

Name: _____

If you do **not** wish to have your graded exam placed outside my office please check here _____

1) Some chemical species are **not** accurately described by a single Lewis Structure. Draw a Lewis structure of an example of such a.... (4pts)

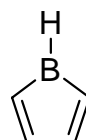
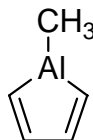
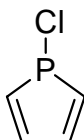
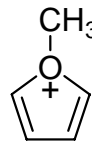
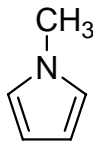
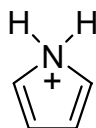
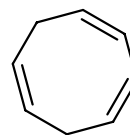
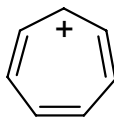
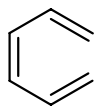
a) Neutral Compound

b) Carbanion

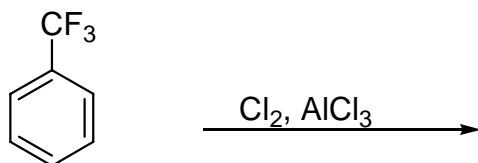
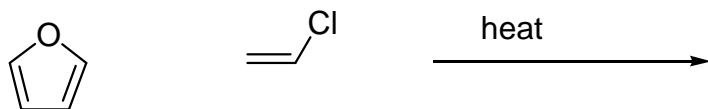
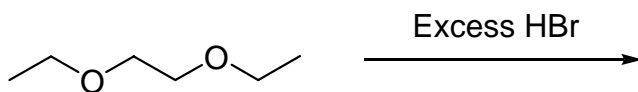
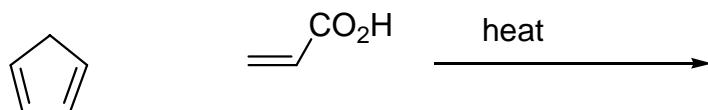
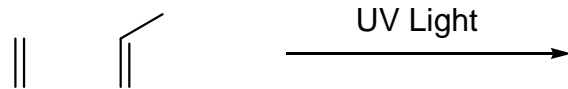
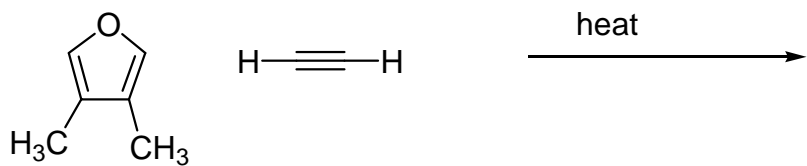
c) Carbocation

d) Radical

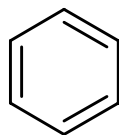
2) Indicate which of the following molecules are aromatic, non-aromatic or anti-aromatic. (Assume all the molecules are planar). (15pts)



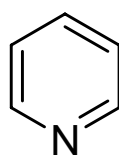
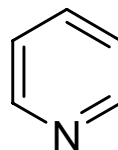
3) Predict the products in the following reactions, paying attention to regio/stereochemistry where applicable. (21pts)



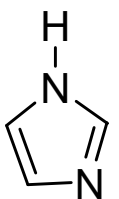
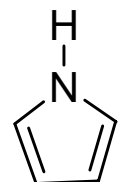
4) In each pair, circle the **stronger base**. (6pts)



