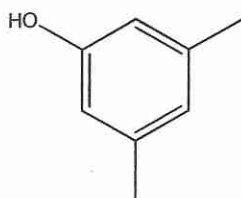


Name: _____

Directions: You may omit three questions you do not want to work. Indicate **VERY** clearly which problems you are not working. The last three questions will not be counted if no questions are crossed out

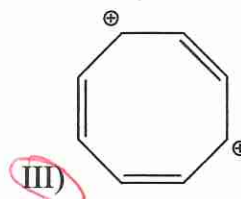
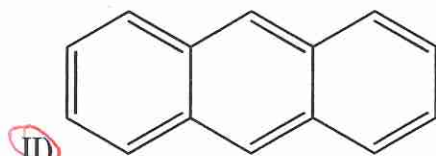
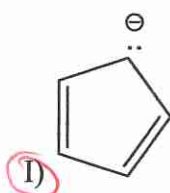
Multiple Choice(s): Circle the most correct answer(s) for the following questions. Some questions will only have one correct answer while other questions may have multiple answers and will be labeled MA after the problem number.

1) What is the IUPAC name of this compound?

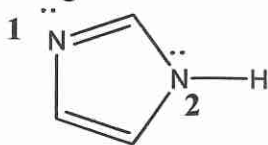


- a) m-hydroxy-m-xylene
b) 3,5-dimethylphenol
c) 2,4-dimethyl-6-hydroxybenzene
d) 3-hydroxy-5-methyltoluene
e) None of the answers above.

2) MA Circle the structure(s) [if any] that would be classified as aromatic.



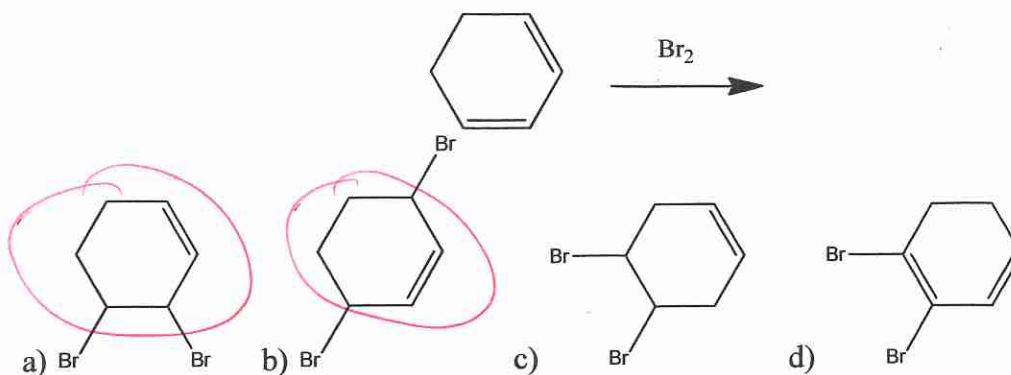
3) The imidazole ring system (shown below), which contains two nitrogen atoms is found in the amino acid histidine. Which statement is true regarding the basicity of the two ring nitrogen atoms?



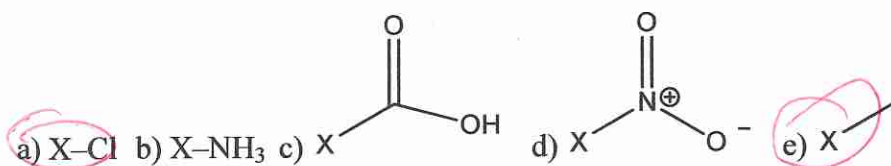
- a) Both are strongly basic since the ring is aromatic.
b) The nitrogen atom labeled 1 is more basic than 2.
c) The nitrogen atom labeled 2 is more basic than 1.
d) Neither of the nitrogen atoms would be considered basic.

