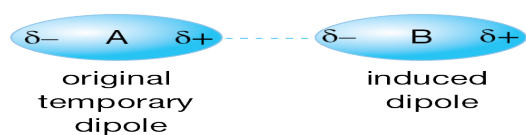


Boiling points and solubility of organic compounds

Physical properties of organic compounds

What type of intermolecular attractions are present in covalent molecular compounds ?

Dispersion forces (van der waals forces)



Dipole –dipole

Hydrogen bonding

Why inter molecular attractions are important for molecular compounds?

Alkanes and alkenes

Name of the alkane	Boiling point $^{\circ}\text{C}$	Name of the alkene	Boiling point $^{\circ}\text{C}$
Ethane	-88.6	Ethene	-103.7
Propane	-42.1	Propene	-47.8
Butane	-0.5	Butene	-6.3
Pentane	36	Pentene	30

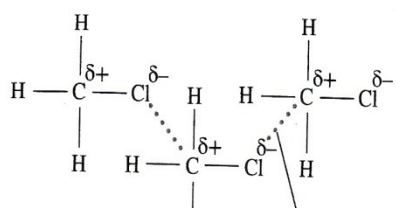
Solubility - Hydrocarbons are more soluble in non-polar solvent (miscible).
 Insoluble in polar solvent

Hydrocarbons are immiscible with water.

Eg Hexane and water -

Haloalkanes

Haloalkanes have higher boiling points and slightly more soluble in water than hydrocarbon. Many haloalkanes are denser than water unlike hydrocarbon, these liquids are settled to form layer at the bottom when added to water.



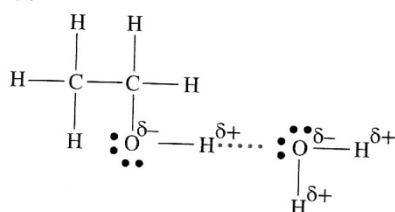
Alcohol

Boiling points

Solubility of carbon compounds

“Like dissolves like.” This means that polar compounds dissolve best in polar solvents (like water and alcohols) and non-polar compounds dissolve best in non-polar solvents (like hexane and benzene).

- Some compounds, like alcohols, have a polar part (the -OH group) and a non-polar part (the hydrocarbon portion).
- Solubility in water depends on which part dominates. Alcohols with a large “organic” (hydrocarbons) portion are not very soluble in water.



Carbonyl compounds will be soluble in water if their hydrocarbon portion is not too large. The water can form hydrogen bonds to the electron lone pairs on the oxygen. But if the organic portion is too large, solubility is decreased.

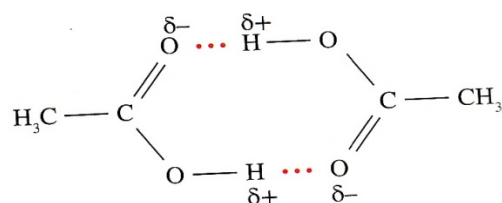
Ketone

Aldehyde

Boiling point of amines and amides

Solubility of amines and amides

Boiling point of carboxylic acid



Solubility of carboxylic acid.

Solubility of alkane

1. in benzene

ii in water

**Compare the boiling points of following compounds;
explain your answer by using intermolecular attraction.**

i.

- **methyl propane and butane pentane**

- **Butane But -1-ene and but -1-yne**

- **Ethane and chloro ethane**

- **Ethanol and pentanol**

The **flash point** of a volatile material is the lowest temperature at which vapours of the material will ignite, when given an **ignition** source. The flash point increases when number of carbon atoms in the chain increases.

Fuel	Flash point °C
Butane	-76
Methyl propane	-83
Hexane	-7
Heptane	25
Octane	56

The autoignition point, which is the temperature at which the vapour ignites spontaneously with absence of external ignition source.

Fuel	Flash point	Autoignition point
Ethanol	16	363
Petrol	-43	280
Jet fuel	>38	210
Diesel	>52	256

Test

1. What is the key type of intermolecular bonding that operates in hydrocarbons?

- A Covalent bonding
- B Hydrogen bonding
- C Dipole-dipole attraction
- D Dispersion forces

2. What is the systematic name of the compound $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$?

- A 1-methylpropan-1-ol
- B Butan-2-ol
- C Butan-3-ol
- D Butanoic acid

The molecular formulas of ethane and butene are, respectively:

3.
 - A C_2H_6 ; C_4H_{10}
 - B C_2H_4 ; C_4H_{10}
 - C C_2H_6 ; C_4H_8
 - D C_2H_4 ; C_4H_8

4. Which one of the following substances is called propanoic acid?

- A $\text{C}_3\text{H}_7\text{COOH}$
- B $\text{C}_3\text{H}_7\text{OH}$
- C $\text{C}_2\text{H}_5\text{COOH}$
- D $\text{C}_4\text{H}_9\text{COOH}$

5. A structural isomer of an organic compound is another organic compound that has the same:

- A molecular formula but different structures.
- B molar mass but different functional groups.
- C general formula but differs in its molecular formula by CH_2 .
- D structure but contains ^{13}C atoms instead of ^{12}C atoms

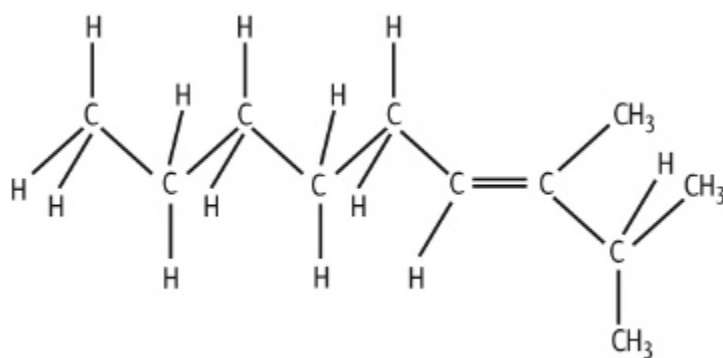
6. What is the name and molecular formula of the compound that is in the same homologous series as ethanamine but contains nine carbon atoms?