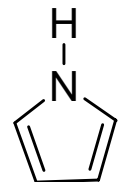
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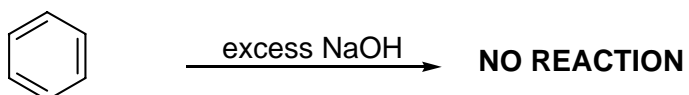
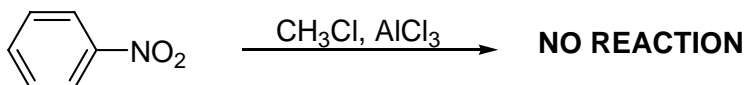
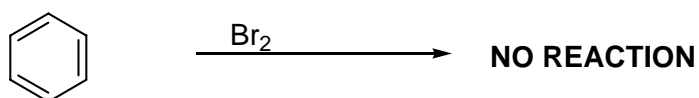
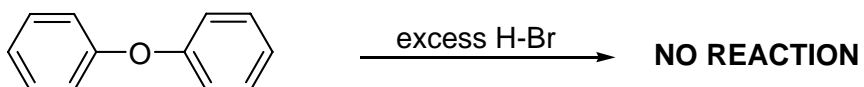
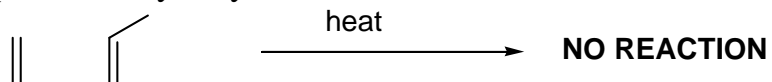
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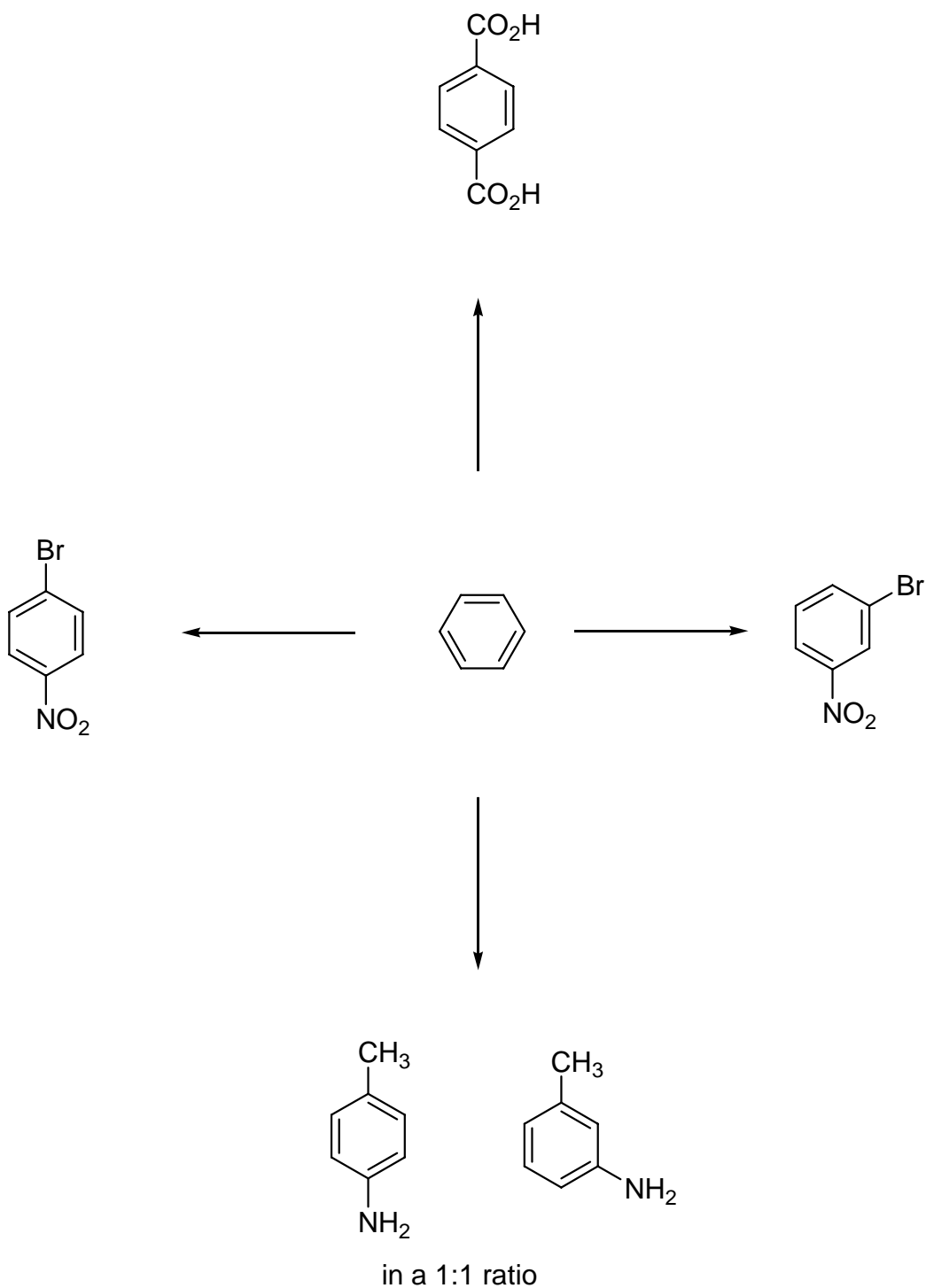
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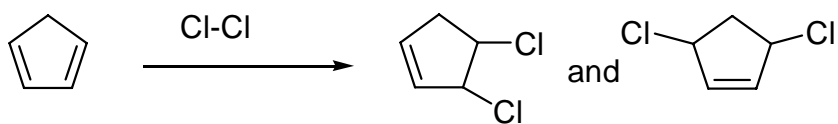
5) Explain briefly why each of these five reactions do not work (15 pts).



