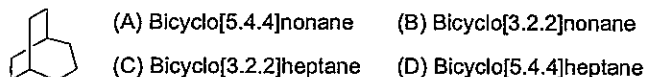


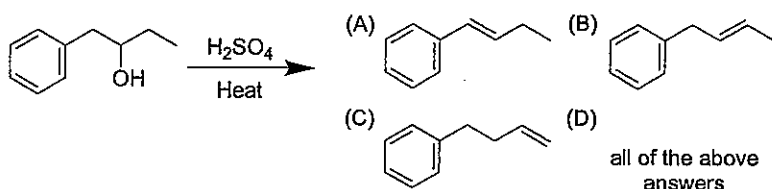
Part I. Organic Chemistry

一、單選題 (共 18 題，每題兩分，答錯倒扣一分) ※注意：請於試卷上”選擇題作答區”依序作答

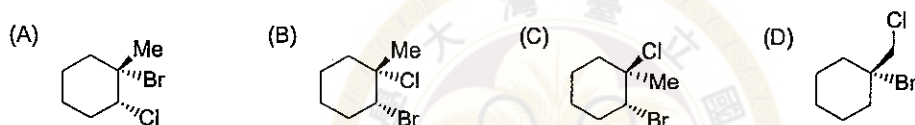
1. What is the name of the following compound?



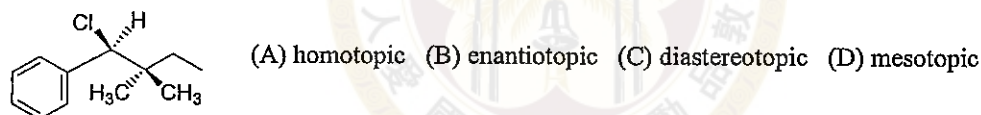
2. Which alkene is likely to be the major product of the following dehydration reaction?



3. What is the major product of the reaction of BrCl with 1-methylcyclohexene?



4. In the following compound, what is the relationship between the two methyl groups?



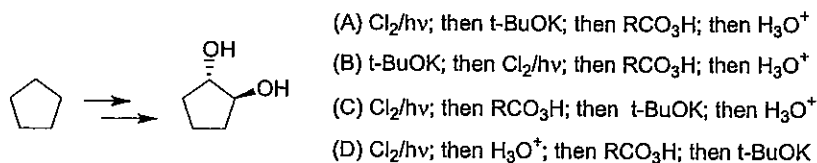
5. How will the methyl carbon appear in the proton off-resonance decoupled ^{13}C NMR spectrum of toluene?

(A) singlet (B) doublet (C) triplet (D) quartet

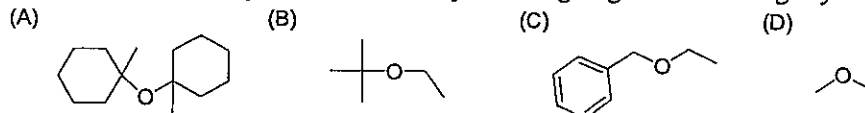
6. A prominent signal of $[M - 18]^+$ in mass spectrum suggests that the compound is most likely to be a(n):

(A) alkane (B) lactone (C) thiol (D) alcohol

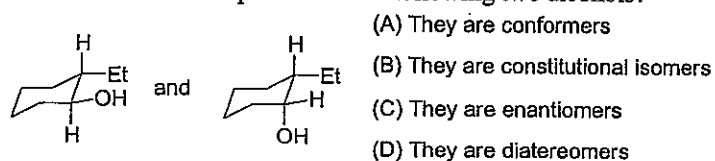
7. Which of the following synthetic routes is the most reasonable one to achieve the transformation below?



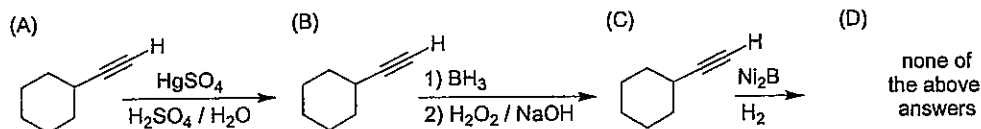
8. Which of the following ether is **least** likely to undergo significant cleavage by hot aqueous H_2SO_4 ?



