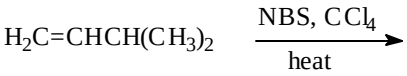
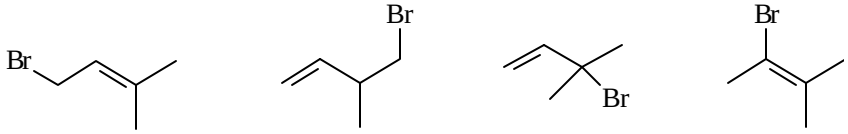
1. What is(are) the expected product(s) of the following reaction?

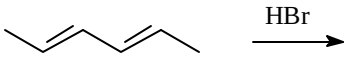


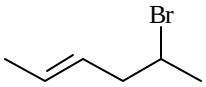


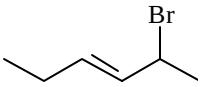
A B C D

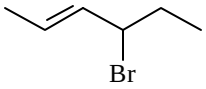
1) only B 2) only C 3) A and C 4) B and D

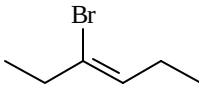
2. Which of the following is the 1,4-addition product in the reaction shown below?



1) 

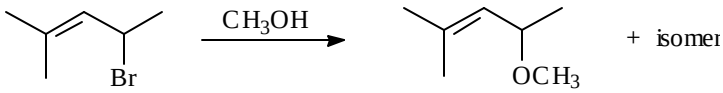
3) 

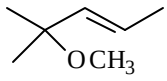
2) 

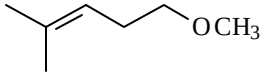
4) 

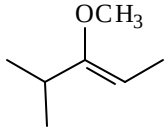
1) 1 2) 2 3) 3 4) 4

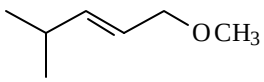
3. Methanolysis of 4-bromo-2-methyl-2-pentene gives two isomeric substitution products, one of which is shown. What is the other substitution product?



1) 

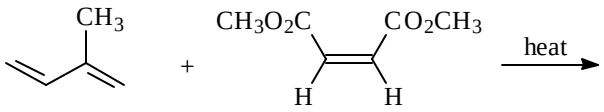
3) 

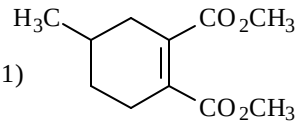
2) 

4) 

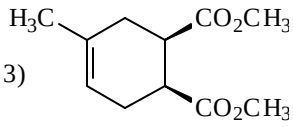
1) 1 2) 2 3) 3 4) 4

4. What is product of the following Diels-Alder reaction?

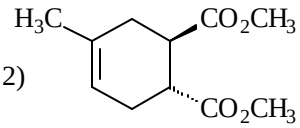


1)


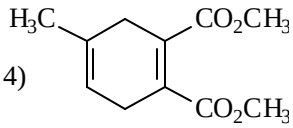
+ enantiomer

3)


+ enantiomer

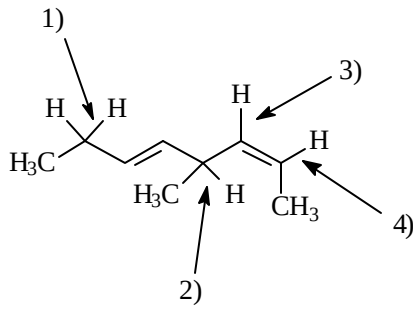
2)


+ enantiomer

4)


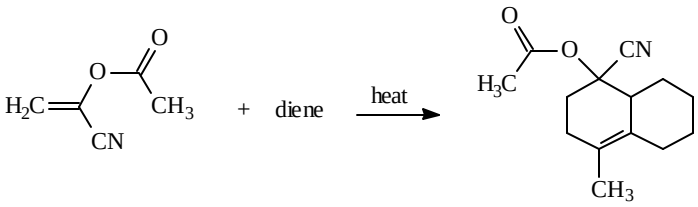
1) 1 2) 2 3) 3 4) 4

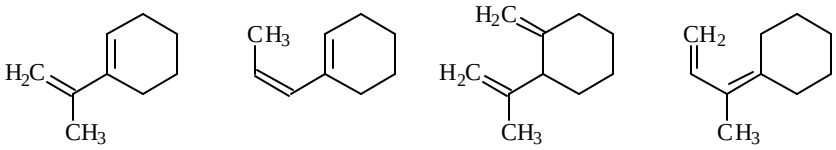
5. Identify the weakest carbon-hydrogen bond in the following diene?



