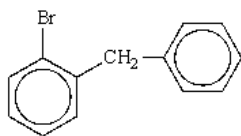


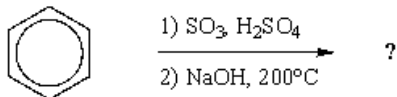
**Chapter 4-Aromatic Compounds and
Chapter 7- Alcohols, Phenols and Thiols**

Attempt all questions showing your answers and work clearly for full and partial credits

- Which of the following statements about benzene is FALSE?
 - the molecule is planar and each carbon is at a corner of regular hexagon
 - there are two resonance structures of equivalent energy
 - the bond angles are all 120° and the bond lengths are all 1.39\AA
 - the typical mechanism by which reactions occur is by addition
 - each carbon in the benzene ring is sp^2 hybridized
- Which of the following is NOT an electrophile in an electrophilic aromatic substitution reaction?
 - NO_2^+
 - $(\text{CH}_3)_3\text{C}^+$
 - SO_3
 - Cl^-
 - all are
- What is the correct name for the following molecule?

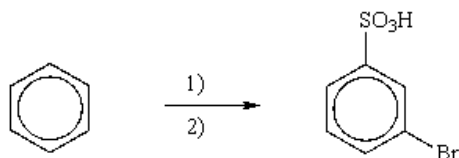


- o-bromobenzyl
 - biphenyl bromide
 - 2-bromodiphenylpropane
 - bromobenzylbenzene
 - o-benzylbromobenzene
- Which of the following groups is a *meta* director?
 - $-\text{Cl}$
 - $-\text{COOH}$
 - $-\text{OCH}_3$
 - $-\text{OH}$
 - $-\text{NH}_2$
 - What is the name of the major product from the following sequence of reactions?

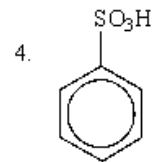
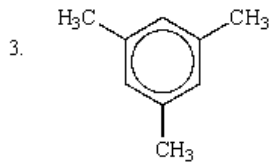
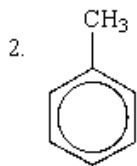
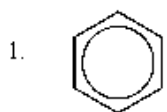


- aniline
- anisole
- benzoic acid
- phenol
- toluene

6. Which is the best reaction sequence to synthesize m-bromobenzenesulfonic acid from benzene?



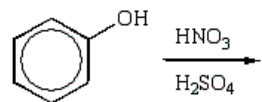
- A) 1) Br_2 , FeBr_3 , 2) H_2SO_4 , SO_3
 B) 1) H_2SO_4 , SO_3 2) Br_2 , FeBr_3
 C) 1) ethene, HF , 2) Br_2 , FeBr_3
 D) 1) CH_3Cl , AlCl_3 , 2) Br_2 , AlBr_3
 E) 1) Br_2 , FeBr_3 , 2) CH_3COCl , AlCl_3
7. In the mechanism for the nitration of benzene, what is the function of H_2SO_4 ?
- A) to act solely as a solvent
 B) to donate a proton to HNO_3
 C) to accept a proton from HNO_3
 D) to generate heat for reaction to occur
 E) to protonate the benzene ring
8. Among the following groups, which ones are *o,p*-directing?
1. $-\text{OCH}_3$ 2. $-\text{NO}_2$ 3. $-\text{Br}$ 4. $-\text{CN}$ 5. $-\text{CH}_2\text{CH}_3$
- A) 1, 3, and 5
 B) 1 and 5
 C) 2 and 4
 D) 2, 3, and 4
 E) 1 and 3
9. The relative rates of nitration of the following are:



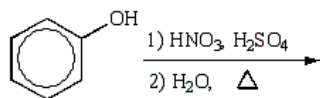
- A) $1 > 2 > 3 > 4$
 B) $4 > 2 > 1 > 3$
 C) $2 > 1 > 4 > 3$
 D) $3 > 4 > 2 > 1$
 E) $3 > 2 > 1 > 4$

10. What is the best sequence of reactions to synthesize m-nitrophenol?

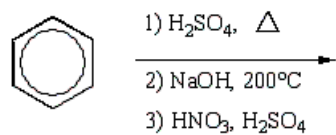
A)



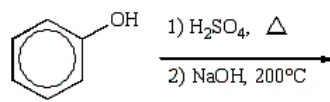
B)



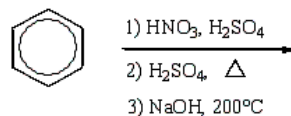
C)



D)



E)



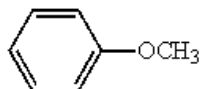
11. Which group is both ortho-para directing and ring deactivating?

