

Writing Organic Structures and Functional Groups

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Classes of Compounds

- Classification based on **functional group**.
- The functional group is where the reaction usually takes place.
- Alkanes don't have a functional group and are the least reactive of all classes.
- Three broad classes
 - Hydrocarbons
 - Compounds containing oxygen
 - Compounds containing nitrogen.
- Organic compounds are classified also as aliphatic (straight chain) and aromatic (benzene like).
- Functional groups can be classified in "families" or homologous series. These series increase by 1 carbon to give the next compound.

Nomenclature - IUPAC

- Prefix tells the number of carbon atoms.
- Suffix tells the name of the functional group.

Prefix	Number of carbons	Prefix	Number of carbons
meth-	1	undec-	11
eth-	2	dodec-	12
prop-	3	tridec-	13
but-	4	tetradec-	14
pent-	5	pentadec-	15
hex-	6	hexadec-	16
hept-	7	heptadec-	17
oct-	8	octadec-	18
non-	9	nonadec-	19
dec-	10	eicos-	20

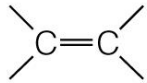
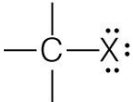
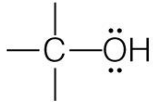
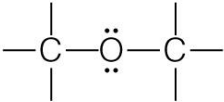

Example:

Methane: meth – 1 carbon; ane – alkane

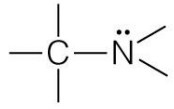
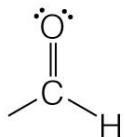
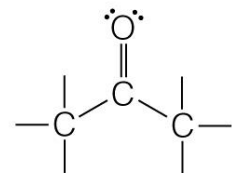
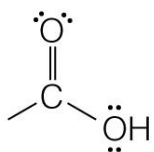
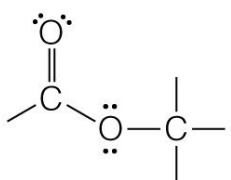
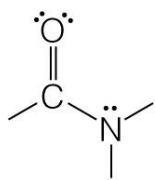
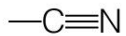
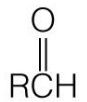

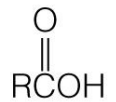

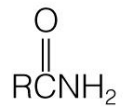
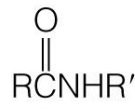
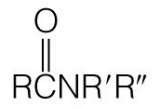

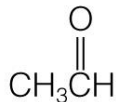
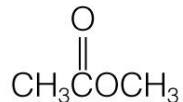
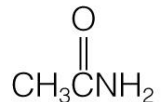
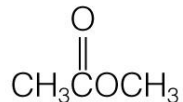
Butanol: but – 4 carbons; ol – alcohol

Ethanal: eth – 2 carbons; al – aldehyde

Propanone: prop – 3 carbons; one - ketone

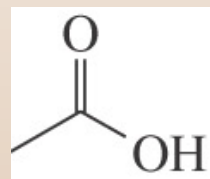
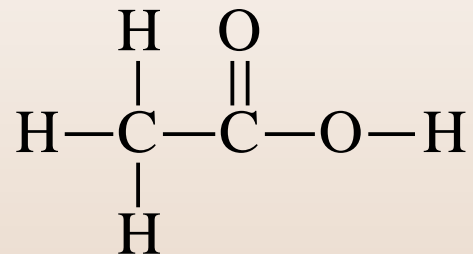
		Family					
	Alkane	Alkene	Alkyne	Aromatic	Haloalkane	Alcohol	Ether
Functional group	C—H and C—C bonds		$\text{—C}\equiv\text{C—}$	Aromatic ring			
General formula	RH	RCH=CH ₂ RCH=CHR R ₂ C=CHR R ₂ C=CR ₂	RC≡CH RC≡CR	ArH	RX	ROH	ROR
Specific example	CH ₃ CH ₃	CH ₂ =CH ₂	HC≡CH		CH ₃ CH ₂ Cl	CH ₃ CH ₂ OH	CH ₃ OCH ₃
IUPAC name	Ethane	Ethene	Ethyne	Benzene	Chloroethane	Ethanol	Methoxymethane
Common name ^a	Ethane	Ethylene	Acetylene	Benzene	Ethyl chloride	Ethyl alcohol	Dimethyl ether

^aThese names are also accepted by the IUPAC.