6) Give reagents for the following multistep transformations.
(4+3+3+5=15pts)



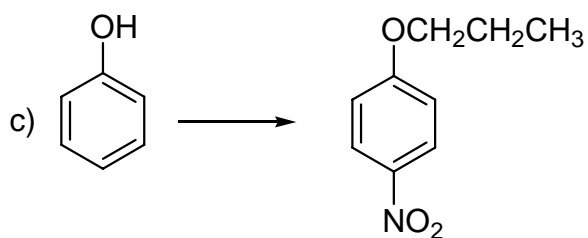
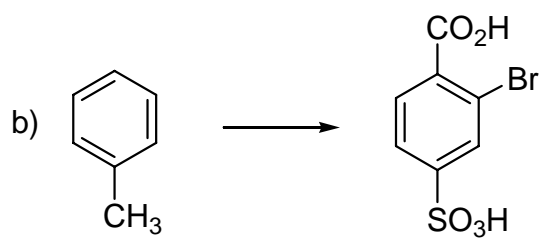
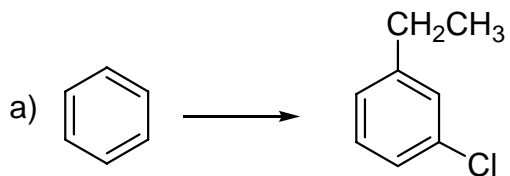
7) The addition of (1 equivalent of) Cl_2 to 1,3-cyclopentadiene generates a mixture of products.



a) Indicate which is the 1,2 and the 1,4 addition product.

b) Draw the mechanism showing how both products are formed. (9pts)

8) Devise synthetic schemes to generate the products from the starting material; bearing in mind more than one step is obviously required. (15pts)



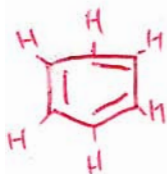
Name:

DWIGHT TANN-LYNES

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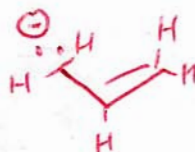
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a) Neutral Compound

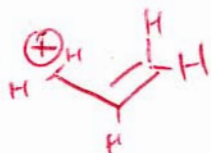


(anything with resonance or conjugation or aromaticity --- etc)

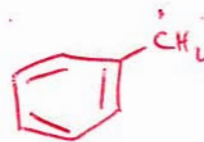
b) Carbanion



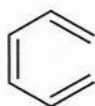
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2) Indicate which of the following molecules are aromatic, non-aromatic or anti-aromatic. (Assume all the molecules are planar). (15pts)



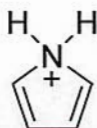
Non aromatic



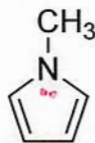
Aromatic



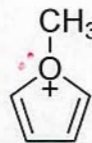
Non Aromatic



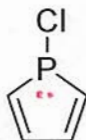
Non Aromatic



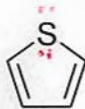
Aromatic



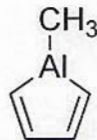
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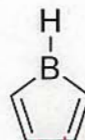
Aromatic



Aromatic

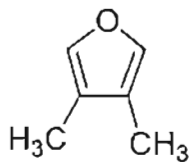
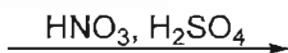
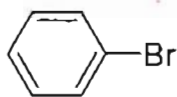


Anti Aromatic

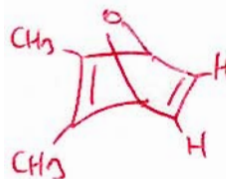


Anti Aromatic

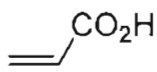
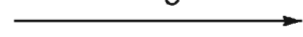
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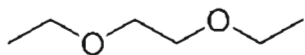
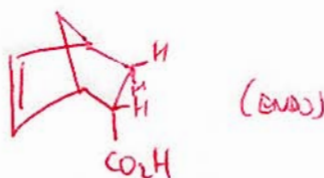
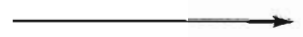
heat