15/15

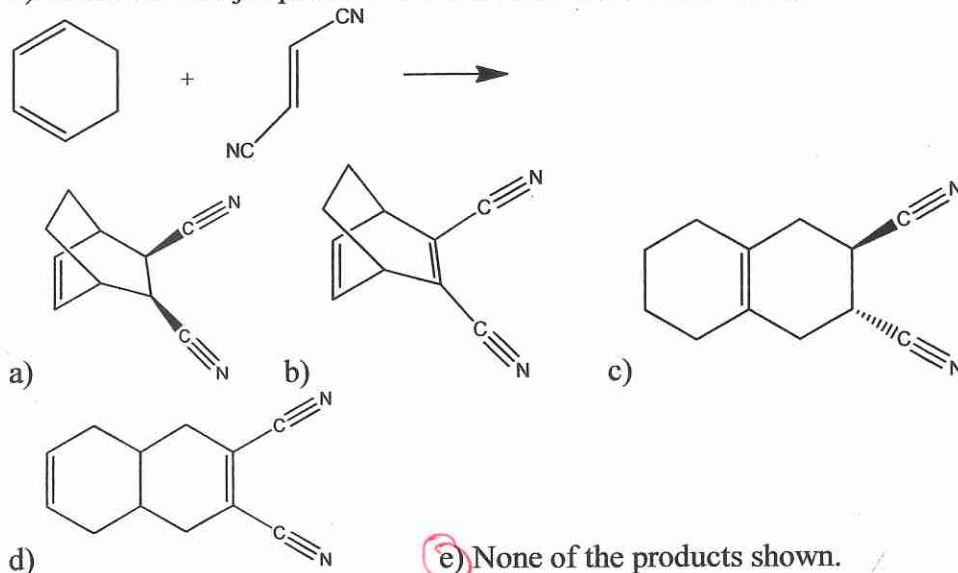
4) MA Circle the product(s) [if any] that would be formed in the reaction shown below.



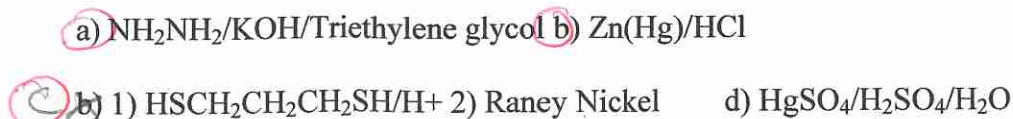
5) MA Circle the substituents (if X is a benzene ring) that will direct ortho/para in an electrophilic aromatic substitution reaction.



6) What is the major product of the Diels-Alder reaction shown?



7) MA Circle all of the reagents below that will reduce a $\text{C}=\text{O}$ next to a benzene ring to a CH_2 .

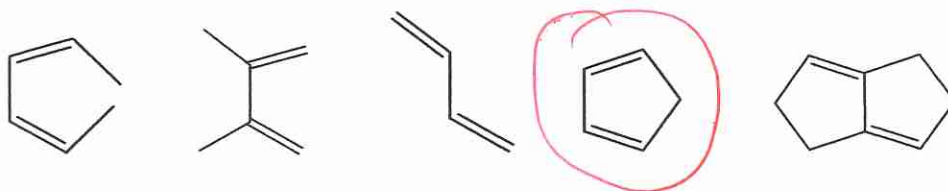


e) None of the reagents given will reduce a $\text{C}=\text{O}$ next to a benzene ring to a CH_2 group.

8) MA Circle all of the Electrophilic Aromatic Substitution reaction(s) [if any] that are reversible.

- a) Nitration
- b) Halogenation
- c) Sulfonation
- d) Friedel-Crafts Alkylation
- e) Friedel-Crafts Acylation

9) MA Circle all of the molecule(s) [if any] that are LOCKED in an s-cis conformation.

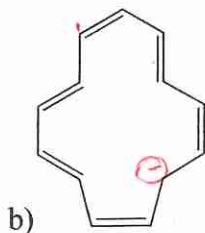
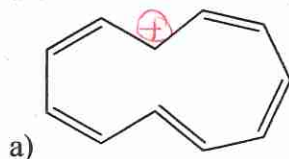


10) MA Circle the molecule(s) [if any] that will form benzoic acid upon reaction with sodium dichromate/sulfuric acid/ water and heat.

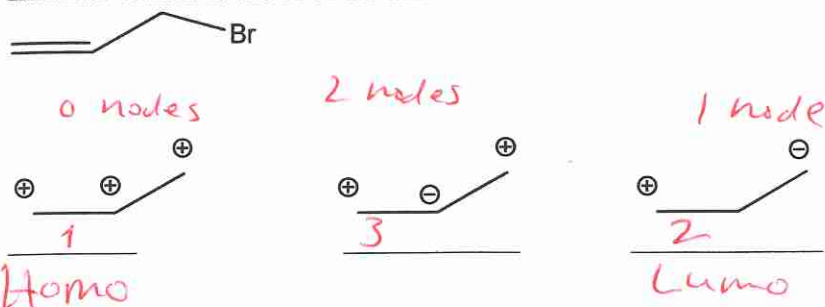
- a) Toluene
- b) Benzaldehyde
- c) Anisole
- d) Bromobenzene
- e) tert-Butylbenzene

Problems: Work the following problems.