Family						
Amine	Aldehyde	Ketone	Carboxylic Acid	Ester	Amide	Nitrile
						
RNH ₂ R ₂ NH R ₃ N						
CH ₃ NH ₂						
Methanamine	Ethanal	Propanone	Ethanoic acid	Methyl ethanoate	Ethanamide	Ethanenitrile
Methylamine	Acetaldehyde	Acetone	Acetic acid	Methyl acetate	Acetamide	Acetonitrile

Chemical Formulas

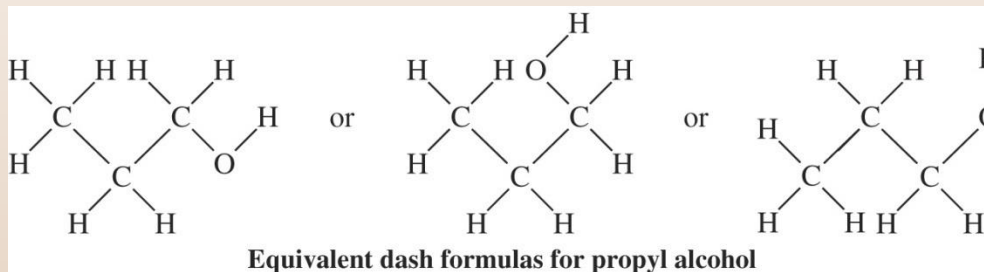
- Full structural formula (no lone pairs shown)
- Line-angle formula
- Condensed structural formula
- Molecular formula
- Empirical formula



- CH_3COOH
- $\text{C}_2\text{H}_4\text{O}_2$
- CH_2O

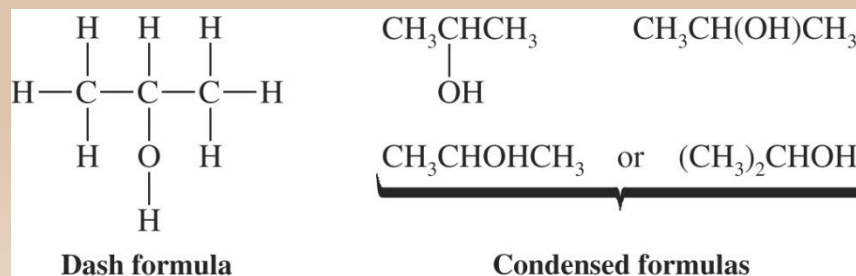
• Expanded (Dash) formulas

- Each line represents a pair of electrons
- This type of representation is meant to emphasize connectivity and does not represent the 3-dimensional nature of the molecule
- There is free rotation around single bonds so the structures below are all equivalent



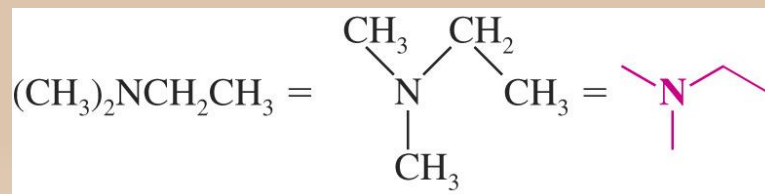
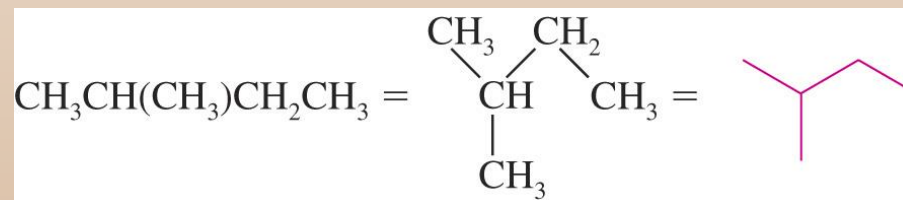
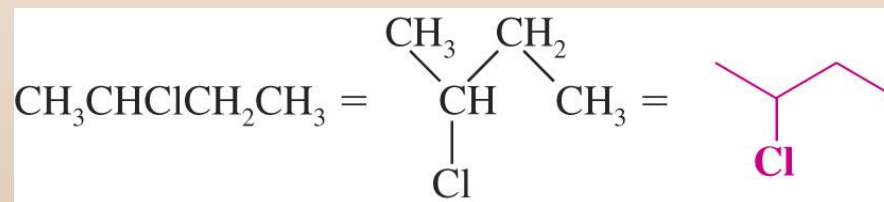
• Condensed Structural Formulas