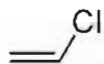
UV Light



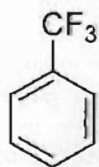
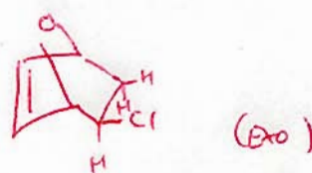
heat



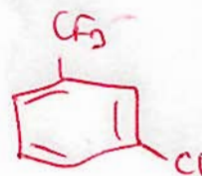
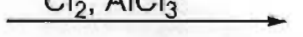
Excess HBr



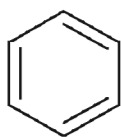
heat



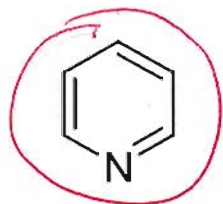
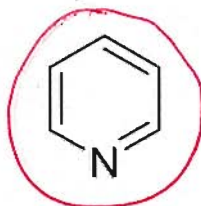
$\text{Cl}_2, \text{AlCl}_3$



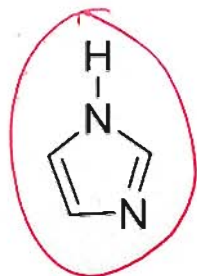
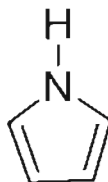
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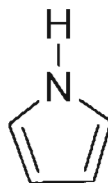
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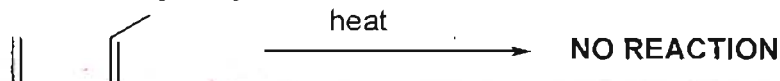
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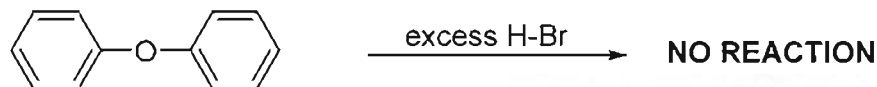
or



5) Explain briefly why each of these five reactions do not work (15 pts).



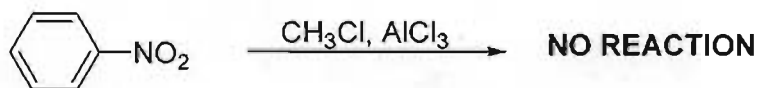
Thermal [2+2] cycloadditions are FORBIDDEN according to the Woodward/Hoffman Rules. The orbitals involved in this pericyclic reaction (HOMO & LUMO) do not match up.



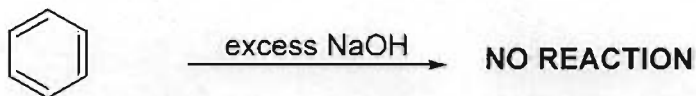
Phenyl ethers are not cleaved by acid since the aromatic ring blocks the nucleophile preventing S_N2 displacement. Also S_N1 reaction is unlikely since the required aryl cation would not likely form.



Bromine is not a strong enough electrophile to react with ^{the very stable} aromatic π system of benzene. The addition of a Lewis acid (e.g. $FeBr_3$) would convert the $Br_2 \rightarrow Br-Br^+-FeBr_3^-$ making it sufficiently electrophilic.

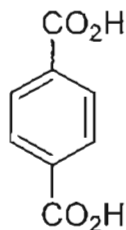


Friedel-Craft reactions do not work on strongly deactivated aromatics. The Nitro group is strongly electron withdrawing and thus a powerful deactivator for E.A.S. reactions.

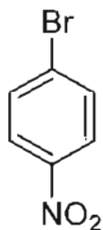


$NaOH$ is a basic and nucleophilic reagent. For eliminations or substitutions to occur with $NaOH$, a leaving group is required. Benzene only has hydrogen substituents (no L.G.) so no reaction occurs.

