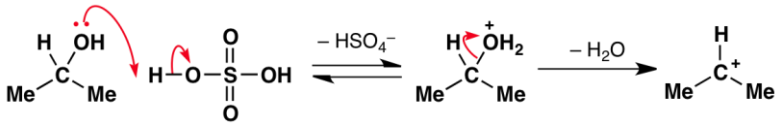
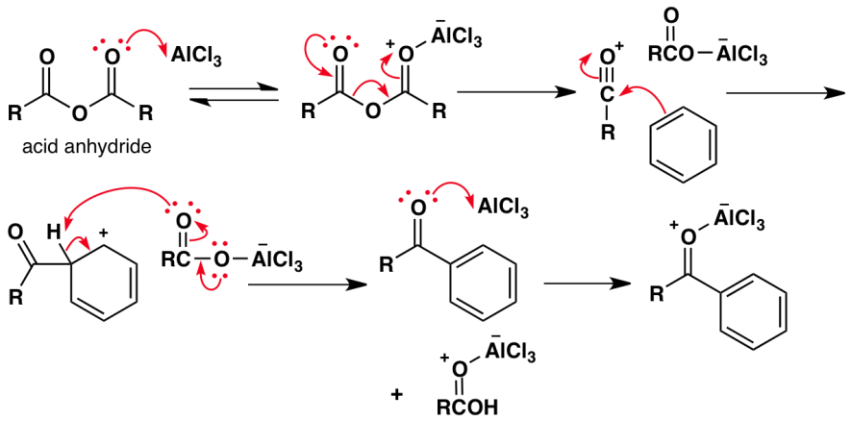
## Solutions to Exercises, Chapter 16

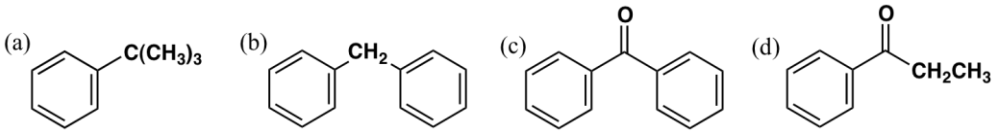
**16.1**



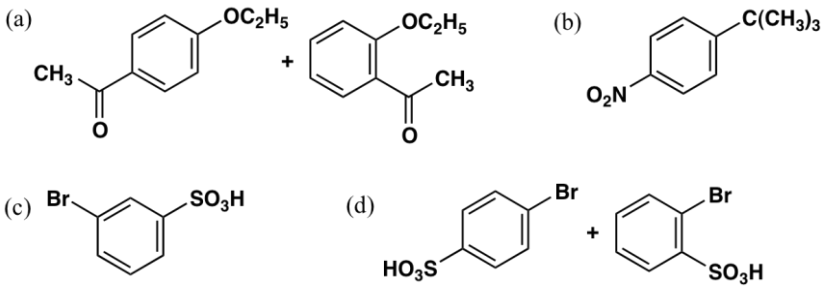

**16.2** More than two equivalents of $AlCl_3$ are needed because the ketone product and the carboxylic acid by-product both form adducts with the $AlCl_3$. The organic compounds are released upon the final treatment with aqueous acid (acidity is necessary to keep the Al(III) in solution as hydrated $Al^{3+}$ cations and thereby facilitate the isolation of the product).