- In these representations, some or all of the lines are omitted
- In partially condensed structures all hydrogens attached to an atom are simply written after it but some or all of the other bonds are explicitly shown
- In fully condensed structure all bonds are omitted and atoms attached to carbon are written immediately after it

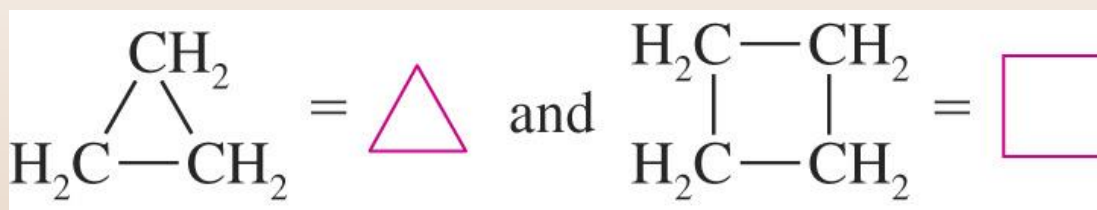


• Line Formulas

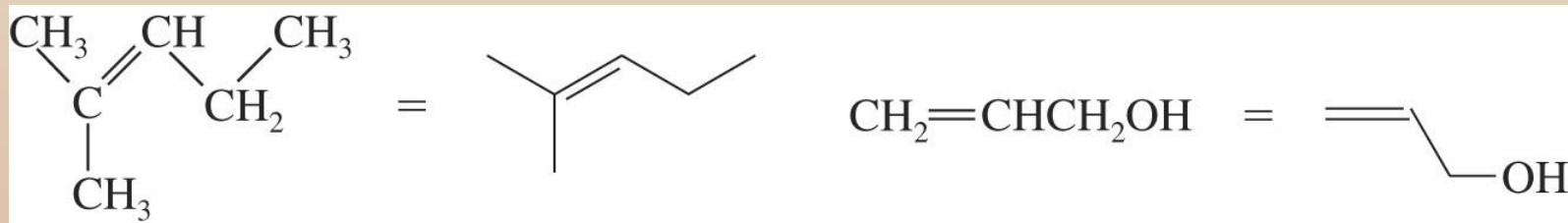
- A further simplification of drawing organic molecules is to completely omit all carbons and hydrogens and only show heteroatoms (*e.g.* O, Cl, N) explicitly
- Each intersection or end of line in a zig-zag represents a carbon with the appropriate amount of hydrogens
 - Heteroatoms with attached hydrogens must be drawn in explicitly



- Cyclic compounds are condensed using a drawing of the corresponding polygon

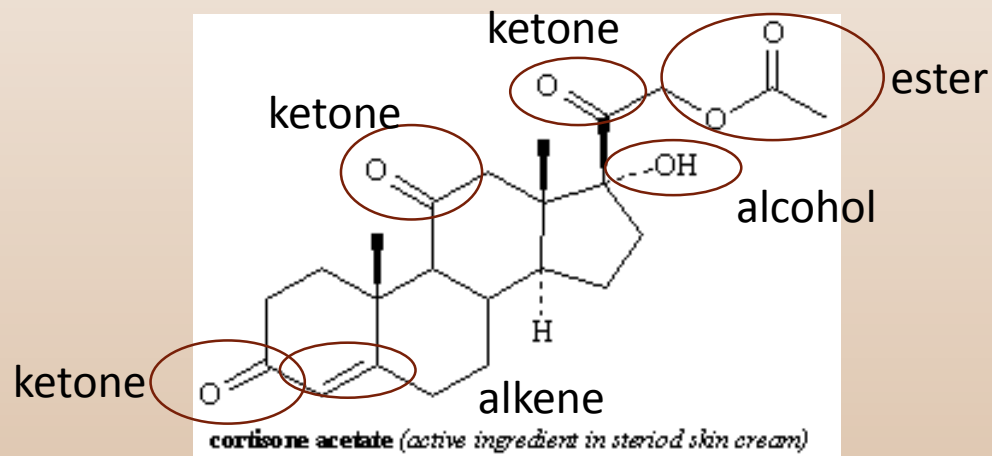


- Multiple bonds are indicated by using the appropriate number of lines connecting the atoms



Solved Example

- Circle and name all the functional groups in the following compound.



Key Words/Concepts

- Fundamentals of naming organic compounds
- Functional Groups
- Writing Organic Compounds
 - Molecular formula
 - Structural formula
 - Line structure
 - Expanded structure