- A) $-\text{Cl}$
- B) $-\text{CH}_3$
- C) $-\text{NO}_2$
- D) $-\text{CHO}$
- E) $-\text{OCH}_3$

12. The only group among the following that is *m*-directing is:

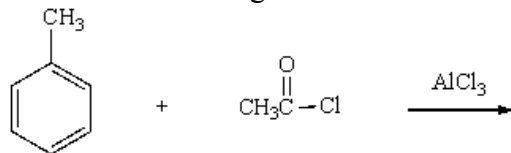
- A) $\begin{array}{c} \text{O} \\ || \\ -\text{C}-\text{NH}_2 \end{array}$
- B) $-\text{F}$
- C) $\begin{array}{c} \text{H} \quad \text{O} \\ | \quad || \\ -\text{N}-\text{C}-\text{CH}_3 \end{array}$
- D) $-\text{C}(\text{CH}_3)_3$
- E) $-\text{N}(\text{CH}_3)_2$

13. The name of the following molecule is:

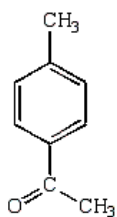


- A) toluene
- B) ethylbenzene
- C) cumene
- D) styrene
- E) anisole

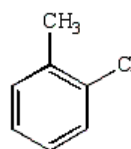
14. What is the product of the following reaction?



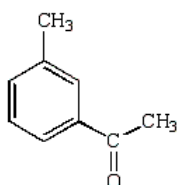
A)



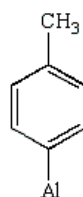
D)



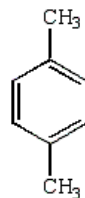
B)



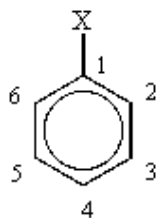
E)



C)



15. Which position would be *para* to X?



A) 1

B) 2

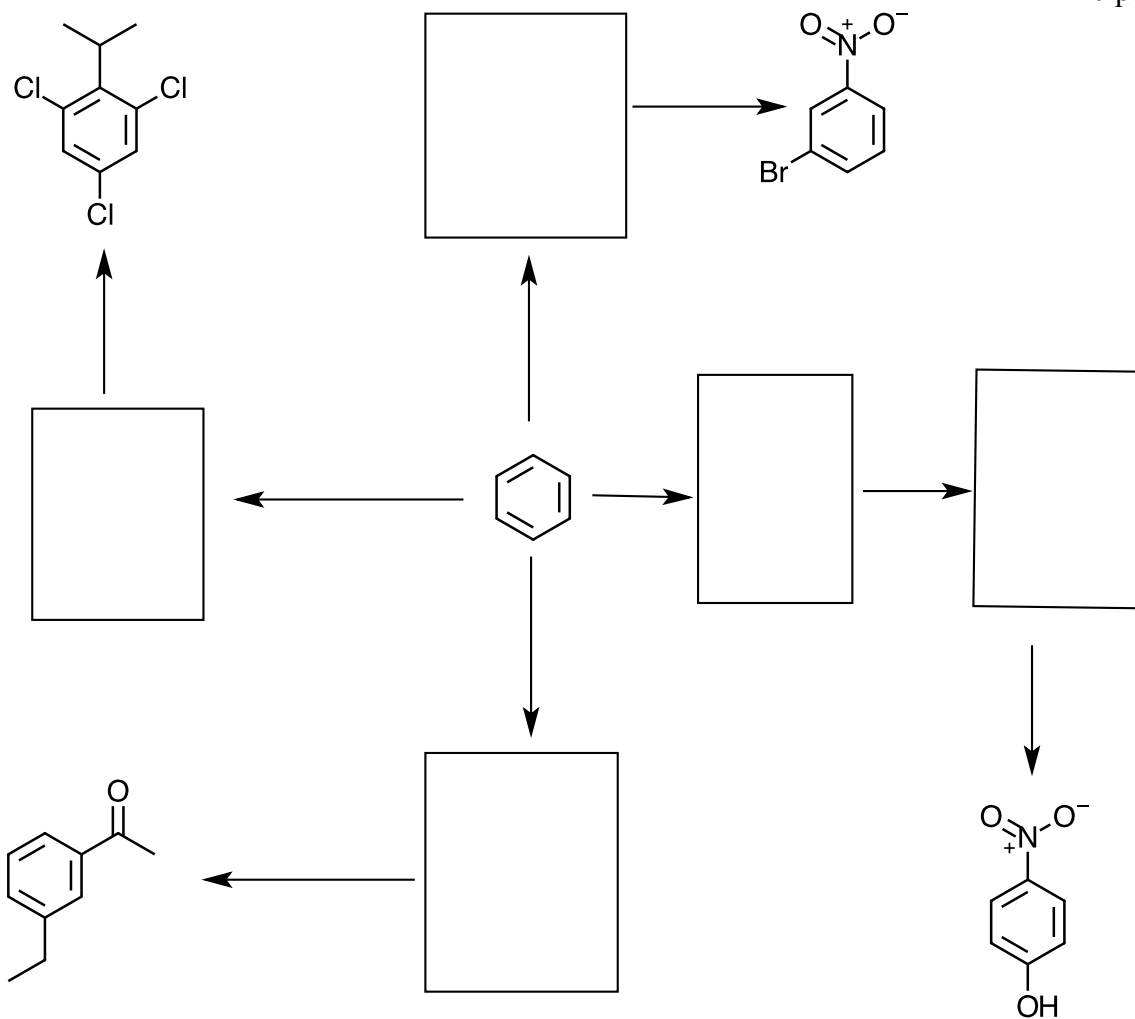
C) 3

D) 4

E) 6

16. Starting with benzene as the only aromatic organic starting material, outline a plausible synthesis route for each of the listed compounds showing all reagents, conditions and intermediate substitution products clearly. The conversions are possible in at most 3 steps and at least 2 steps. (In case of a repeating step, use excess reagents and show as one step)