11) Write a positive or negative charge at the appropriate position so that each of the following structures contains the proper number of pi electrons to be considered an aromatic ion. For this problem, ignore steric effects that might destabilize the molecule.



12) Bam means Allylic. Allylic bromide is shown below. Loss of bromine from allylic bromide forms the allylic cation with 2 pi electrons. The three possible molecular orbitals for the allylic cation are shown below with a positive or negative sign signifying the orbital sign. If no + or - is seen on a carbon, this carbon does not contribute to the molecular orbital. a) Put them in order from 1 to 3 with 1 being the most stable. b) Indicate which is the HOMO and which is the LUMO.



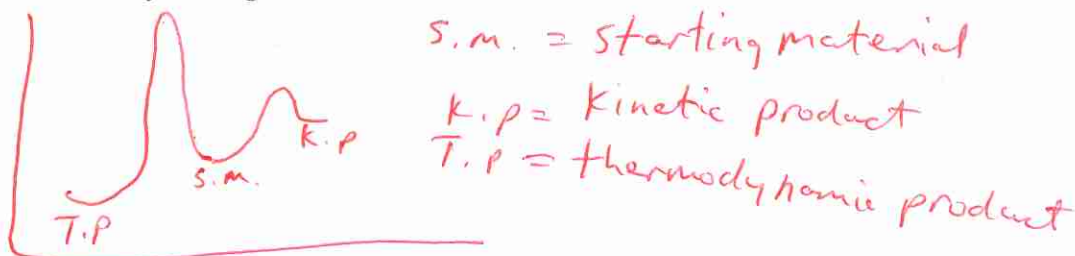
13) Give a molecule with the molecular formula $C_{10}H_{14}$ that will not be react with 1) sodium dichromate/sulfuric acid/water or with 2) NBS/Heat. The molecule will react in a Birch reduction to give an isolated diene.

- 1) sp^3 carbon next to benzene has no Hydrogen.
 2) no benzylic hydrogen.

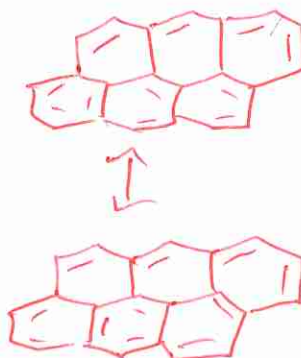
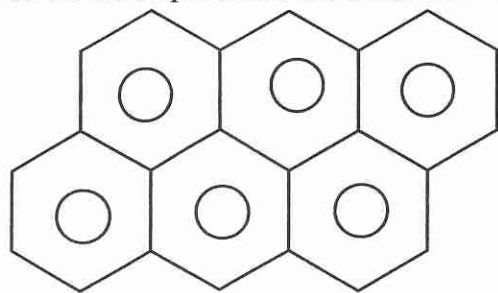


$C_{10}H_{22}$
 $C_{10}H_{14}$
 $\frac{8}{2} = 40\%$
 2 unsat.

