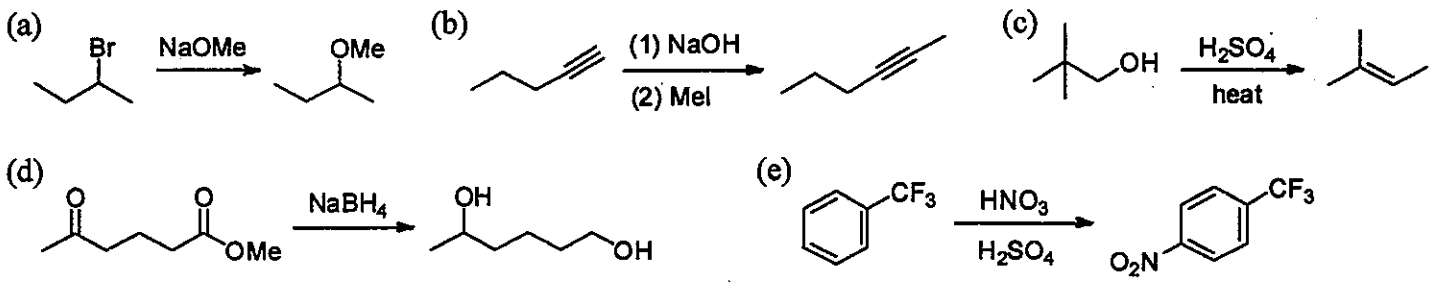
第一部份：單選題 (3pts each) 請用 2B 鉛筆作答於答案卡，並先詳閱答案卡上之「畫記說明」。

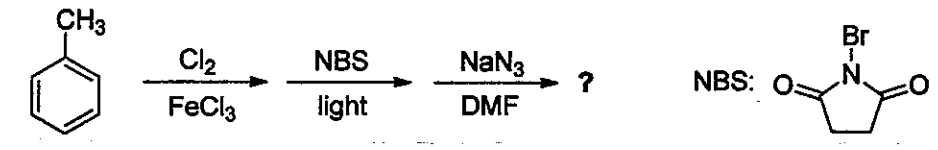
1. How many of the following species can primarily serve as a nucleophile?
(a) proton (b) hydroxide ion (e) triethylamine (c) boron trifluoride (d) triphenylphosphine
(f) methanol (g) pyridine
(A) 3 (B) 4 (C) 5 (D) 6 (E) 7

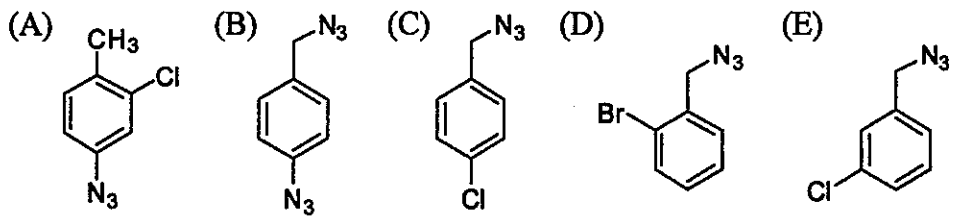
2. How many of the following reactions can afford the major product as shown?



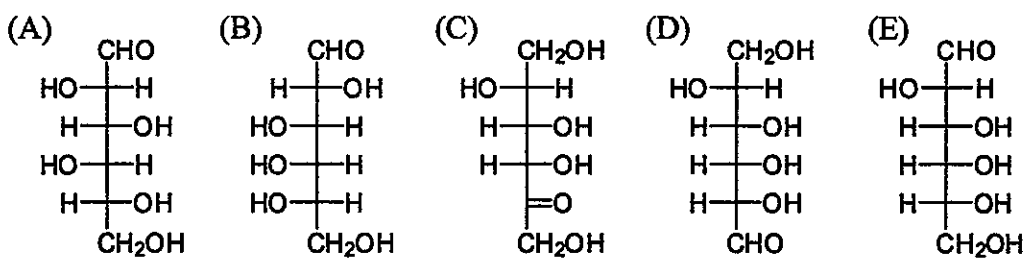
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

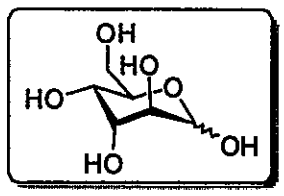
3. Which is the major product of the following synthetic scheme?



