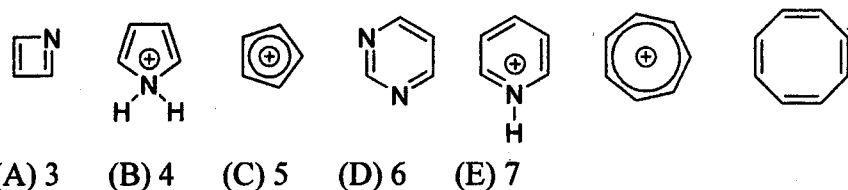


第一部份：單選題 (3pts each) ※ 注意：請用 2B 鉛筆作答於答案卡，並先詳閱答案卡上之「畫記說明」。

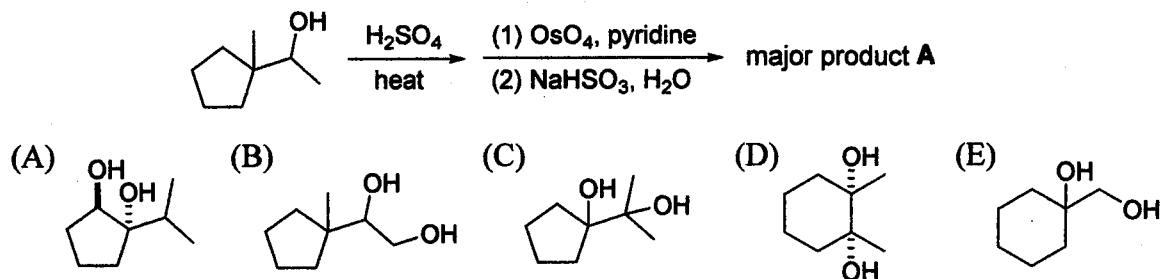
1. How many of the following compound(s) can be deprotonated by lithium diisopropylamide (LDA)?

- (a) pentane (b) 1-pentene (c) 1-pentyne (d) 2-pentanone (e) 2,4-pentanedione
 (f) cyclopentane (g) cyclopentanone (h) cyclopentanol (i) cyclopentadiene
 (A) 3 (B) 4 (C) 5 (D) 6 (E) 7

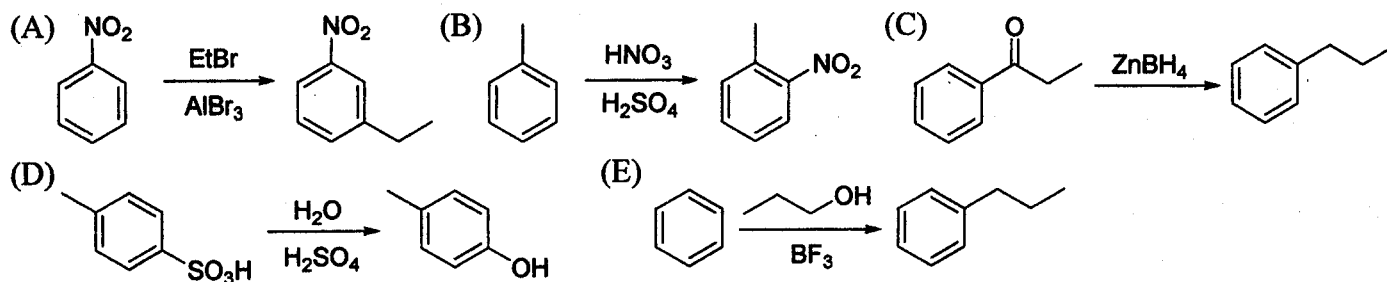
2. How many of the following species are aromatic?



