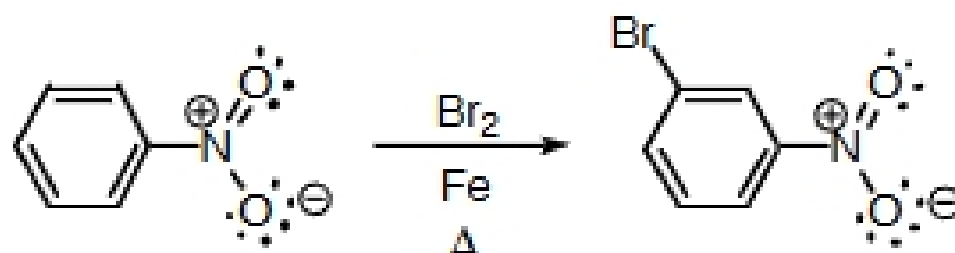


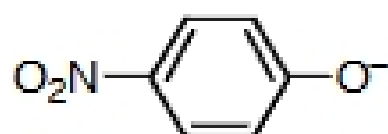
(Covering material through section 15.13)

1. (6) When nitrobenzene is brominated, the -Br group is directed to the meta position:

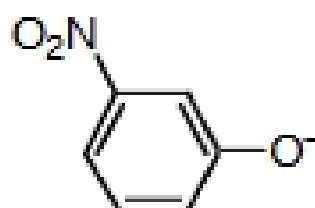


Very little of the ortho or para product forms. The reason for this is that the intermediate carbocation (arenium ion) formed from attack of the " $\text{Br}^+$ " at the ortho or para positions have three resonance contributors each, just like for meta attack, but one of them is deemed to be unstable relative to the others. Draw this particular resonance contributor for either ortho or para attack.

2. (6) We learned that a substituent on an aromatic ring can operate electronically via either an inductive effect, resonance effect, or both. Experimentally it is known that *p*-nitrophenol ( $pK_a = 7.14$ ) is more acidic than *m*-nitrophenol ( $pK_a = 8.39$ ). What does this say about how the  $\text{NO}_2$  group is operating electronically in these two substituted phenols? Support your answer with resonance structures of the conjugate base form of the phenols.



conjugate base of  
*p*-nitrophenol



conjugate base of  
*m*-nitrophenol

3. (12) Outline how each of the following compounds could be made starting from benzene.

