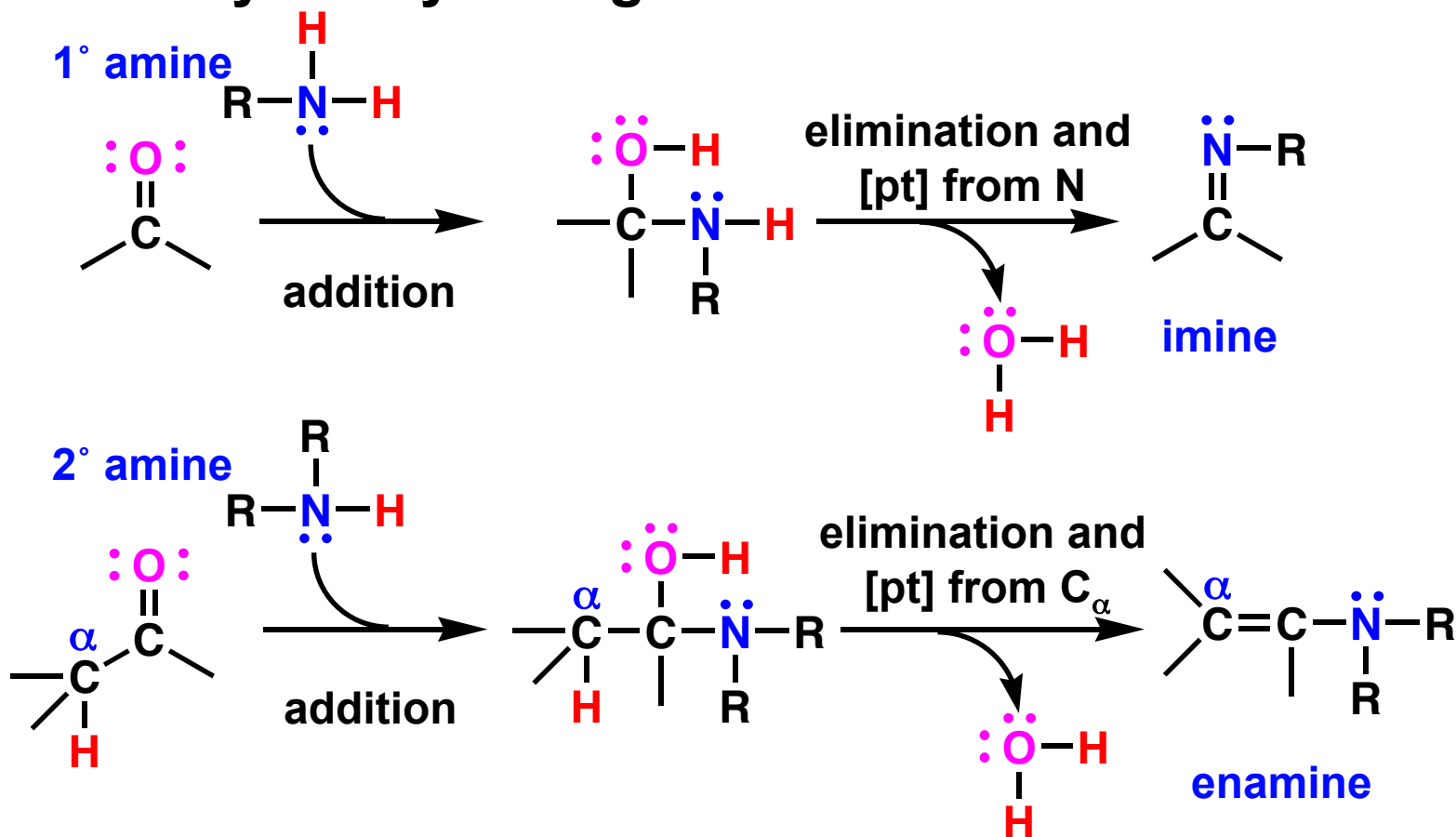


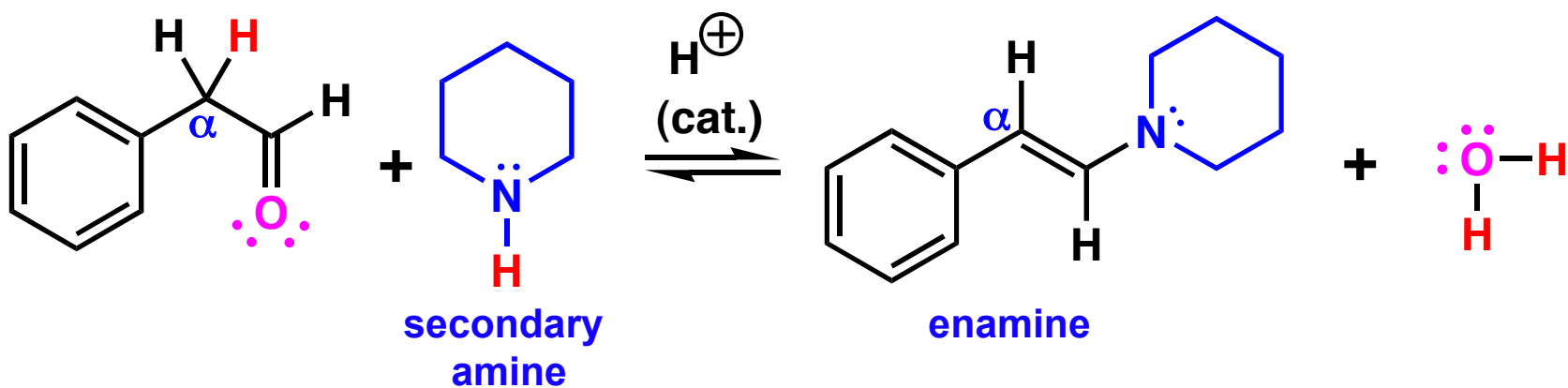
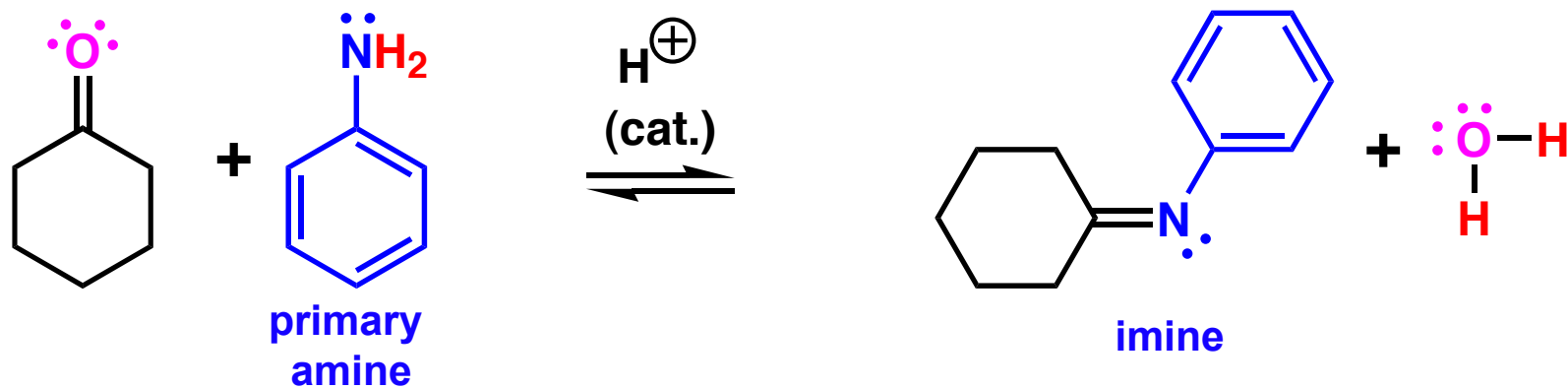
Substitution of the Carbonyl Oxygen of Ketones and Aldehydes by Nitrogen: Imines and Enamines



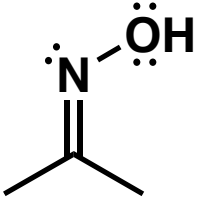
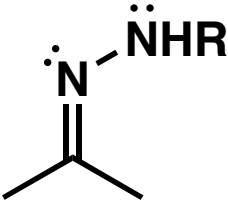
When **primary amines** are combined with ketone and aldehyde groups, the carbonyl C=O is replaced by the C=N (**imine**) group. The mechanistic sequence is addition followed by elimination of water (the second N–H proton is necessary for imine formation). When **secondary amines** are combined with aldehydes and ketones, there is no second proton on nitrogen to permit imine formation. In this case, elimination of water is achieved via proton transfer from a H–C $_{\alpha}$ bond (assuming that the aldehyde or ketone substrate has at least one α -hydrogen). The functional group that results is called an **enamine**.



Examples of Imine and Enamine Formation



Other Amino Reagents that Produce Derivatives of Aldehydes and Ketones

Reagent $\text{H}_2\ddot{\text{N}}-\text{R}$	Derivative Name	Structure
$\text{H}_2\ddot{\text{N}}-\ddot{\text{O}}\text{H}$ hydroxylamine	oxime	
$\text{H}_2\ddot{\text{N}}-\ddot{\text{N}}\text{HR}$ hydrazine	hydrazone	
$\text{H}_2\ddot{\text{N}}-\text{H}-\overset{\cdot\ddot{\text{O}}}{\parallel}{\text{C}}-\ddot{\text{N}}\text{H}_2$ semicarbazide	semicarbazone	