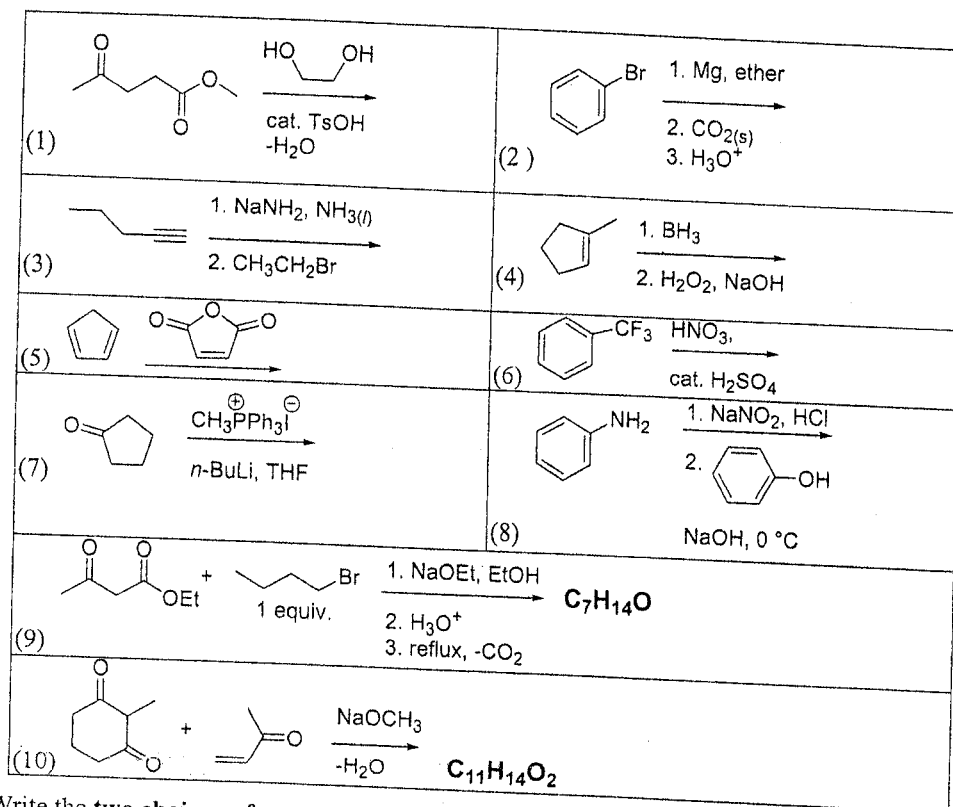


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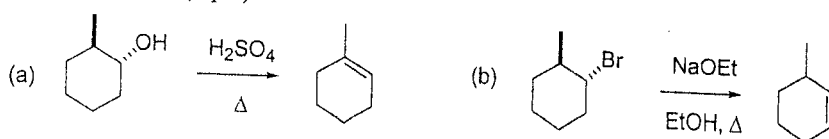
1. Please provide **one** major product with appropriate stereochemistry for each of the following transformations (20 pts).



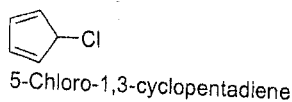
2. Write the **two chair conformations** for each of the following compounds and assign which conformation would be more stable. (4 pts)

(a) *cis*-1-*tert*-butyl-3-methylcyclohexane (b) *trans*-1-*tert*-butyl-4-methylcyclohexane

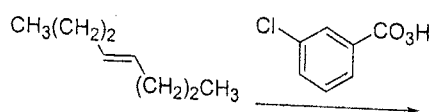
3. **Explain** the different products formed in the two reactions below. You may start from the reactions types to give a rational. (4 pts)



4. 5-Chloro-1,3-cyclopentadiene undergoes S_N1 solvolysis in the presence of silver ion extremely slow even though the chlorine is allylic. Provide an explanation for this behavior. (4 pts)



