



# Aldehydes, Ketones and Carboxylic Acids

## REDUCTION

Group	Product	LAH in Ether	NaBH <sub>4</sub> in H <sub>2</sub> O	B <sub>2</sub> H <sub>6</sub> in THF	H <sub>2</sub> /Catalyst Δ
1°RX	RH	+	–	–	+
–C≡C–	–CH=CH–	–	–	+	+
>C=C<	>CH–CH<	–	–	+	+
–CHO	–CH <sub>2</sub> OH	+	+	+	+
>C=O	>CH–OH	+	+	+	+
–CO <sub>2</sub> H	–CH <sub>2</sub> OH	+	–	+	+
–CO <sub>2</sub> R	–CH <sub>2</sub> OH	+	–	+	+
–COCl	–CH <sub>2</sub> OH	+	+	–	+
–CONH <sub>2</sub>	–CH <sub>2</sub> NH <sub>2</sub>	+	–	+	+
(RCO) <sub>2</sub> O	RCH <sub>2</sub> OH	+	–	+	+
–CN	–CH <sub>2</sub> NH <sub>2</sub>	+	–	+	+
>C=NOH	–CH <sub>2</sub> NH <sub>2</sub>	+	–	–	+

### Note:

1. B<sub>2</sub>H<sub>6</sub> in THF not able to reduce cyclic ester.
2. NaBH<sub>4</sub> can also reduce imine group ( $\text{>C=NH}$ ).
3. Reactivity order towards H<sub>2</sub>/Ni, Δ  $\Rightarrow \text{–C}\equiv\text{N} > \text{–}\overset{\text{O}}{\underset{\text{||}}{\text{C}}}\text{–O–R}$

Name	Reagent	Function
Wolf Kishner Reduction	(i) N <sub>2</sub> H <sub>4</sub> / (ii) KOH, Δ	
Clemmenson Reduction	Zn–Hg/HCl	
Mozingo Reduction	$\begin{bmatrix} \text{SH} \\ \text{Dry HCl, followed by Raney Ni} \\ \text{SH} \end{bmatrix}$	

Stephen's Reduction	$\text{SnCl}_2/\text{HCl}$ followed by $\text{H}_3\text{O}^+$	$\text{R}-\text{C}\equiv\text{N} \rightarrow \text{R}-\text{CH}=\text{O}$
Rosenmund Reduction	$\text{H}_2$ , $\text{Pd}-\text{BaSO}_4$	$\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl} \rightarrow \text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$ $*\text{-C}\equiv\text{C-} \rightarrow \begin{array}{c} \text{C}=\text{C-} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$
DIBAL-H ( $-78^\circ\text{C}$ )	$\text{H}-\text{Al} \left( \begin{array}{c} \text{---CH}_2\text{---CH---CH}_3 \\   \\ \text{CH}_3 \end{array} \right)_2$ followed by $\text{H}_3\text{O}^+$	$\left. \begin{array}{l} \text{---COOR} \\ \text{---C}\equiv\text{N} \\ \text{---COOCl} \\ \begin{array}{c} \text{O} \quad \text{O} \\ \parallel \quad \parallel \\ \text{---C---O---C---} \end{array} \end{array} \right\} \rightarrow \text{---CHO}$
MPV Reduction	$\text{Al} \left( \begin{array}{c} \text{---O---CH---CH}_3 \\   \\ \text{CH}_3 \end{array} \right)_3 / \text{HO---CH} \begin{array}{c} \text{CH}_3 \\   \\ \text{CH}_3 \end{array}$	$\text{>C=O} \rightarrow \text{>CH-OH}$
Red phosphorus in presence of HI	Red P + HI	$\begin{array}{l} \text{R-CO}_2\text{H} \rightarrow \text{RCH}_3 \\ \text{R-CH=O} \rightarrow \text{RCH}_3 \\ \text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{R} \rightarrow \text{RCH}_2\text{R} \\ \text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH} \rightarrow \text{R-H} \end{array}$
Hydroboration Reduction	$\text{B}_2\text{H}_6/\text{AcOH}$ , $\text{H}_2\text{O}$	$\text{>C=C<} \rightarrow \begin{array}{c} \text{C} \quad \text{C} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$ $\text{>C=O} \rightarrow \begin{array}{c} \text{C} \quad \text{O} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$
Bouvault Blank Reduction	$\text{Na}/\text{EtOH}$	$\text{R-COO-R} \rightarrow \text{RCH}_2\text{OH} + \text{ROH}$
Transfer Hydrogenation	$\text{N}_2\text{H}_4/\text{H}_2\text{O}_2$	$\text{>C=C<} \rightarrow \begin{array}{c} \text{C} \quad \text{C} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$