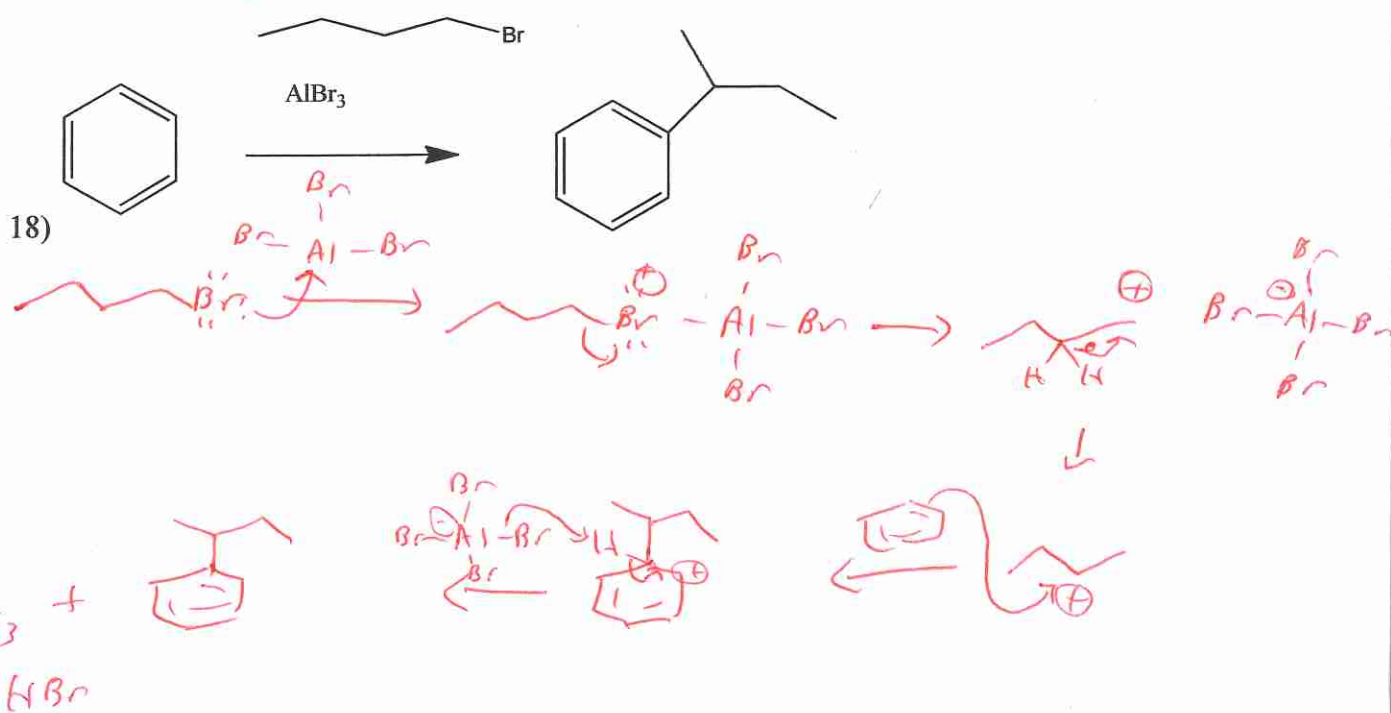
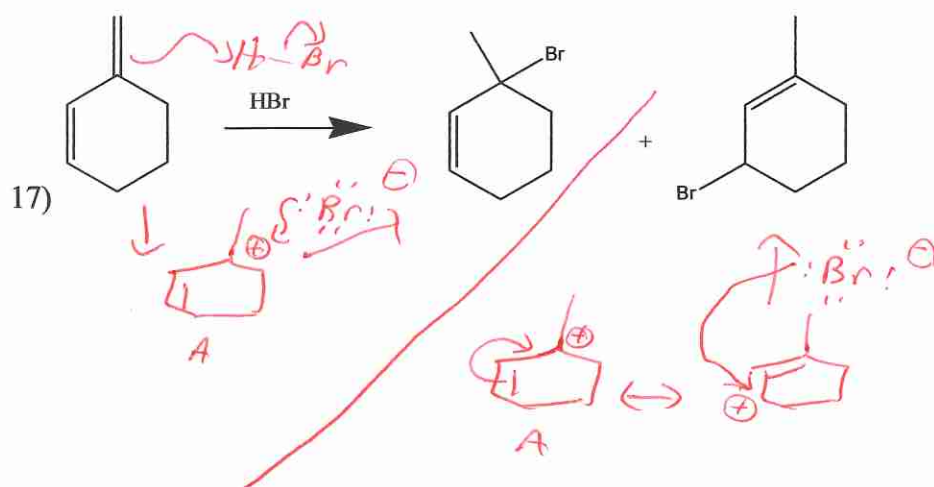
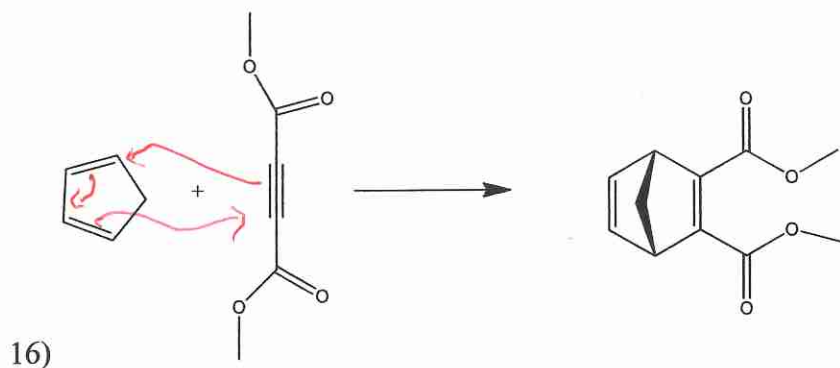
14) Give a potential energy diagram for a reaction that can form a kinetic AND thermodynamic product. Label very clearly on your diagram which is the kinetic product and which is the thermodynamic product.