1) 1 2) 2 3) 3 4) 4

6. Identify the diene used in the reaction shown below.

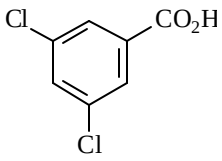




1) 2) 3) 4)

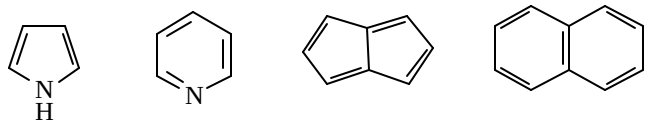
1) 1 2) 2 3) 3 4) 4

7. What is the IUPAC name of the following compound?



1) 4,6-dichloro-2-benzoic acid
2) 2,4-dichlorobenzoic acid
3) 3,5-dichlorobenzoic acid
4) *meta*-dichlorobenzoic acid

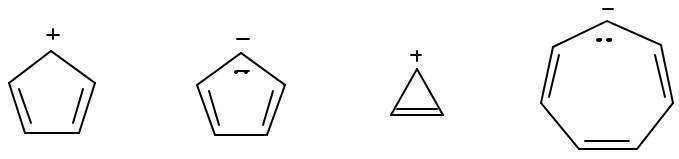
8. Identify the aromatic compounds.



A B C D

1) A and B
2) C and D
3) A, B, and D
4) all of them

9. Which of the following ions are aromatic species?



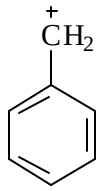
A B C D

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

10. Which of the following reacts at the fastest rate when heated with N-bromosuccinimide (NBS) and benzoyl peroxide in carbon tetrachloride at 80°C?

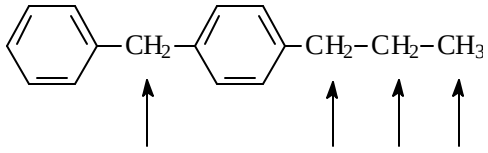
1) toluene
2) ethylbenzene
3) isopropylbenzene (cumene)
4) *tert*-butylbenzene

11. The benzyl carbocation is shown below. Besides the benzylic carbon, identify any other carbon atoms which carry a partial positive charge based on resonance theory.



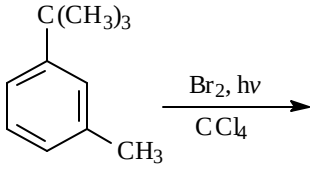
1) ortho and para carbon atoms
2) meta carbon atoms
3) meta and para carbon atoms
4) ortho, meta, and para carbon atoms

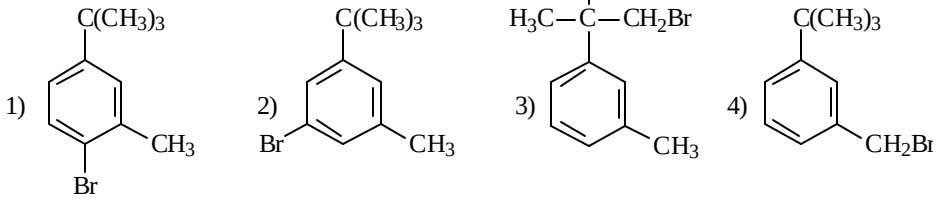
12. Which hydrogen atom would be most easily extracted by a bromine atoms?



1) 1 2) 2 3) 3 4) 4

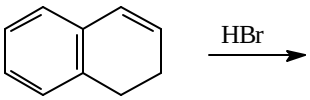
13. What is the product of the reaction shown below?

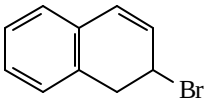


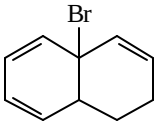


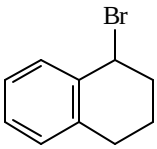
1) 1 2) 2 3) 3 4) 4

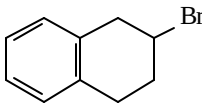
14. Predict the major organic product in the following reaction.



1) 

3) 

2) 

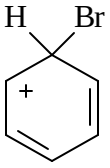
4) 

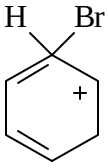
1) 1 2) 2 3) 3 4) 4

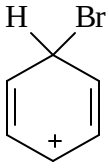
15. In which of the following are carbon-carbon bond lengths arranged in the correct order?

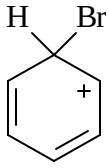
	shortest		longest
1)	benzene	ethylene	cyclohexane
2)	ethylene	cyclohexane	benzene
3)	cyclohexane	benzene	ethylene
4)	ethylene	benzene	cyclohexane

16. Which one of the following is not a resonance form of the cyclohexadienyl cation intermediate in the bromination of benzene?