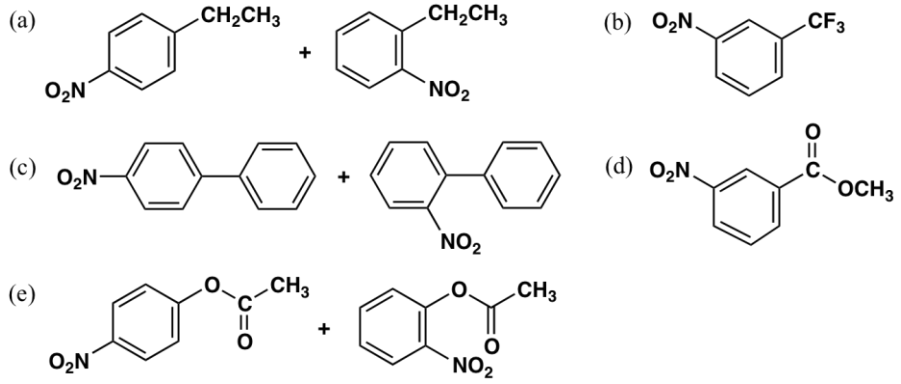

**16.3**



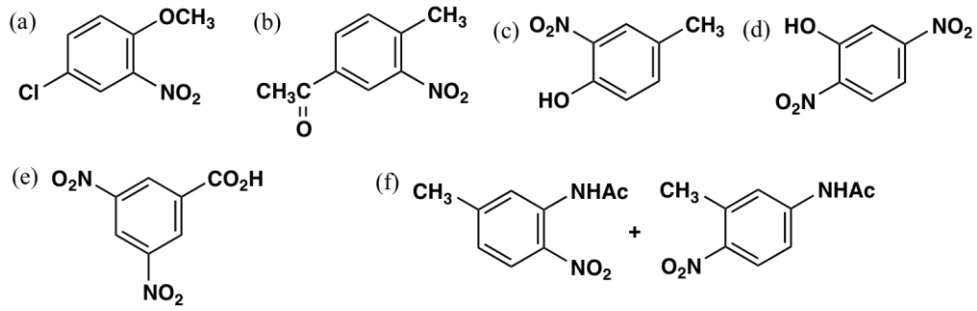

**16.4**



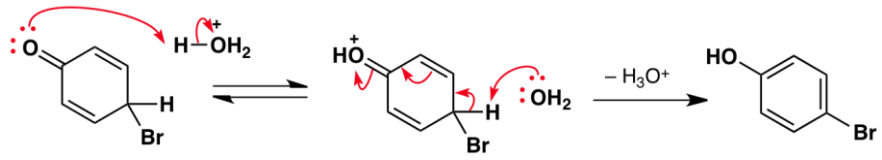
**16.5**



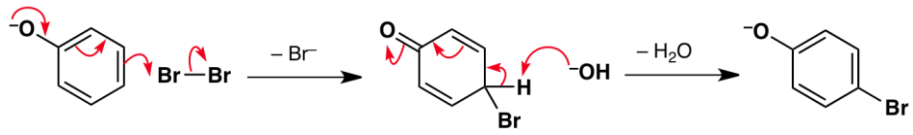

**16.6**



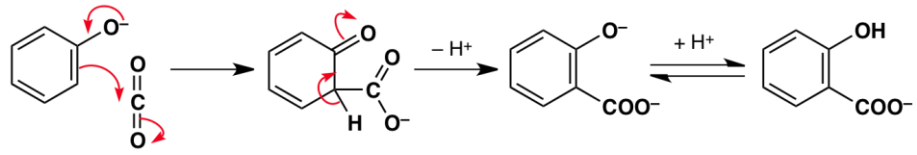

**16.7**



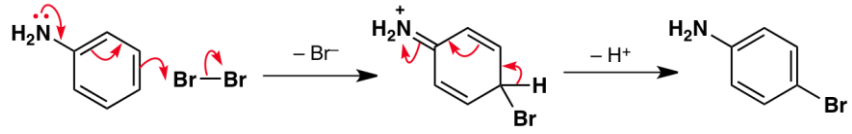

**16.8**



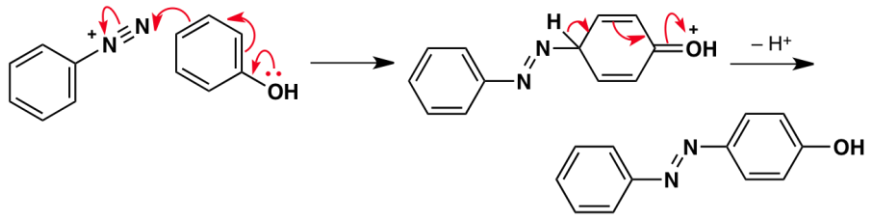
**16.9**



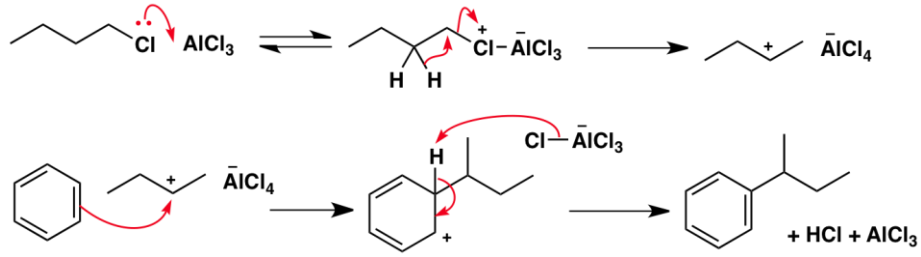
**16.10**



**16.11**

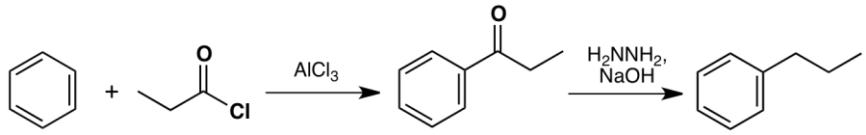


**16.12**

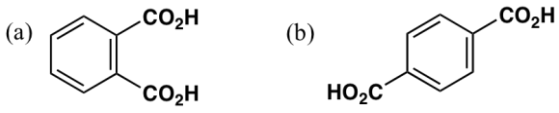


**16.13** The adduct of 1-chloropropane with $AlCl_3$ will react with benzene to give propylbenzene; it will also form the isopropyl cation by 1,2-hydride shift which leads to isopropylbenzene upon reaction with benzene. Some multiple alkylation will also occur.

**16.14**




**16.15**




**16.16**

(a) A large excess of benzene is used to minimize polyalkylation in the first step.