1. Complete the following reactions.

$$\text{C}_{6}\text{H}_{5}-\text{NH}_2 + \text{HCl} \rightarrow \text{C}_{6}\text{H}_{4}(\text{H})\text{N}_{\ominus}+\text{Cl}^\ominus$$ (benzenediazonium chloride = A)

b. A + CuCN $\rightarrow$ Ph(CN)
c. A + CuBr $\rightarrow$ PhBr
d. A + CuCl $\rightarrow$ PhCl
e. A + H$_3$PO$_2$ $\rightarrow$ PhH
f. A + KI $\rightarrow$ PhI
g. A + HBF$_4$ $\rightarrow$ PhF
h. A + H$_2$O, heat $\rightarrow$ PhOH

2. Provide reasonable synthetic sequences for the preparation of each of the following compounds from the indicated starting materials and any other necessary reagents.  

a.) from ethylbenzene  

b.) from benzene

c.) from aniline  

d.) from aniline

3. Starting with benzene or toluene, suggest efficient synthetic sequences for preparing each of the following compounds:  

a) COOH  

b) Br  

c) $\text{C}_{6}\text{H}_{4}$-CH$_3$  

d) $\text{C}_{6}\text{H}_{4}$-Br

4. Arrange the following compounds in order of increasing reactivity (least reactive $\rightarrow$ most reactive toward sulfonation with SO$_3$/H$_2$SO$_4$). Justify your reasoning.
4. Complete the following reactions. [see 3B Addendum]

a) \( \text{Ph-Br} + \text{Ph-ZnCl} \xrightarrow{\text{Pd[PPh$_3$]}_4} \)

b) \( \text{C}_5\text{H}_5 + \text{Ph-Br} \xrightarrow{\text{Pd[PPh$_3$]}_4, \text{THF, base}} \)

c) \( \text{Ph-SO$_2$CF$_3$} + \text{B(OH)$_2$} \xrightarrow{\text{Pd[PPh$_3$]}_4, \text{NaOCH$_2$CH$_3$}} \)

d) \( \text{Ph-C≡C-Sn(C}_4\text{H}_9)_3 + \text{Ph-Br} \xrightarrow{\text{Pd[PPh$_3$]}_4, \text{THF}} \)

e) \( \text{Pyrene} + \text{Ph-Br} \xrightarrow{(\text{CH}_3)_3\text{CONa, cat. Pd(0), Ph$_3$P}} \)

f) \( \text{N$_2$H$_5$} + \text{Ph-Br} \xrightarrow{\text{Pd(OAc)$_2$, Ph$_3$P}} \)

6. Identify reagents A through G and the missing intermediate products in the following reaction sequence. [see 2B Addendum]

1. NBS, heat  \( \text{Ph-OCH$_3$} + \text{CH$_2$Cl} \xrightarrow{\text{AlCl$_3$}} 1 \xrightarrow{A} \text{H$_3$CO-Ph-CH$_2$CH$_2$CH$_3$} \)

2. KOH/EtOH, heat  \( 2 \xrightarrow{\text{B}} \text{H$_3$CO-Ph-CH$_2$CH$_3$} \xrightarrow{\text{OH}} \text{C} \)

D \( \text{H$_3$CO-Ph-CH$_2$CH$_3$} \xrightarrow{\text{OTs}} \text{D} \xrightarrow{\text{CN}} \text{H$_3$CO-Ph-CH$_2$CH$_3$} \)