Questions 1 - 5 are 3 point multiple choice questions. Questions 6-12 are 5 point multiple choice questions. Questions 13-19 are short answer questions worth 5 or 10 points each as indicated.

Selected Reactions of CHE 321-326

\[
\begin{align*}
\text{O} & \quad \text{PBr}_3 \\
\text{O} & \quad \text{SOCl}_2 \\
\text{O} & \quad \text{SOCl}_2 \\
\text{O} & \quad \text{H}_2\text{SO}_4 \\
\text{OH} & \quad \text{PCC} \\
\text{OH} & \quad \text{H}_2\text{CrO}_4 \\
\text{O} & \quad \text{Cl}\text{-SiR}_3 \\
\text{O} & \quad \text{SiR}_3 \\
\end{align*}
\]
Use the answers above to predict the main product for each of the following reaction sequences.

1. ______

2. ______

3. ______

Use the answers below to answer the following questions.

4. Which one of the rings is anti-aromatic?
5. Which one of the rings is non-aromatic?
6. The reaction of HBr with phenyl butadiene gives one main product at all temperatures. Identify the product.

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7. Which of the following compounds would absorb light of the longest wavelength?

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8. Which of the dienes below would be the most reactive with acrolein?

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<table>
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<th>acrolein</th>
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|   |   |   |   |   |   |
```
9. Give the product of the following reaction.

\[
\begin{align*}
\text{H}_3\text{C}_-\text{C}_-\text{O} & \xrightarrow{\text{Li}} \text{H}_3\text{C}_-\text{C}_-\text{O} \\
\text{H}_3\text{C}_-\text{C}_-\text{O} & \xrightarrow{\text{liquid NH}_3} \text{C}_2\text{H}_5\text{OH}
\end{align*}
\]

\[ \text{A} \quad \text{B} \quad \text{C} \quad \text{D} \quad \text{E} \quad \text{F} \]

10. Which compound undergoes an intramolecular Diels Alder reaction to give the compound shown?

\[
\begin{align*}
\text{O} & \text{H}_3\text{C}_-\text{H} \\
\text{O} & \text{H}_3\text{C}_-\text{H}
\end{align*}
\]

\[ \text{A} \quad \text{B} \quad \text{C} \quad \text{D} \quad \text{E} \quad \text{F} \]

11. Which of the following phenols is the most acidic?

\[ \text{A} \quad \text{B} \quad \text{C} \quad \text{D} \quad \text{E} \quad \text{F} \]
12. When benzene undergoes a Friedel Crafts reaction with CH₃Cl, which structure best represents the HOMO of the cationic intermediate?

![Friedel Crafts reaction diagram]

A. 
B. 
C. 
D. 
E. 

13. Pat, a very excited chemistry student doing undergraduate research, read all about the Diels Alder reaction and decided to take it one step further. Pat proposed to allow hexatriene to react with butadiene to give a ten membered ring. Pat drew a bunch of arrows and everything looked okay.

![Diels Alder reaction diagram] (10 pts)

Will Pat’s idea work? Perhaps you should check the orbitals.

A. Draw the LUMO and HOMO of hexatriene and label each orbital S or A.
B. Draw the LUMO and HOMO of butadiene and label each orbital S or A.
C. Is the reaction allowed or forbidden?

![LUMO and HOMO diagrams] (check one)
Give the final product of each of the following two reaction sequences.

14. (5 pts)

15. (5 pts)

16. Give a synthesis of the following compound starting with benzene and any other compounds of your choice. (5 pts each)

17. The compound shown below is the product of a Diels Alder reaction. Give the structures of the two reactants. (5 pts)
18. Draw a curved arrow mechanism for the following transformation.

\[
\begin{align*}
\text{CH}_3\text{C}(\text{CH}_2\text{C}_6\text{H}_5)\text{CO} & \xrightarrow{H^+} \text{C}_6\text{H}_{11}
\end{align*}
\]

(10 pts)

19. The compound sesquicineole is sesquiterpene found in many flowering plants. Give a synthesis of sesquicineole starting with carbon compounds of four carbons or less

\[
\text{sesquicineole}
\]

(10 pts)

Hint: form the ether linkage as your last step