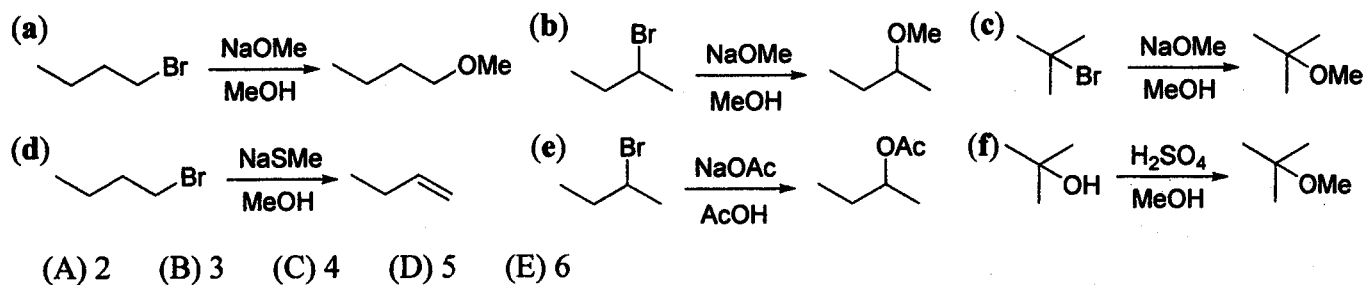
3. Which compound would be formed in the following scheme as the major product A?



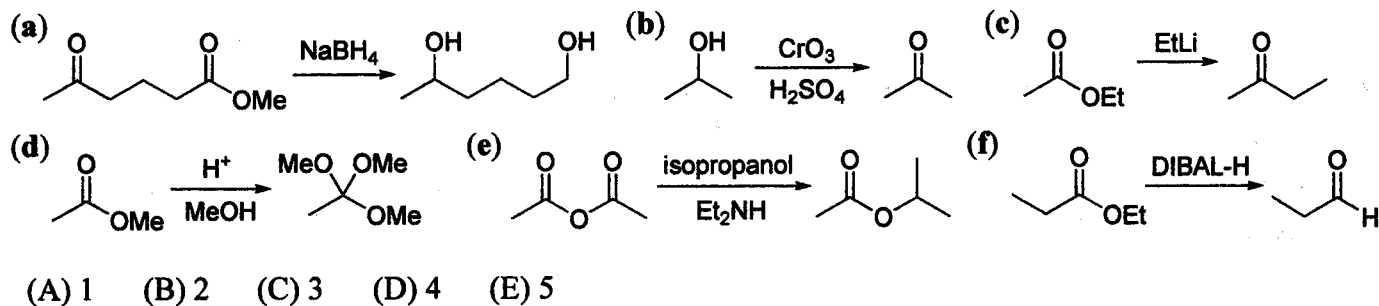
4. Which of the following reaction gives the major product as shown?



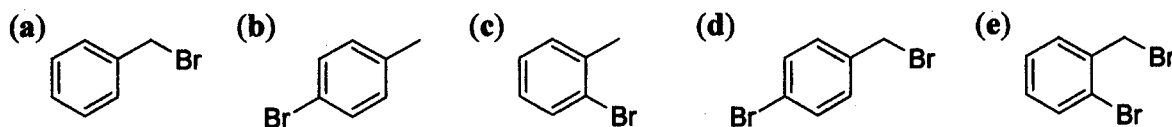
5. How many of the following reactions can afford the major product as shown?



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

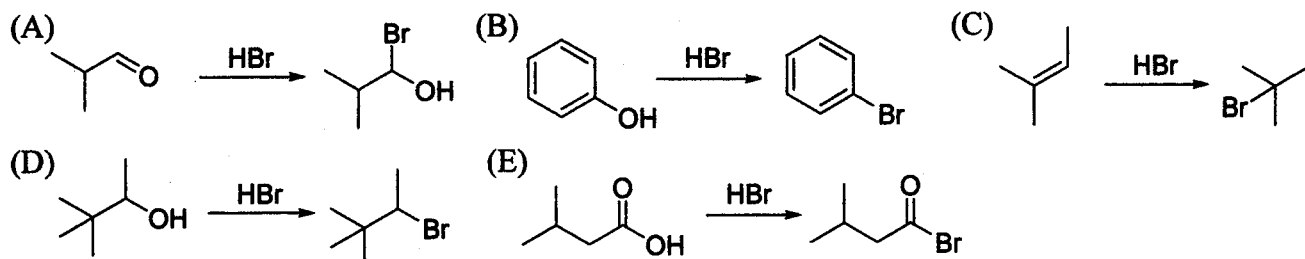


7. Which of the following nitrogen-containing compound is **most basic**?
- (A) 4-nitroaniline (B) trimethylamine (C) pyrrole (D) pyridine (E) acetamide
8. In a typical ^{13}C NMR spectrum, how many **^{13}C signals** can you observe in *tert*-butyl 4-nitrobenzoate?
- (A) 7 (B) 8 (C) 9 (D) 10 (E) 11
9. When toluene was reacted with bromine under light irradiation, which of the following compound(s) will be generated as the major product(s)?