- A Nonamine, $\text{C}_9\text{H}_{19}\text{NH}_2$
- B Nonamine, $\text{C}_9\text{H}_{19}\text{NH}_3$
- C Nonanamine, $\text{C}_9\text{H}_{19}\text{NH}_2$
- D Nonanamine, $\text{C}_9\text{H}_{18}\text{NH}_3$

7. Which one of the following is the correct semi-structural formula for 5-ethyl-2,2-dimethyl decane?

- A $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_3$
 B $\text{CH}_3\text{CH}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
 C $\text{CH}_3\text{CH}_3\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
 D $\text{CH}_3\text{C}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

8. The diagram below shows a certain organic molecule.



What is its systematic name?

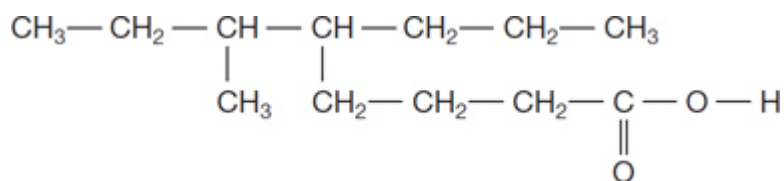
- A 2-propyloct-2-ene
 B 6,7-dimethylnon-6-ene
 C 2,3-dimethylnon-3-ene
 D 2,3-dimethylnon-4-ene

9. How many structural isomers of $\text{C}_4\text{H}_8\text{Cl}_2$ are possible?

- A 6
 B 7
 C 8
 D 9

10. Which statement about organic compounds is INCORRECT?

- A Many are highly toxic and many are flammable.
 B Their properties are mainly determined by the functional groups present.
 C Many can be synthesised from crude oil and natural gas.
 D They all contain C atoms and H atoms.



11. An organic compound has the formula:

The name of this compound is:

- A. 3-methyl-4-butyloctanoic acid
- B. 4-propyl-5-methyloctanoic acid
- C. 5-propyl-6-methyloctanoic acid
- D. 3-methyl-4-propyloctanoic acid.

12. Which of the following compounds is likely to have the lowest flashpoint?

- A. cooking oil
- B. pentane
- C. ethanol
- D. carbon dioxide

13. Which of the following is the most soluble in water?

- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- B. $\text{CH}_3\text{CH}_2\text{OH}$
- C. $\text{CH}_3\text{CH}_2\text{CH}_3$
- D. $\text{CH}_3\text{CH}_2\text{Cl}$

14. When comparing the boiling points of aldehydes and ketones with compounds of similar molecular mass, it can be observed that their boiling points are:

- A. higher than those of alcohols and alkanes
- B. lower than those of alcohols and alkanes
- C. higher than those of alcohols but lower than those of alkanes
- D. higher than those of alkanes but lower than those of alcohol.

15. Which of the following is an *incorrect* statement about the properties of carboxylic acids?

- A. The boiling points of carboxylic acids are higher than alcohols of similar size.
- B. The smaller carboxylic acids are liquids at room temperature.
- C. Carboxylic acids cannot form hydrogen bonds with water.
- D. Carboxylic acids ionise only partially in water.

1. Comparison of boiling points of following compounds, with an explanation.

- **methyl propane and butane pentane**

- **Butane But -1-ene and but -1-yne**

- **ethane and chloroethane**

- **Ethanol and pentanol**

2. Identify each of the following pair is miscible or immiscible and explain with inter molecular attraction.

a. Water and hexane

b. Chloro ethane and water

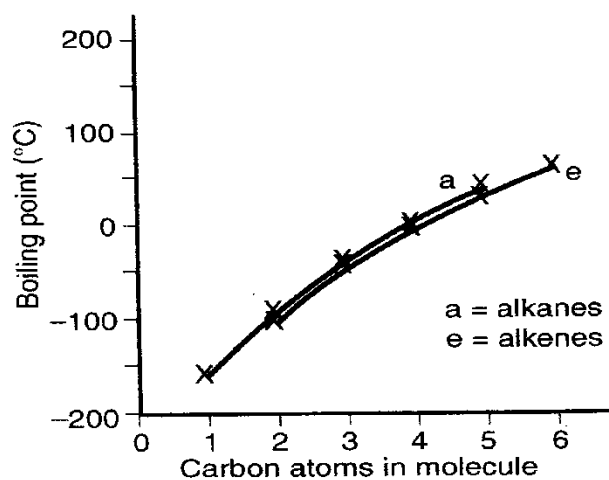
c.. Pent 1-1yne and benzene .

d. 3-Bromo butane and 3-chloro

e.. Ethanol and Water

f. Ethanol and hexane

g. Butanoic acid and water .



- Explain the trends in these graphs
- Explain the change in shape for the curves of alkane and alkyne.

Boiling points of chloro alkane

Solubility of chloroalkane in water and hexane .

Reaction of alkanes

1. Combustion reaction

- **Complete**

- **Incomplete**

2 Substitution reactions

Alkenes

Preparation of alkenes

Cracking

Dehydration of alkanols

Reactions of alkenes

1. Combustion

2 . Addition reactions

1. Bromination or halogenation

2. Hydrogenation

3. Hydration

4. Hydrohalogenation

Addition polymerisation