

3.8 Distinction between alkanes, alkenes and alkynes.

Property	Alkane (Ethane)	Alkene (Ethene)	Alkyne (Ethyne)
Molecular formula	$C_nH_{2n+2}(C_2H_6)$	$C_nH_{2n}(C_2H_4)$	$C_nH_{2n-2}(C_2H_2)$
Nature	Saturated	Unsaturated	Unsaturated
	Single bond between carbon atoms. Each carbon atom is sp^3 -hybridized $C - C$ Bond length 1.54 Å Bond energy : 83 Kcal mol ⁻¹	Double bond between two carbon atoms. Both carbon atoms are sp^2 -hybridized $C = C$ 1.34 Å 146 Kcal mol ⁻¹	Triple bond between two carbon atoms both carbon atoms are sp -hybridized $- C \equiv C -$ 1.20 Å 200 Kcal mol ⁻¹
Burning	Burns with nonluminous flame $C_2H_6 + 7/2O_2 \rightarrow 2CO_2 + 3H_2O$	Burns with luminous flame $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$	Burns with smoky flame $C_2H_2 + 5/2O_2 \rightarrow 2CO_2 + H_2O$
Reaction with H_2	–	Forms alkane	Forms alkene and alkane
		$C_nH_{2n} + H_2 \xrightarrow[300^\circ C]{Ni} C_nH_{2n+2}$ Alkane $C_2H_4 + H_2 \rightarrow C_2H_6$	$C_nH_{2n} + H_2 \xrightarrow[300^\circ C]{Ni} C_nH_{2n+2}$ Alkane $C_nH_{2n-2} + H_2 \xrightarrow[300^\circ C]{Ni} C_nH_{2n}$ Alkene
Reaction with conc. H_2SO_4 and hydrolysis	–	Addition $C_2H_4 + H_2SO_4 \rightarrow C_2H_5HSO_4$ $\xrightarrow{H_2O} C_2H_5OH$	Addition $C_2H_2 \rightarrow CH_3CH(HSO_4)_2$ $\xrightarrow[Alcohol]{H_2O} CH_3CHO$ Aldehyde
Br_2/CCl_4	–	Decolorizes Dibromo derivative, $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$	Decolorizes Tetrabromo derivative, $C_2H_2Br_4$

Baeyer's reagent (Alk. KMnO_4)	–	Decolorizes Glycol is formed $\begin{array}{ccc} \text{CH}_2 & & \text{CH}_2\text{OH} \\ & + \text{H}_2\text{O} + \text{O} \rightarrow & \\ \text{CH}_2 & & \text{CH}_2\text{OH} \end{array}$	Decolorizes Oxalic acid is formed $\begin{array}{ccc} \text{CH} & & \text{COOH} \\ & + 4\text{O} \rightarrow & \\ \text{CH} & & \text{COOH} \end{array}$
Ammonical Cu_2Cl_2	–	–	Red precipitate $\begin{array}{ccc} \text{CH} & & \text{CCu} \\ & + \text{Cu}_2\text{Cl}_2 + 2\text{NH}_4\text{OH} \rightarrow & \\ \text{CH} & & \text{CCu} \\ & & \text{(Red)} \end{array}$ $+ 2\text{NH}_4\text{Cl} + 2\text{H}_2\text{O}$
Ammonical silver nitrate	–	–	White precipitate $\begin{array}{ccc} \text{CH} & & \text{C - Ag} \\ & + 2\text{AgNO}_3 + 2\text{NH}_4\text{OH} \rightarrow & \\ \text{CH} & & \text{C - Ag} \end{array}$ $+ 2\text{NH}_4\text{Cl} + 2\text{H}_2\text{O}$