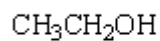
20 pts



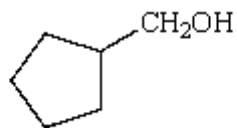
17. Using chlorination of benzene as an example, write the reaction mechanism for showing all possible resonance structures of intermediates if any for the electrophilic aromatic substitution of benzene. 10pts

Chapter 8 Questions

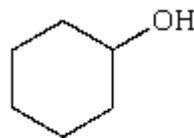
1. Which of the following is a secondary (2°) alcohol?



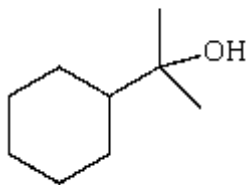
I



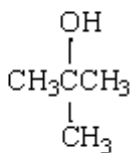
II



III

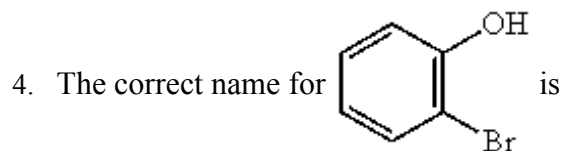


IV



V

- A) I
B) II
C) III
D) IV
E) V
2. What is the IUPAC name for isobutyl alcohol?
A) 1-butanol
B) 2-butanol
C) 2-methyl-2-butanol
D) 2-methyl-1-propanol
3. What is a correct name for $(\text{CH}_3)_3\text{CO}^- \text{Na}^+$?
A) sodium alkoxide
B) sodium trimethyloxiide
C) sodium butoxide
D) sodium trimethylethoxide
E) sodium *tert*-butoxide

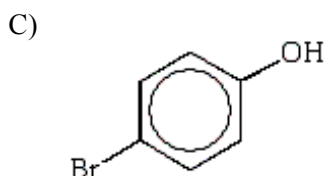
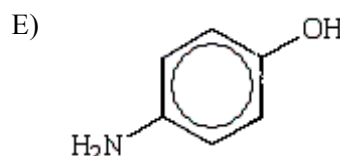
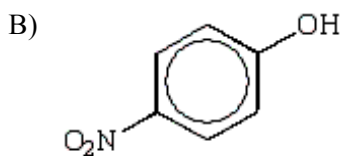
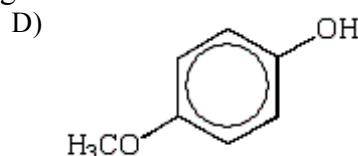
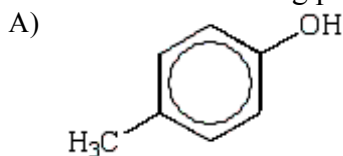


- A) 2-hydroxybromobenzene.
- B) 2-bromobenzyl alcohol.
- C) 2-bromobenzol.
- D) *o*-bromophenol.
- E) 2-bromohexanol

5. If the pK_a of isopropyl alcohol is 17, what is the K_a of isopropyl alcohol?

- A) $17 \cdot 10^{-17}$
- B) 10^{-17}
- C) 10^{-3}
- D) 10^{17}
- E) 10^3
- F) $17 \cdot 10^{17}$

6. Which of the following phenols is the strongest acid?



7. Phenols are stronger acids than alcohols because of the

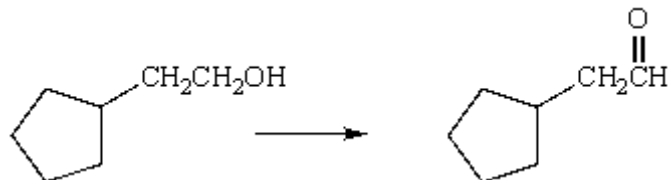
- A) resonance stabilization of phenoxide ions.
- B) resonance stabilization of phenols.
- C) resonance stabilization of alkoxide ions.
- D) resonance stabilization of alcohols.
- E) hydrogen bonding in phenols.

8. Which reagents would you use to accomplish the following transformation?



- A) H_2SO_4 , H_2O , acetone
- B) CrO_3 , H_2SO_4 , acetone
- C) PCC/ CH_2Cl_2
- D) Zn, HCl, acetone
- E) H_2 , Pd, acetone

9. What reagents would accomplish the following transformation?



- A) 1. PCl_3 2. H_3O^+
- B) CrO_3 , H^+ in acetone
- C) PCC, CH_2Cl_2
- D) 1. Na 2. CH_3OH
- E) none of the above