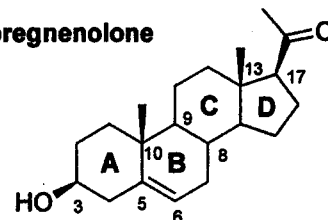
- (A) a (B) bc (C) de (D) ade (E) abc

10. Which of the following reaction gives the major product as shown?



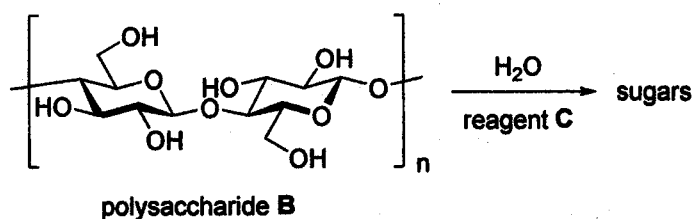
- The chemical structure of pregnenolone is shown. Answer Question 11-14.

pregnenolone



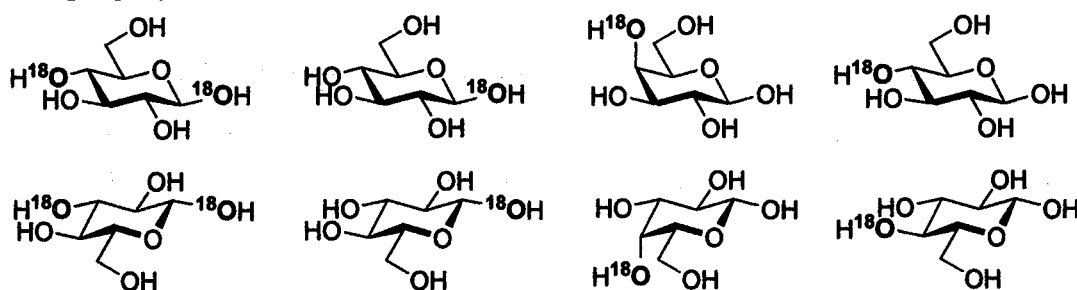
11. How many chiral centers are there in pregnenolone?
- (A) 4 (B) 5 (C) 6 (D) 7 (E) 8
12. The structure shown is incomplete. How many possible stereoisomers might it have?
- (A) 3 (B) 4 (C) 6 (D) 8 (E) 16
13. For carbon atoms C3, C10, C13 and C17, how many of them have the “*R*” configuration?
- (A) 0 (B) 1 (C) 2 (D) 3 (E) 4
14. According to the shown chemical structure, how many of the following statement(s) is(are) correct?
- (a) pregnenolone is a nonpolar compound.
- (b) pregnenolone can decolorize the bromine solution.
- (c) when reacting with Jones reagent, pregnenolone will become a carboxylic acid.
- (d) the C5-C6 double bond has the “*cis*” configuration.
- (e) the C14 is a tertiary carbon atom.
- (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

- As shown in the reaction scheme, polysaccharide (sugar polymer) B can be broken down into sugars, which can then be used for the biofuel production. Answer Question 15-17.



15. Which of the following chemical is most likely the reagent C?
 (A) bromine (B) sulfuric acid (C) Tollen's reagent (D) Na/Hg (E) periodic acid

16. When heavy-oxygen water ($H_2^{18}O$) was used to replace normal water (H_2O) in the reaction, how many of the following eight products can be observed?



- (A) 2 (B) 4 (C) 5 (D) 6 (E) 8

17. How many of the following statement(s) is(are) correct?

- (a) polysaccharide B is water soluble.
 (b) the monomer units in polysaccharide B are linked through the ether functional group.
 (c) when fully breaking down in the reaction, polysaccharide B will produce two type of sugars.
 (d) there are tertiary alcohols in polysaccharide B.
 (e) all substituents in polysaccharide B are in the axial positions.