5. For the reaction of *trans*-4-octene and *m*-chloroperbenzoic acid:

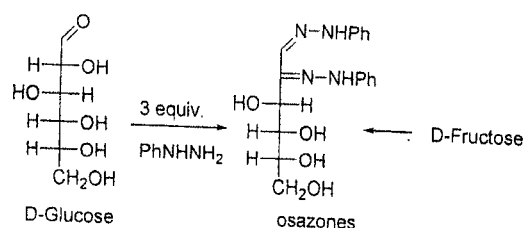


(a) Give the product with appropriate stereochemistry. (2 pts). (b) Is the product from this reaction optically active? (1 pt). (c) How would you describe the product from this reaction *stereochemically*? (1 pt).

6. Both D-glucose and D-fructose undergo reaction with phenylhydrazine to give the same product, osazones, as shown below:

注：背面有試題

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- (a) Draw D-glucose in its α -pyranose form. (2 pts) (b) D-Fructose is a ketose. Provide the structure of D-fructose. (3 pts) (c) Provide a reaction mechanism to explain the transformation of D-glucose to osazones. (3 pts)
7. Compound A has the molecular formula $C_6H_{12}O_3$ and shows a strong IR absorption peak at 1710 cm^{-1} . When treated with iodine in aqueous sodium hydroxide, A gives a yellow precipitate. When A is treated with Tollen's reagent, no reaction occurs, however, if A is treated with water containing a drop of sulfuric acid and then with Tollen's reagent, a silver mirror forms in the test tube. Compound A shows the following 1H NMR spectrum:
Singlet δ 2.1 (3H); Doublet δ 2.1; Triplet δ 4.7; Singlet δ 3.2 (6H).
Write a structure for A. You should show how you deduce the structure as much as you can. (6 pts)
8. Silicates are very common materials in earth, what is the chemical formula of silicate? Name three silicates. (5 pts)
9. Hydrogen bonding is a very important inter- or intra-molecular interaction. Give five examples about the effect of hydrogen bonding on the properties of the materials. (5 pts)
10. Using the character table given below, draw the molecular orbitals of CO_2 . (10 pts)

D_{2h}	E	$C_2(z)$	$C_2(y)$	$C_2(z)$	i	$\sigma(xy)$	$\sigma(xz)$	$\sigma(yz)$	
A_g	1	1	1	1	1	1	1	1	x^2, y^2, z^2
B_{1g}	1	1	-1	-1	1	1	-1	-1	xy
B_{2g}	1	-1	1	-1	1	-1	1	-1	Rz
B_{3g}	1	-1	-1	1	1	-1	-1	1	Ry
A_u	1	1	1	1	-1	-1	-1	1	Rx
B_{1u}	1	1	-1	-1	-1	-1	1	1	yz
B_{2u}	1	-1	1	-1	-1	1	-1	1	z
B_{3u}	1	-1	-1	1	1	-1	1	-1	y
									x

11. Arrange the following acids according to its acidic strength and explain why? (6 pts)
 SiH_4 , AsH_3 , HBr , HI .
12. Write down the products of the following reactions. (2 pts each, 10 pts)
- $2NH_4NO_3 \longrightarrow$
 - $P_4O_{10} + 6H_2O \longrightarrow$
 - $2SF_4 + XeF_4 \longrightarrow$
 - $V(CO)_6 + NO \longrightarrow$
 - $[(\eta^5-C_5H_5)Fe(CO)_2]_2 + Al(C_2H_5)_3 \longrightarrow$
13. Classify the following configurations as A, E, or T in complexes having O_h symmetry. (2 pts each, 4 pts)
- $t_{2g}^4 e_g^2$
 - $t_{2g}^3 e_g^3$
14. Lead can be accumulated in the bones and other body tissues unless removed soon after ingestion. In some cases, treatment with chelating agents such as EDTA has been used to remove lead, mercury or other heavy metals from the body. Discuss the advantages and disadvantages of such treatment. Include both thermodynamic and kinetic arguments in your answer. (10 pts)