the structures of the following. (6 pts)
 (a) IOF_4^- (b) XeOF_4 (c) XeF_8^{2-}
6. Which compound has the smallest bond angle in each series? (4 pts)
 (a) OSF_2 , OSCl_2 , OSBr_2 (X-S-X angle); (b) PI_3 , AsI_3 , SbI_3
7. Classify the following configuration as A, E or T in complexes having O_h symmetry. Some of these configurations represent excited states. (6 pts)
 (a) t_{2g}^5 (b) $t_{2g}^3 e_g^3$
8. Identify the most likely second-row transition metal for each of the following:
 (a) $\text{M}(\text{PF}_3)_2(\text{NO})_2^+$ (linear M-N-O bond) (3 pts)
 (b) $[\text{M}(\text{CO})_4(\mu_2\text{-H})]_3$ (3 pts)
9. Predict the relative order of $\text{IR}_{(\text{NO})}$ frequencies for the following compounds. (6 pts)
 $[\text{Cr}(\text{CN})_5(\text{NO})]^{4+}$, $[\text{Mn}(\text{CN})_5(\text{NO})]^{3+}$, $[\text{Fe}(\text{CN})_5(\text{NO})]^{2+}$
10. $\text{BrCH}_2\text{CH}_2\text{CH}_2\text{Mn}(\text{CO})_5$ is formed by reaction of $\text{Mn}(\text{CO})_5^-$ with 1,3-dibromopropane. However, the reaction does not stop here; the product reacts with additional $\text{Mn}(\text{CO})_5^-$ to yield a carbene complex. Propose a structure for this complex and suggest a mechanism for its formation. (10 pts)
11. Three isomers of $\text{W}_2\text{Cl}_4(\text{NHR})_2(\text{PMe}_3)_2$ are possible. Determine the point group of each. (6 pts)



12. BrF_3 , I_2Cl_6 and even H_2SO_4 are widely used as nonaqueous solvents. They undergo significant autodissociation. Show the corresponding reaction. (6 pts)