- (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

■ The compound D ($C_4H_8Br_2$) is the derivative of butane (C_4H_{10}). Answer Question 18-22.

18. How many structural (constitutional) isomers does butane have?

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

19. How many structural (constitutional) isomers does D have?

- (A) 6 (B) 7 (C) 8 (D) 9 (E) 10

20. How many of D has(have) stereoisomer(s)?

- (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

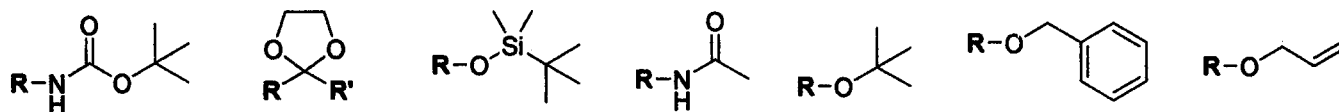
21. Including all (structural + stereo) isomers, how many isomers of D are chiral?

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

22. The dihydroxy compound E ($C_4H_8(OH)_2$) is also the derivative of butane. How many stable structural isomers does E have?

- (A) 6 (B) 7 (C) 8 (D) 9 (E) 10

■ Utilization of protecting groups is crucial and practical in organic synthesis. Seven protected functional groups are shown below. Answer Question 23-24.



見背面

23. How many of them can be deprotected through catalytic hydrogenation (Pd/C, H₂)?

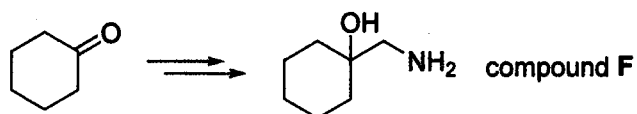
- (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

24. How many of them can be resistant to the Grignard reagent?

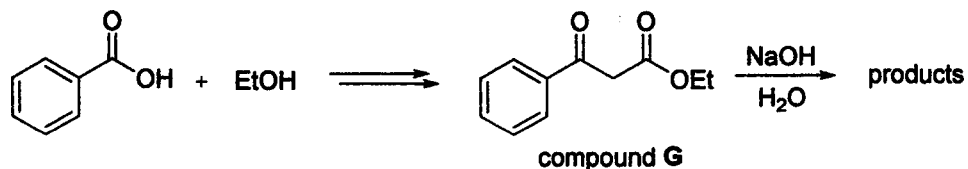
- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

第二部份：問答題 ※ 本大題請於試卷內之「非選擇題作答區」標明題號依序作答。

25. Compound F can be prepared through the following scheme. Provide **three** distinct schemes (three methods) to accomplish the synthesis. (the more diverse schemes you provide, the better scores you will be awarded.) (7pts)



26. (A) Compound G can be prepared through benzoic acid and ethanol by the following synthetic plan. Give the detailed **reagents**, **procedures** and **intermediate compounds**. (Hint: you might use ethanol many times and you do **NOT** need to write the mechanism.) (6pts)

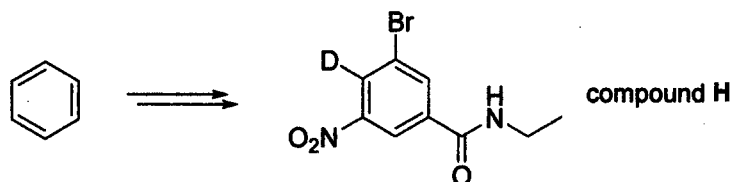


(B) Compound G can be hydrolyzed under the basic aqueous condition into smaller organic compounds.

Provide a detailed **mechanism** and give all **possible products**. (6pts)

(C) In the hydrolysis reaction (B), what is the driving force to push the reaction to completion. (3pts)

27. Compound H can be prepared from benzene through the following scheme. Give the detailed **reagents**, **procedures** and **intermediate compounds**. (Hint: D is the deuterium atom, as known as heavy hydrogen) (6pts)



試題隨卷繳回