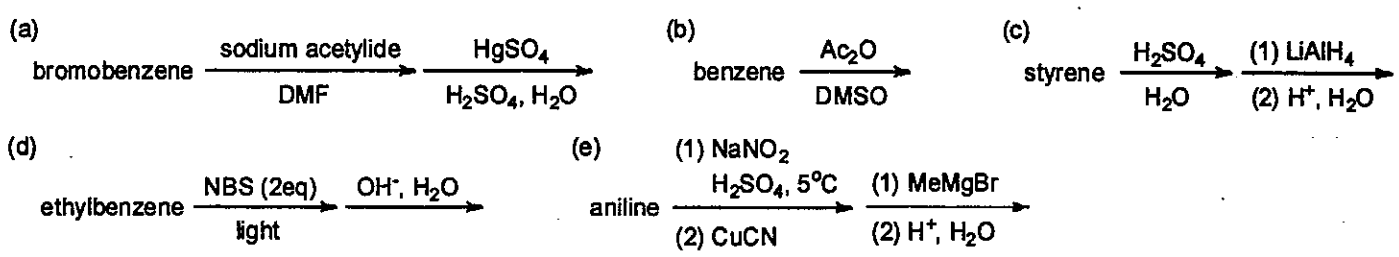


4. Which is the following open-chain form does the boxed compound have?





5. Which of the following transformation(s) can yield acetophenone (C_8H_8O) as the major product?



(A) de (B) abe (C) ade (D) bde (E) abcde

6. Which of the following nitrogen-containing compound is most basic?
(A) acetamide (B) ethylamine (C) pyridine (D) aniline (E) imidazole

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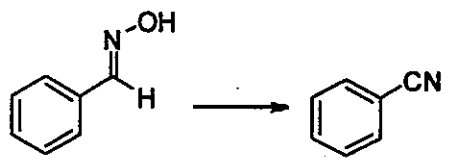
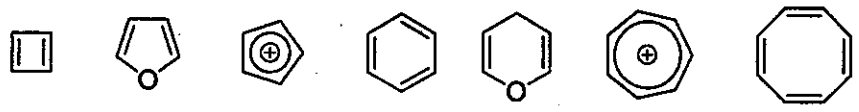
7. How many of the following reagents can complete the transformation?



(a) MnO_2 (b) Ac_2O (c) DCC (d) NaOEt
(e) dilute $H_2SO_{4(aq)}$ (f) $NaBH_4$
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

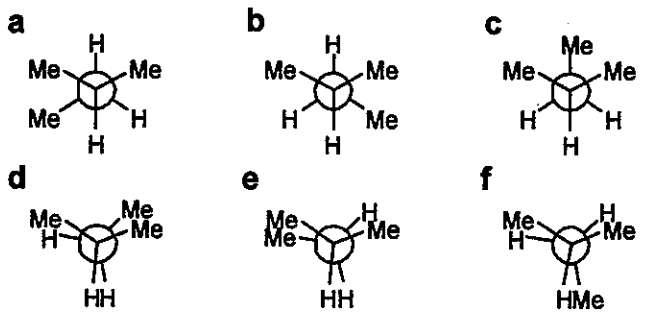
8. In the reaction of sodium acetate (0.1M) and (*R*)-3-bromo-3-methylhexane (0.1M) in EtOH, which of the following statement is correct? ([S] = concentration of S)
(A) The reaction is faster when [sodium acetate] is 0.2M.
(B) The reaction yields a racemic mixture. Therefore the products are achiral.
(C) The major product is 3-ethoxyl-3-methylhexane
(D) The major product has the *S* configuration.
(E) The reaction is faster in chloroform than in EtOH.

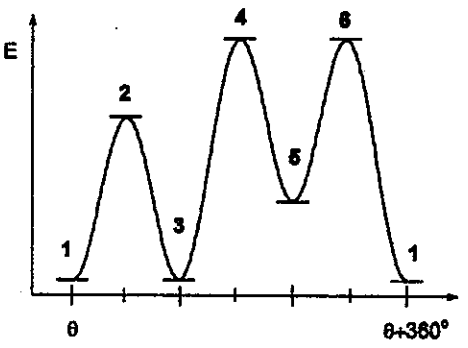
9. How many of the following species are aromatic?



(A) 3 (B) 4 (C) 5 (D) 6 (E) 7

The representative conformations (**a** to **f**) of 2-methylbutane and its potential energy diagram of internal rotation (position **1** to **6**) are shown here. Answer Question 10-12.





10. In the energy diagram, what is the conformation in the position **1** ?
(A) **a** (B) **b** (C) **c** (D) **d** (E) **e**

11. Starting from the position **1** on the left side, what is the rotational sequence of conformations to the next position **1** on the right side?
(A) **aecdbfa** (B) **bfcdaeb** (C) **cdbfaec** (D) **bfaecdb** (E) **adbecfa**

12. Which of the following statement is correct?
(A) The position **2**, **4** and **6** are stable conformations.
(B) When temperature is rising, there will have more molecules in the position **2** than in the position **5**.
(C) 2-Methylbutane is achiral; therefore, conformation **a** to **f** are also achiral.
(D) The conformations in the position **1** and **3** are enantiomers.
(E) The conformation **d** is unstable due to gauche interactions.