15) Draw the molecule below showing two different resonance contributors. Double bonds are required for the resonance contributors.

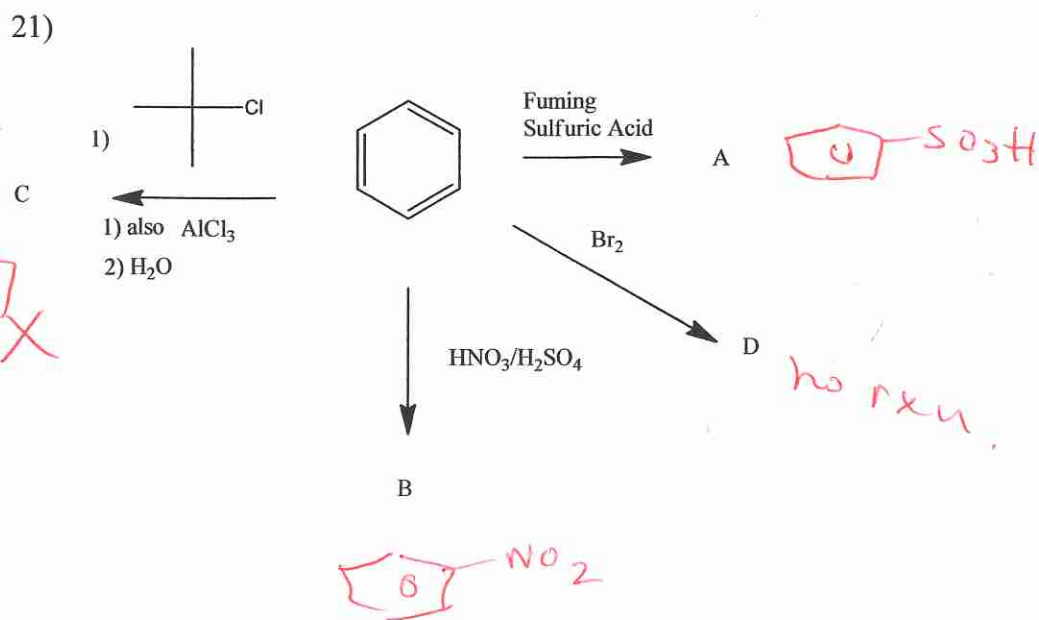
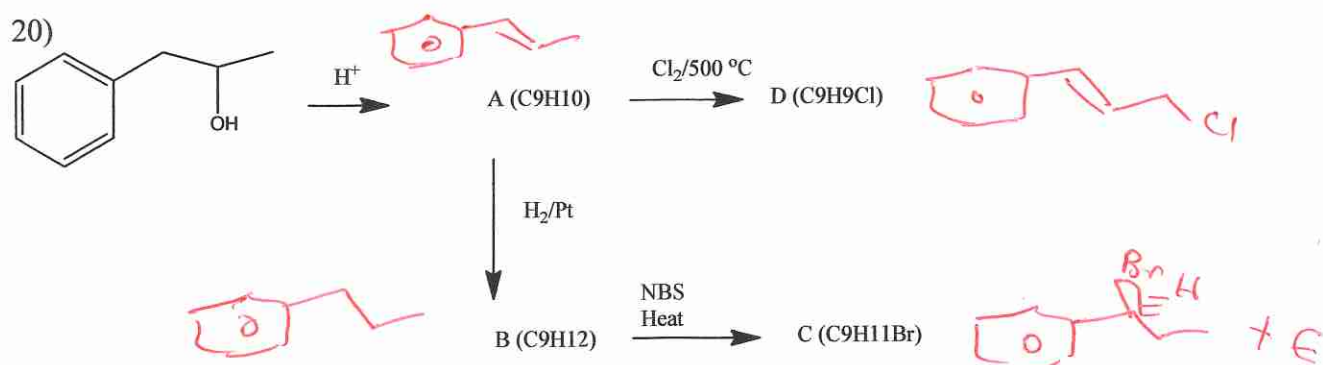
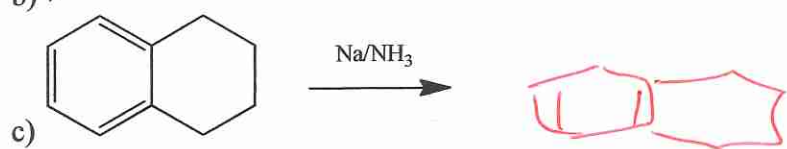
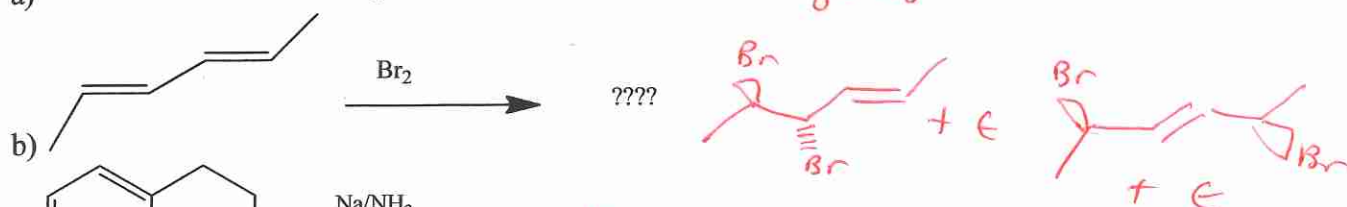
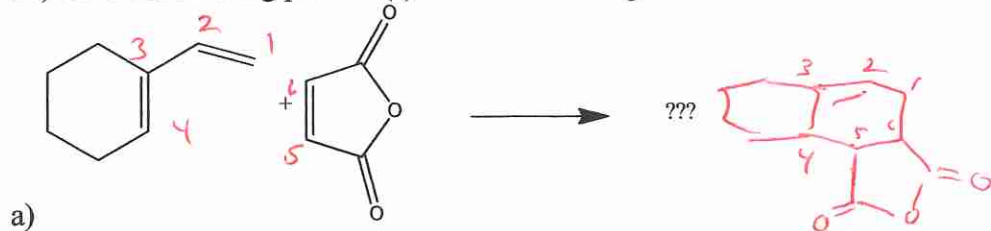