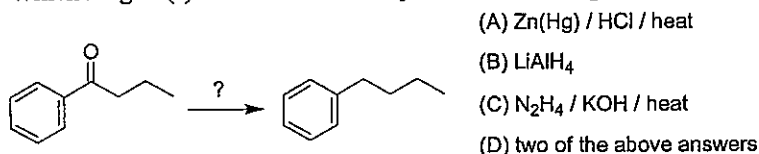
9. What is the relationship between the following two alcohols?



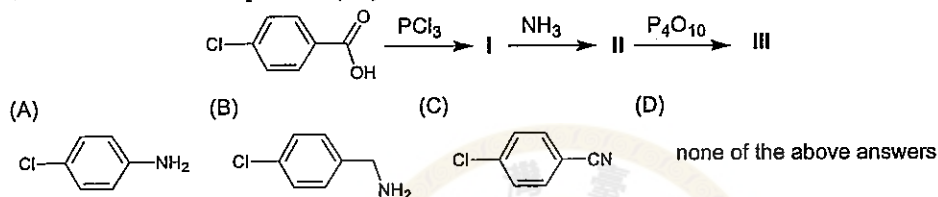
10. Which of the following reaction is most likely to produce compound that give positive iodoform test?



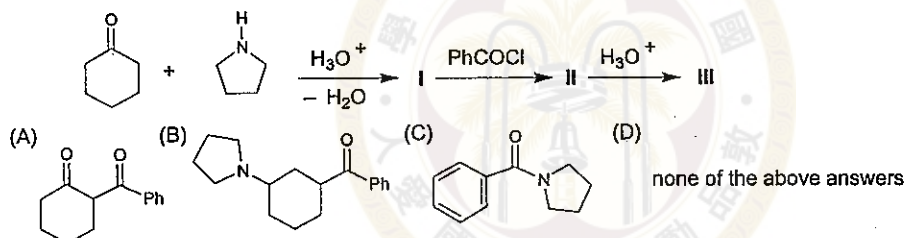
11. Which reagent(s) can be used to carry out the following transformation efficiently?



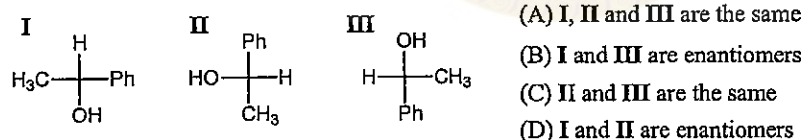
12. What will be the final product (III) of the following reaction sequence?



13. What will be the final product (III) of the following reaction sequence?



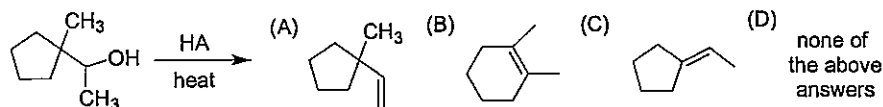
14. For compound I, II and III, which of the following statement is correct?



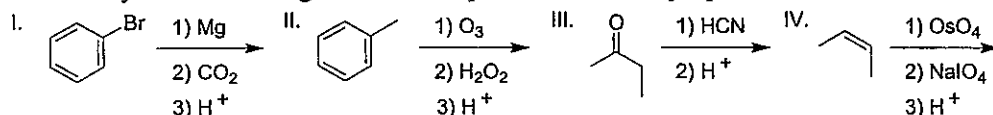
15. In general, diastereomers that differ in configuration of only one stereogenic center called:

(A) tautomers (B) edimers (C) epimers (D) ecimer

16. Which of the following compound is most likely to be the major product of the following reaction?

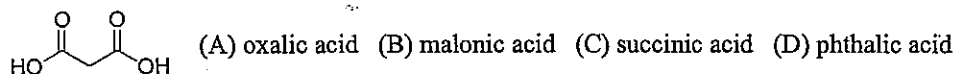


17. How many of the following reactions will produce acid as major product?



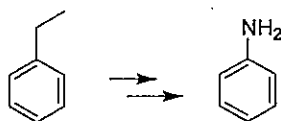
(A) 1 (B) 2 (C) 3 (D) 4

18. What is the name of the following compound?

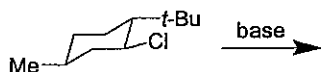


二、問答題 (14 分, 共 3 題) ※注意:請於試卷上”非選擇題作答區”依序作答並應註明作答之題號

19. Propose the structure of unknown compound $C_5H_{10}O_2$ according to its strong absorption band near 1740 cm^{-1} and the $^1\text{H NMR}$ data below: (4 points)
 $^1\text{H NMR}$: δ 0.90 (triplet); δ 1.60 (multiplet); δ 1.95 (singlet); δ 3.95 (triplet).
20. Propose a reasonable synthetic route for the following transformation. Key intermediates and important reagents are required to show in each step. (5 points)



21. If limited the following reaction in E2 pathway only, how many elimination product(s) can be obtained in reasonable amount? Explain. (5 points)



Part II. Inorganic Chemistry

三、多重選擇題: (30分; 共6題; 每個選項1分, 答錯倒扣0.5分) ※注意:請於試卷上”非選擇題作答區”以”(a) O (b) X (c) O (d) X (e) O”的方式, 依序作答並註明作答之題號

22. Which of the following species has “square planar” geometry?
- (a) SiF_4 (b) SF_4
(c) XeF_4 (d) IF_4^+
(e) PdCl_4^{2-}
23. Which of the following lattices has two lattice points per unit cell
- (a) primitive tetragonal (b) body-centered cubic
(c) face-centered orthorhombic (d) end-centered cubic
(e) primitive triclinic
24. Which of the following compounds has “normal spinel” structure?
- (a) MgAl_2O_4 (b) CaTiO_3
(c) FeNi_2O_4 (d) Mn_3O_4
(e) Fe_2O_3
25. Which of the following statements is CORRECT?
- (a) The basicity toward gas phase H^+ is $\text{NH}_3 < \text{CH}_3\text{NH}_2 < (\text{CH}_3)_2\text{NH} < (\text{CH}_3)_3\text{N}$
(b) The basicity in water is $\text{NH}_3 < \text{CH}_3\text{NH}_2 < (\text{CH}_3)_2\text{NH} < (\text{CH}_3)_3\text{N}$
(c) The 10Dq value is $\text{CrO}_4^{4-} > \text{MnO}_4^{3-} > \text{FeO}_4^{2-}$
(d) The 10Dq value is $\text{OsO}_4^{2-} > \text{RuO}_4^{2-} > \text{FeO}_4^{2-}$
(e) The oxidizing power is $\text{ReO}_4^{2-} > \text{TcO}_4^- > \text{MnO}_4^-$

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26. Based on the 18 e- Rules, which of the following complexes is stable?

- (a) $\text{Fe}(\text{C}_5\text{H}_5)_2$ (b) $[\text{Fe}(\text{CN})_6]^{3-}$
(c) $[\text{Co}(\text{NH}_3)_6]^{3+}$ (d) $\text{Pd}(\text{CO})_4$
(e) $(\text{C}_5\text{H}_5)\text{Mo}(\text{CO})_3\text{H}$

27. Which of the following term symbols can be found on free gas Ti^{2+} ion?

- (a) ^1S (b) ^3G (c) ^1P (d) ^3F (e) ^1D

四、問答題 (20分，每大題10分，共2大題) ※注意：請於試卷上“非選擇題作答區”依序作答並應註明作答之大題及小題之題號

28.

- (a) Show the molecular orbital energy level diagram of HF, indicating the bonding, antibonding and non-bonding orbitals.
(b) What are the bond orders of HF, HF^+ , and HF^- , respectively? Also, put them in the order of increasing bond length.

29.

- (a) Show the crystal field splitting diagrams of 3d-orbitals for the following complexes. Which of them is paramagnetic?
(i) $[\text{NiL}_4]^{2-}$ (ii) $[\text{Ni}(\text{CN})_4]^{2-}$
(b) How can you distinguish complex (i) and (ii), by UV and IR spectroscopies? Explain.