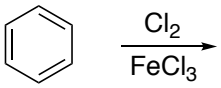
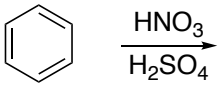
**Chemistry 234**
**Chapter 16 Problem Set**

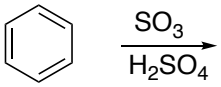
Color Codes: Exam 1 Material  Exam 2 Material  Final Exam Material

## Electrophilic Aromatic Substitution

1) Predict the product and draw the mechanism for electrophile generation for each of the following reactions.

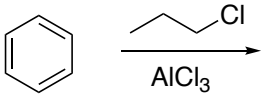
**(a)** 

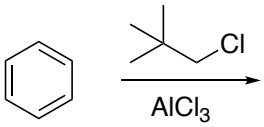

**(b)** 

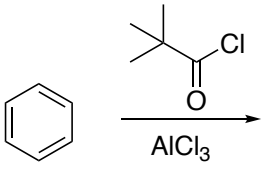

**(c)** 


2) Explain why reaction of benzene with $Br_2/FeBr_3$ results in the product bromobenzne instead of 5,6-dibromo-1,3-cyclohexadiene.

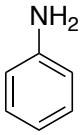
3) Predict the product and draw the active electrophile for each reaction shown below.

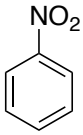
**(a)** 

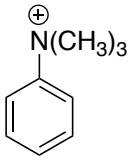

**(b)** 

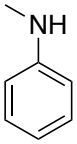

**(c)** 

4) Explain why each of the following substrates do not undergo Freidel-Crafts reactions.

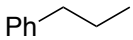


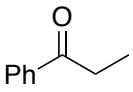


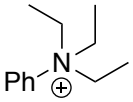


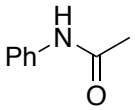


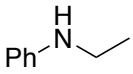

5) Arrange the following benzene substituents in order of reactivity in electrophilic aromatic substitution reactions.

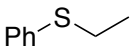


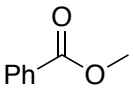




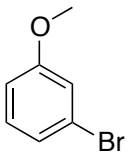









6) Predict the major products when the following benzene derivatives are treated to nitration conditions ($HNO_3/H_2SO_4$).

a.
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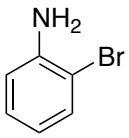
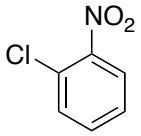
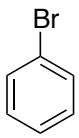
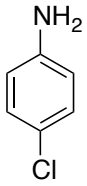


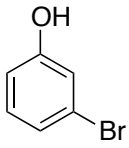

c.


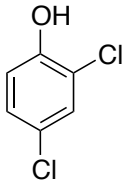

7) Write the full electron pushing mechanism for the nitration of toluene.

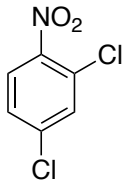
8) Predict the product(s) when each of the following benzene derivatives is treated to chloroethane and $AlCl_3$.

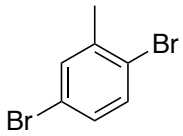
a. 

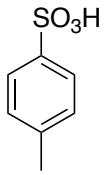

b. 


c. 

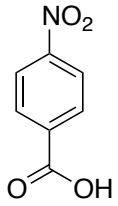

d. 

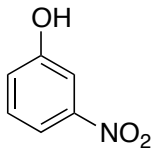

e. 

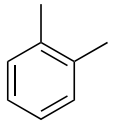

f. 

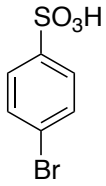

g. 

9) Predict the product(s) when the following benzene derivatives are subjected to electrophilic chlorination conditions ($Cl_2$, $FeCl_3$).

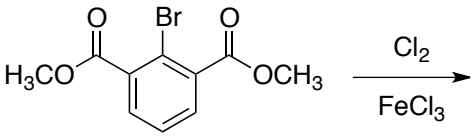
a. 

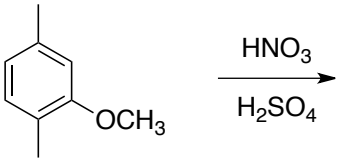

b. 

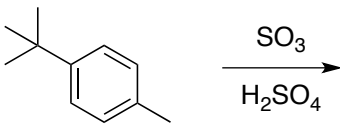

c. 

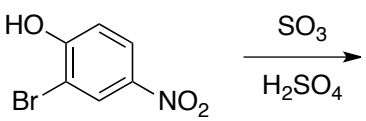
d. 


10) Predict the product(s) for each of the following reactions.

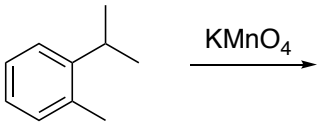
a. 

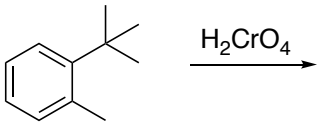

b. 

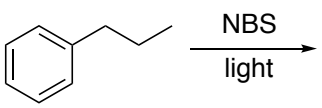

c. 

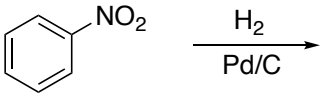

d. 

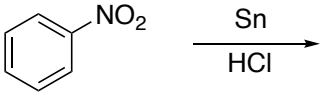
11) Predict the product for each benzene side-chain modification reaction shown below.

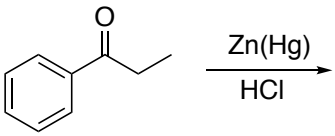
a. 

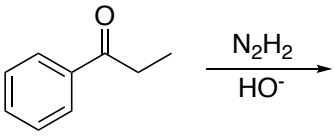

b. 


c. 

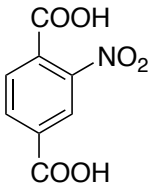

d. 

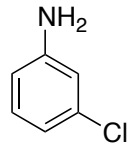

e. 

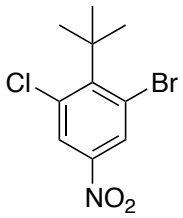

f. 

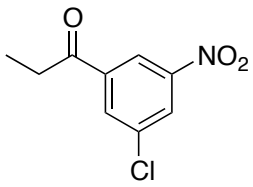

g. 

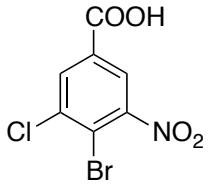

12) Propose a synthesis for each of the following compounds starting with benzene.

a. 

b. 


c. 


d. 


e. 

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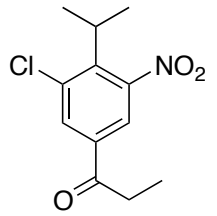


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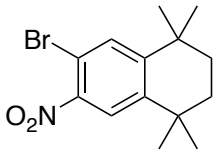
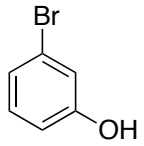



**Diazonium Ion Reactions (Final Exam Material – to be covered with Ch 24)**

13) Write out the synthetic sequence to prepare phenol and acetanilide (Ph-$NHCOCH_3$) from benzene.

14) Provide syntheses for each of the following compounds, free of other isomers. Your starting material should be benzene in each case.

a.

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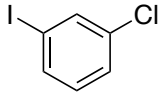
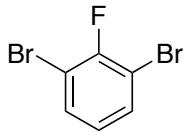



c.



d.