Mechanisms: Work the following mechanisms showing every step. ONLY use what you are given in the reaction. Addition of other reagents will result in no credit for the mechanism.

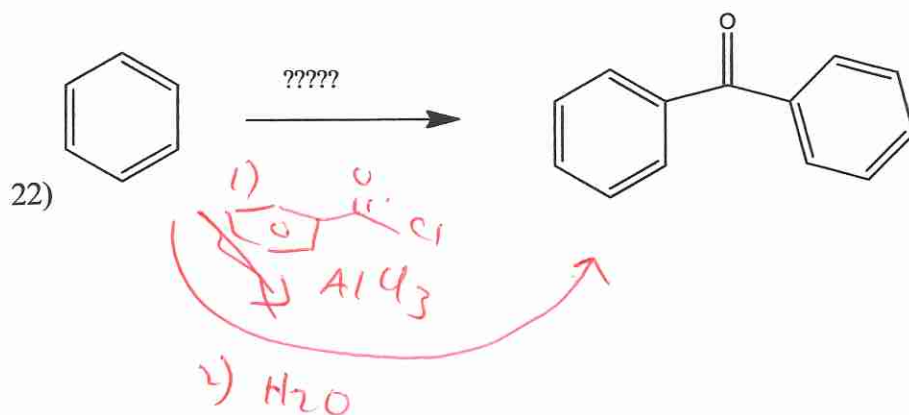


Reactions: Work the following reactions.

19) Give the missing product(s) for the following reactions.



Synthesis: Work the following synthesis using any necessary organic or inorganic reagents.



23) Free Question: Give me something you studied that I did not ask.