## **Summary Sheet - The Oxidation Ladder**

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Note - this sheet is not meant to be comprehensive. Your course may provide additional material, or may not cover some of the reactions shown here. Your course instructor is the final authority

Oxidation state of carbon Notes: to keep things relatively simple, several common functional groups (amines,  $CO_2$ Indicates oxidations epoxides, ethers, and many more) have been omitted. All alkyl halides are drawn as chlorides ("Cl"). For Br and I, the corresponding +4 Indicates reductions Carbon dioxide reagent containing those atoms should be employed. Neither oxidations nor reductions Oxidation here is defined as: loss of a C–H bond or gain of a C–O bond (or equivalent) Reduction here is defined as: gain of a C–H bond or loss of a C–O bond (or equivalent) H<sub>2</sub>O, acid ROH, acid  $P_{2}O_{5}$ N.C. NH<sub>3</sub> or other +2 amine H<sub>2</sub>O, acid H<sub>2</sub>O or NaOH Carboxylic acid Amide Nitrile Ester H<sub>2</sub>O, acid REDUCT amine, DCC NH<sub>3</sub> or other amine mCPBA O<sub>3</sub>, H<sub>2</sub>O D H<sub>2</sub>CrO<sub>4</sub> RMgCl or H<sub>2</sub>O<sub>2</sub> or RLi H<sub>2</sub>CrO<sub>4</sub> KMnO<sub>4</sub> 0 0 BH<sub>3</sub>, H<sub>2</sub>O<sub>2</sub> H<sub>2</sub>O, H<sub>2</sub>SO<sub>4</sub> or HgSO<sub>4</sub>, H<sub>2</sub>O, H<sub>2</sub>SO<sub>4</sub> Ν RMgCI NaNH<sub>2</sub> or RLi NaNH<sub>2</sub> 0 Ketone HCI Aldehyde Alkyne Dihalide (Geminal) Dihalide H<sub>2</sub>, Lindlar's (Vicinal) NaBH PCC catalyst  $Cl_2$ O<sub>3</sub>, Zn (or DMS) PCC O<sub>3</sub>, Zn (or DMS) LiAIH H<sub>2</sub>CrO<sub>4</sub> H<sub>2</sub>SO<sub>4</sub>, heat H<sub>2</sub>SO<sub>4</sub>, heat H<sub>2</sub>O, H<sub>2</sub>SO<sub>4</sub> or Hg(OAc)<sub>2</sub>, H<sub>2</sub>O, then NaBH<sub>4</sub> BH<sub>3</sub>, H<sub>2</sub>O<sub>2</sub> NaOH NaOH (S<sub>N</sub>2) HCI (S<sub>N</sub>2) base (e.g. NaOEt)  $\bigwedge_{\mathsf{R}}$ -2  $PCl_3$  or  $SOCl_2$ HCI base (e.g. NaOEt) Alkene Alcohol Alcohol Alkyl halide Alkyl halide -Alcohol (Primary) (Primary) (Secondary) (Secondary) (Tertiary) Pd/C H<sub>2</sub> Mg, then acid Mg, then acid CI<sub>2</sub>, Cl<sub>2</sub>, light light Alkanes Omissions, Mistakes, Suggestions? james@writechem.com This sheet copyright 2011, James A. Ashenhurst masterorganicchemistry.com