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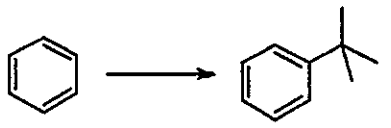
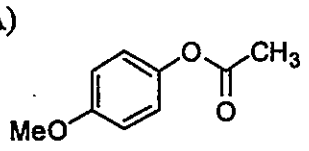
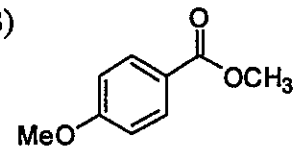
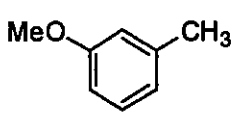
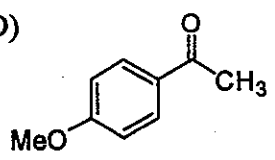
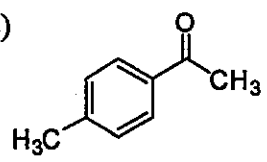
13. How many of the following reagents can complete the transformation?

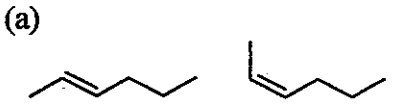
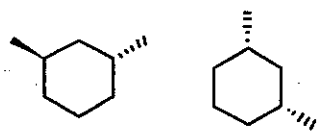
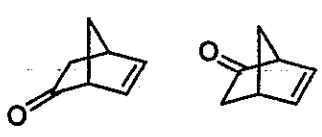
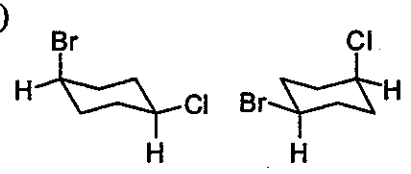
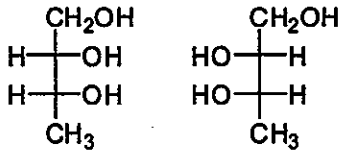


(a) 2-methylpropan-2-ol + BF_3　(b) 2-methylpropene + H_3PO_4
(c) 1-chloro-2-methylpropane + $AlCl_3$　(d) *t*-butyl chloride + $FeCl_3$
(A) 0　(B) 1　(C) 2　(D) 3　(E) 4

14. Which compound most likely has the following NMR data?
^1H NMR ($CDCl_3$): δ 2.56 (s, 3H), 3.88 (s, 3H), 6.94 (d, J = 8.5Hz, 2H), 7.95 (d, J = 8.5Hz, 2H)
^{13}C NMR ($CDCl_3$): δ 21.3, 26.6, 125.6, 128.4, 128.7, 133.8, 137.2, 138.3, 198.3

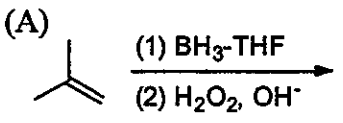
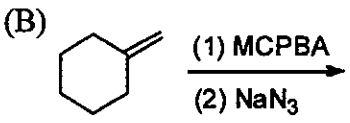
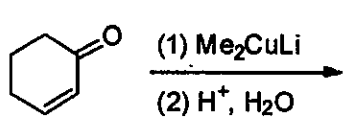
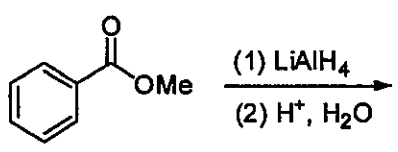
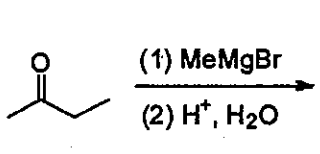
(A) 
(B) 
(C) 
(D) 
(E) 

15. In the following five pairs of ten compounds, which of the statement is correct?

(a) 
(b) 
(c) 
(d) 
(e) 

(A) There are three pairs of enantiomers.
(B) There are three pairs of diastereomers
(C) There are three meso compounds.
(D) There are five chiral compounds.
(E) There are two pairs of constitutional isomers.

