1. Identify reagents A-G and identify the missing intermediate products 1-2 in the following reaction sequence:

\[
\begin{align*}
\text{H}_3\text{CO}- & \xrightarrow{\text{Cl}} \text{Cl-CO-H} & \text{1} \\
& \xrightarrow{A} \text{H}_3\text{CO}- & \text{2} \\
& \xrightarrow{B} \text{H}_3\text{CO}- & \\
& \xrightarrow{C} \text{H}_3\text{CO}- & \\
& \xrightarrow{D} \text{H}_3\text{CO}- & \\
\end{align*}
\]

1. NBS, Δ
2. KOH/EtOH, Δ

2. When the alcohol shown below was treated with aqueous sulfuric acid, a hydrocarbon of molecular formula $\text{C}_{20}\text{H}_{16}$ was produced as the major product. Propose a structure for this product and suggest a mechanism to account for its formation.

\[\begin{array}{c}
\text{H}_3\text{CO} \\
\text{OH}
\end{array}\]

3. Furan (3) is aromatic. Explain how the molecule can satisfy each of the criteria for aromaticity. Are the two nonbonding electron pairs on oxygen equivalent?

\[\text{3} \text{ O} \]

4. Furan undergoes electrophilic aromatic substitution, as shown below. The product is written to indicate that more than one mono-substituted product is possible.

\[\begin{array}{c}
\text{Furan} \\
\xrightarrow{\text{E}^+\text{B}^-} \\
\end{array}\]

(a) How many isomers of mono-substituted furan are there?
(b) By drawing resonance structures of possible cationic intermediates for the above electrophilic aromatic substitution reaction, decide which mono-substituted furan(s) is (are) the major product(s).

5. Predict the order of reactivity of compounds 4-6 shown below toward solvolysis in aqueous acetone (i.e., SN1 reaction in H2O/acetone) (least reactive first). Keep in mind the electronic effects exerted by the nitro and the methoxy groups. Draw the necessary resonance forms to justify your answer.

![Chemical Structures](image)

6. Starting with benzene or toluene, suggest efficient syntheses for preparing each of the following compounds:

(a) ![Chemical Structure](image)  
(b) ![Chemical Structure](image)  
(c) ![Chemical Structure](image)