1) Provide a synthesis for the following molecules starting from the given reactant.

a) 

\[
\text{Phosphorus oxychloride (POCl}_3\text{) and triethylamine (Et}_3\text{N) are used to convert the starting compound to an intermediate. Then, upon addition of \(\text{BH}_3\text{THF}\), followed by hydration with \(\text{H}_2\text{O}_2\text{, the desired product is obtained.}}\]

b) Make p-bromobenzoic acid from benzene in 3 steps.

\[
\text{First, benzene (C}_6\text{H}_6\text{) is treated with chloroform (CH}_3\text{Cl) in the presence of \(\text{AlCl}_3\). After bromination with \(\text{Br}_2\), followed by oxidation with potassium permanganate (KMnO}_4\), the p-bromobenzoic acid is obtained.}\]

c) The synthesis involves four steps. The starting material is treated with hydrazine \((\text{NH}_2\text{NH}_2\text{)) and then hydrolyzed with \(\text{H}_2\text{O}\). Further steps involve conversion to the desired product.

\[
\text{The reactions involve: (1) Reduction with HI, (2) Addition of Mg, and (3) Oxidation with \(\text{H}_2\text{O}_2\).}\]

Need to protect!

\[ \text{Br} \quad \text{OH} \quad \text{TMS-Cl} \quad \text{Et}_2\text{N} \quad \text{O-Si-} \quad \text{BrMg} \quad \text{Ng} \quad \text{Ether} \quad \text{OH} \quad \text{Cl}\]

(3 steps)

\[ \text{OH} \quad \text{SOCl}_2 \quad \text{Cl} \quad \text{Mg} \quad \text{Ether} \quad \text{OH} \quad \text{H}_3\text{O} \quad \text{Cl}\]

(3 steps)

\[ \text{only source of benzene rings} \quad \text{Br} \quad \text{FeBr}_3 \quad \text{MgBr} \quad \text{Br} \quad \text{EtOH} \quad \text{OH} \quad \text{Add twice} \quad \text{OH} + \text{Br}\]

(5 steps total)
2) Complete the following reactions

- **First Reaction**
  - Aromatic compound with nitro group
  - Reactions:
    1. **HNO₃, H₂SO₄**
    2. **NaBH₄**
    3. **2 H₂O⁺, DL LiAlH₄**
    4. **2 H₂O⁺**

- **Second Reaction**
  - Aldehyde formation
  - Reactions:
    1. **CrO₃, H⁺, acetone**
    2. **PCC**

- **Third Reaction**
  - Alcohol to aldehyde
  - Reactions:
    1. **NaH**
    2. **Br**

- **Fourth Reaction**
  - Diol formation
  - Reactions:
    1. **NaBH₄ (excess)**
    2. **H⁺ workup**

- **Fifth Reaction**
  - Hydrolysis
  - Reactions:
    1. **KOH**
    2. **H₂O⁺**
3) Electron movements:

a) Using resonance structures, show if benzoic acid is either a meta or ortho/para director.

- Ring is deactivated

- Less electron dense at ortho & meta positions = Less likely to grab electrophile

b) Propose a mechanism for the following reactions:
1) Make E⁺
2) Attack E⁺, non-aromatic
3) Reform aromatic compound

Adding Halides & F-C reactions

\[
\text{Br}_2 \quad \text{FeBr}_3 \quad \rightarrow \quad \text{Br}^- \quad \text{Fe}^+ \quad \text{Br}_2 \quad \rightarrow \quad \text{Br}^- \quad \text{Fe}^+ \quad \text{Br}_2
\]

\[
\text{FeBr}_3 + HBr \rightarrow \text{FeBr}_4 + H_2\text{Br}_3
\]

Don't need to show on exams typically.

1. Ph-MgBr (Excess)
2. H⁺
4) Naming (draw or name the following)

cyclopent-3-ene-1-ol

1-p-Bromoaniline  4-Bromoaniline

3-methyl-2-pentanol

4,4-dimethyl-2-pentanol