16. Which is the following reaction does **NOT** give alcohol as the major product?

(A) 
(B) 
(C) 
(D) 
(E) 

17. When reacting with hept-6-en-2-one ($C_7H_{12}O$), how many of the following reagents will show "positive" results?
(a) Jones reagent　(b) iodoform test　(c) Lucas' reagent　(d) $KMnO_{4(aq)}$
(e) 2,4-dinitrophenylhydrazine test　(f) Br_2/CCl_4　(g) Tollens' reagent
(A) 3　(B) 4　(C) 5　(D) 6　(E) 7

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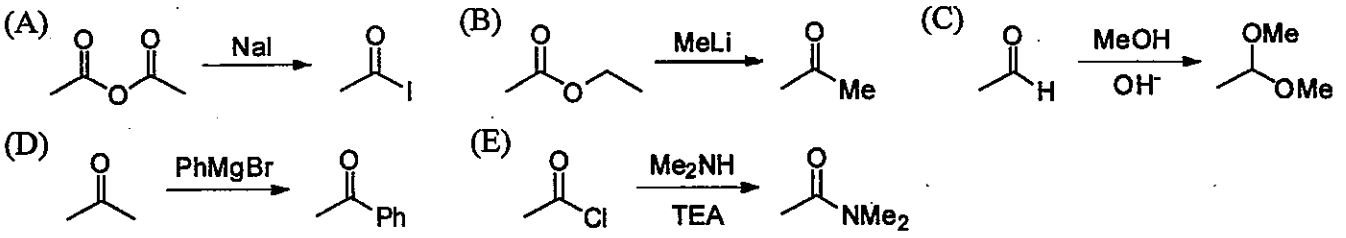
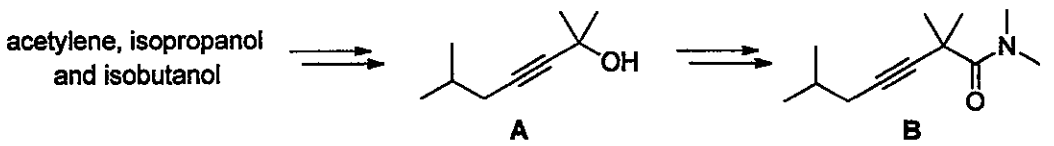
18. Which of the following compound contain the most acidic C-H bond?
(A) 1-hexyne (B) 2,4-hexadiene (C) 2-hexanone (D) 3,4-hexanedione (E) 2,4-hexanedione

19. Which of the following transformation(s) can yield the major product as shown?

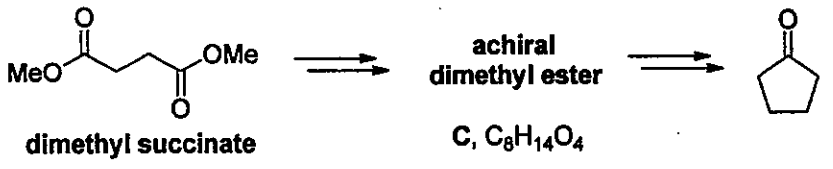


第二部份：問答題

20. Compound **B** can be prepared through compound **A** by the following synthetic plan:
(A) Provide the IUPAC name of compound **A**. (3pts)
(B) Design a synthetic scheme to prepare **A** using acetylene (C_2H_2), isopropanol, isobutanol as sole organic materials along with any other inorganic materials and common organic solvents. (8pts)
(C) Design a synthetic route to prepare **B** from compound **A**. (6pts)

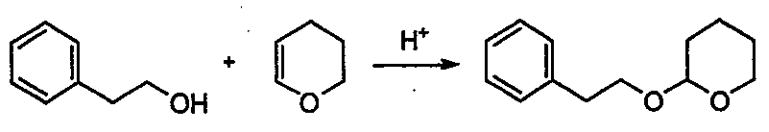


21. Cyclopentanone can be prepared from dimethyl succinate through compound **C** by the following synthetic scheme. Compound **C** is an "achiral" dimethyl ester and does NOT contain any chiral centers. Provide suitable reagents to complete the synthetic scheme. (8pts)



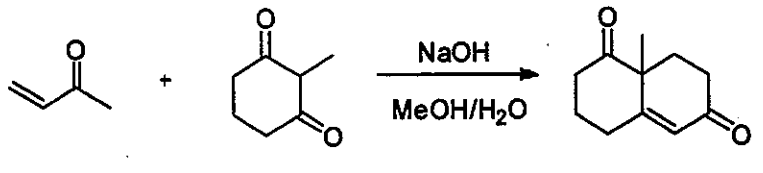
22. Design a synthetic scheme to prepare ethyl 3-bromobenzoate from benzene. (You may use any other required reagents. If some of your reactions produce two major products, you can separate them.) (6pts)

23. Give a detailed reaction mechanism for the following reactions.
(A)



(4pts)

(B)



(8pts)

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