6) Give reagents for the following multistep transformations.
(4+3+3+5=15pts)



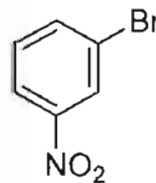
- ① $\text{CH}_3\text{Cl}, \text{AlCl}_3$
- ② $\text{CH}_3\text{Cl}, \text{AlCl}_3$
- ③ $\text{KMnO}_4, \text{OH}^-$, then H_3O^+



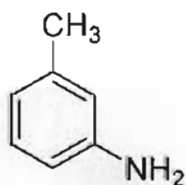
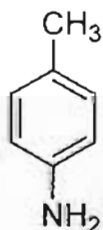
- ① $\text{Br}_2, \text{FeBr}_3$
- ② $\text{HNO}_3, \text{H}_2\text{SO}_4$



- ① $\text{HNO}_3, \text{H}_2\text{SO}_4$
- ② $\text{Br}_2, \text{FeBr}_3$

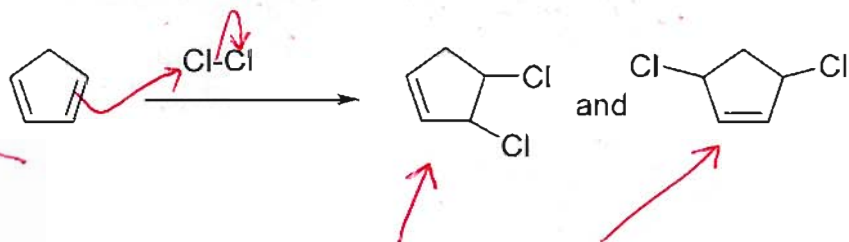


- ① $\text{CH}_3\text{Cl}, \text{AlCl}_3$
- ② $\text{Cl}_2, \text{AlCl}_3$
- ③ NaNH_2 (2 equivs.)



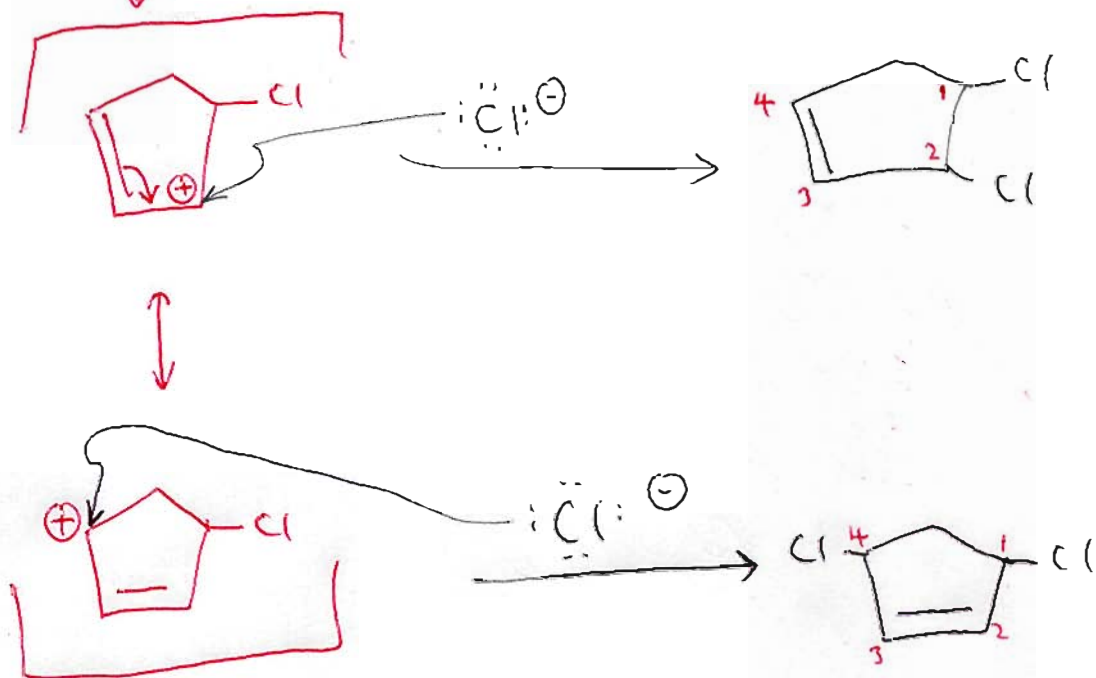
in a 1:1 ratio

7) The addition of (1 equivalent of) Cl_2 to 1,3-cyclopentadiene generates a mixture of products.



a) Indicate which is the 1,2 and the 1,4 addition product.

b) Draw the mechanism showing how both products are formed. (9pts)



8) Devise synthetic schemes to generate the products from the starting material; bearing in mind more than one step is obviously required. (15pts)

