

**Chem. 118B Workshop/Doug Kent/LSC: Electrophilic Aromatic Substitution Reactions Of Benzene From Chapter 15, Vollhardt & Schore, 5th Edition (Benzene = C<sub>6</sub>H<sub>5</sub>-H)**

Reaction	Reagents/Catalysts	Electrophile	Product	Comments
Halogenation	X <sub>2</sub> /MX <sub>3</sub> (X = Cl or Br; M = Al or Fe (III))	$\begin{matrix} + & - \\ X = X - MX_3 \end{matrix}$	C <sub>6</sub> H <sub>5</sub> -X (Chlorobenzene, Bromobenzene)	
Nitration	HNO <sub>3</sub> /H <sub>2</sub> SO <sub>4</sub>	$\text{+NO}_2$	C <sub>6</sub> H <sub>5</sub> -NO <sub>2</sub> (Nitrobenzene)	May be reduced to aniline (C <sub>6</sub> H <sub>5</sub> -NH <sub>2</sub> ) by H <sub>2</sub> /Ni, Fe/HCl, etc. (Ch. 16)
Sulfonation	SO <sub>3</sub> /H <sub>2</sub> SO <sub>4</sub>	SO <sub>3</sub>	C <sub>6</sub> H <sub>5</sub> -SO <sub>3</sub> H (Benzenesulfonic Acid)	Reversible (desulfonation) by hydrolysis using H <sub>2</sub> O/ $\Delta$ /H <sub>2</sub> SO <sub>4</sub> (catalyst)
Friedel-Crafts Alkylation	RCH <sub>2</sub> X/MX <sub>3</sub>	$\begin{matrix} + & - \\ RCH_2-X-MX_3 \end{matrix}$	C <sub>6</sub> H <sub>5</sub> -CH <sub>2</sub> R (Alkylbenzene)	Drawbacks: possible rearrangements, polyalkylation, etc.
Friedel-Crafts Acylation	1) RCOCl/AlCl <sub>3</sub> or RCO <sub>2</sub> COR/AlCl <sub>3</sub> 2) H <sup>+</sup> /H <sub>2</sub> O	$\begin{matrix} + \\ R - C = O \end{matrix}$	C <sub>6</sub> H <sub>5</sub> -COR (acylbenzene = phenyl ketone)	Product may be reduced to alkylbenzene (Ch. 16); need <b>equivalent</b> amount of AlCl <sub>3</sub>