1) 

2) 

3) 

4) 

1) 1 2) 2 3) 3 4) 4

17. Starting with toluene, which of the following is the best synthesis of *meta*-bromobenzoic acid?

1) (1) Br_2, $FeBr_3$ (2) $K_2Cr_2O_7$, H_2SO_4 (heat)

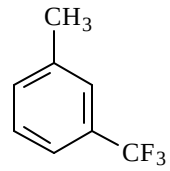
2) (1) Br_2, hν (2) $K_2Cr_2O_7$, H_2SO_4 (heat)

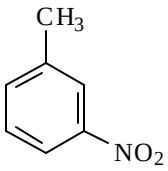
3) (1) $K_2Cr_2O_7$, H_2SO_4 (heat) (2) Br_2, $FeBr_3$

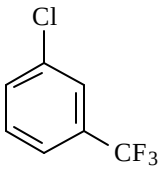
4) (1) $K_2Cr_2O_7$, H_2SO_4 (heat) (2) Br_2, hν

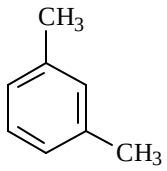
1) 1 2) 2 3) 3 4) 4

18. Which one of the following compounds undergoes electrophilic aromatic sulfonation at the fastest rate?

1) 

2) 

3) 

4) 

1) 1 2) 2 3) 3 4) 4

19. Which of the following is the best method to make *meta*-bromoethylbenzene from benzene?

1) (1) benzene + $CH_3CH_2Cl/AlCl_3$ (2) $Br_2/FeBr_3$

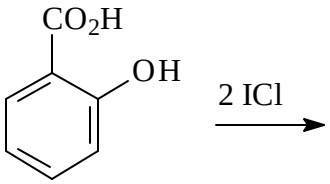
2) (1) benzene + $Br_2/FeBr_3$ (2) $CH_3CH_2Cl/AlCl_3$

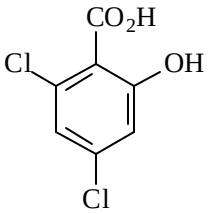
3) (1) benzene + $CH_3\overset{\overset{O}{\|}}{C}Cl/AlCl_3$ (2) Zn(Hg), HCl (3) $Br_2/FeBr_3$

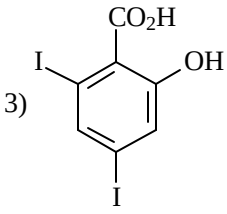
4) (1) benzene + $CH_3\overset{\overset{O}{\|}}{C}Cl/AlCl_3$ (2) $Br_2/FeBr_3$ (3) Zn(Hg), HCl

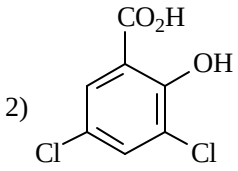
1) 1 2) 2 3) 3 4) 4

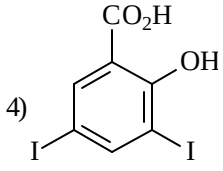
20. Salicylic acid reacts with two equivalents of ICl to give one of the products below. Which one is it? (hint: Cl is more electronegative than I)



1) 

3) 

2) 

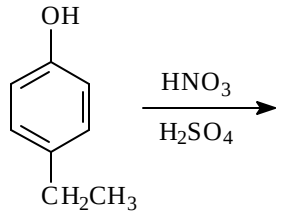
4) 

1) 1 2) 2 3) 3 4) 4

21. Which isomer of dichlorobenzene gives a single mononitration product?

1) ortho
2) meta
3) para
4) none of them

22. What is the major product of the following reaction?



1) 4-ethyl-2-nitrophenol
2) 4-ethyl-3-nitrophneol
3) 1-ethyl-4-nitrobenzene
4) 4-nitrophenol

23. Which of the following is the best method to make *n*-butylbenzene?

1) benzene + $CH_3CH_2CH_2CH_2Cl/AlCl_3$

2) benzene + $CH_3CH_2CH{=}CH_2/H_2SO_4$

3) (1) benzene + $CH_3CH_2CH_2C(=O)Cl/AlCl_3$ (2) H_2NNH_2/KOH, heat

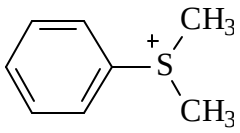
4) (1) benzene + $CH_3CH_2CH_2CH_2OH/H_2SO_4$

1) 1
2) 2
3) 3
4) 4

24. In the Friedel-Crafts alkylation of benzene, dialkylation is often a significant byproduct. In the Friedel-Crafts acylation of benzene, diacylation is <u>not</u> a significant byproduct. Which of the following is the primary reason for this difference?

1) Alkyl groups activate the ring to further substitution, acyl groups deactivate it.
2) Alkyl groups are less sterically hindered than acyl groups.
3) Acyl cations are more difficult to make with Lewis acids.
4) Unlike acyl cations, carbocations can undergo rearrangements.

25. Predict the effect the substituent attached to the benzene ring below would have on electrophilic aromatic substitution reactions?



1) ortho/para director, activator
2) ortho/para director, deactivator
3) meta director, activator
4) meta director, deactivator