Determination of boiling point

The boiling point of an organic liquid is the temperature at which the vapor & liquid phases are in equilibrium at a given pressure

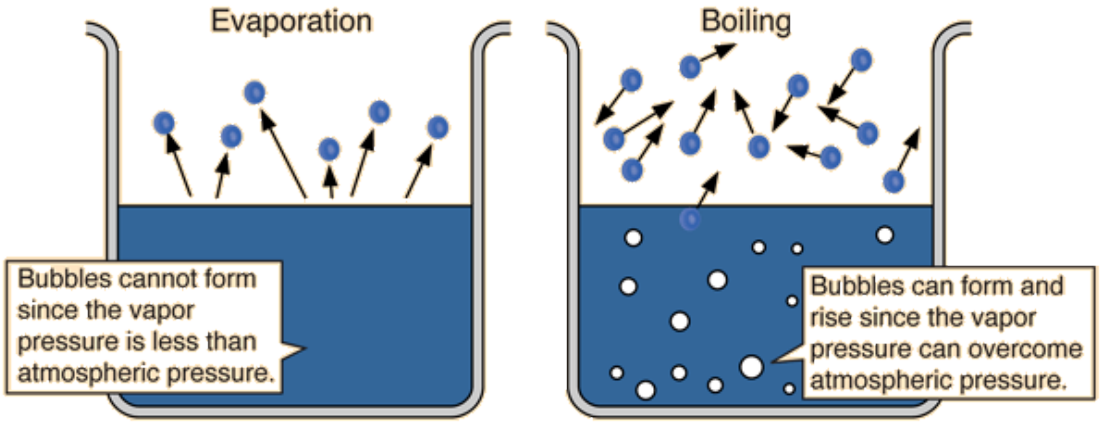
It's the temperature at which the liquid's vapor. Pressure equals the atmospheric pressure over the liquid.

The vapor pressure of a compound is the pressure exerted by the vapor above the compound's surface.

Factors affecting the boiling point of a liquid:

1- Atmospheric pressure

The atmospheric pressure plays an important role in the determination of b.p correctly



Reduction of the pressure leads to a decrease or depression in the b.p and versa

2- Molecular weight

When considering the b.p., for a homologous series of molecules, m.wt is an important factor. As m.wt increase the b.p increase & vice versa

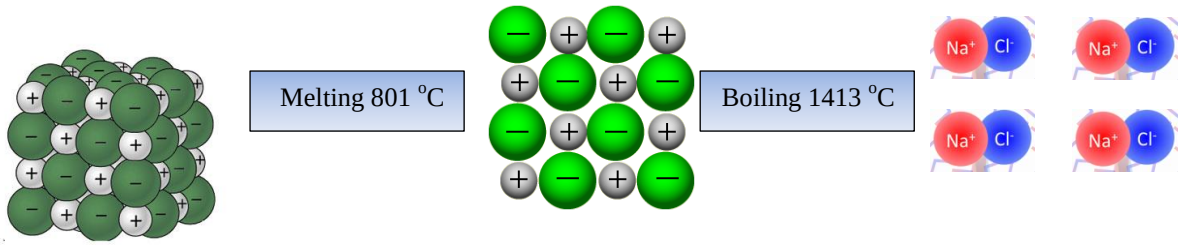
3- Intermolecular forces :

A- Ionic compound :

In the liquid state the unit of ionic compound is ions.

Interionic forces

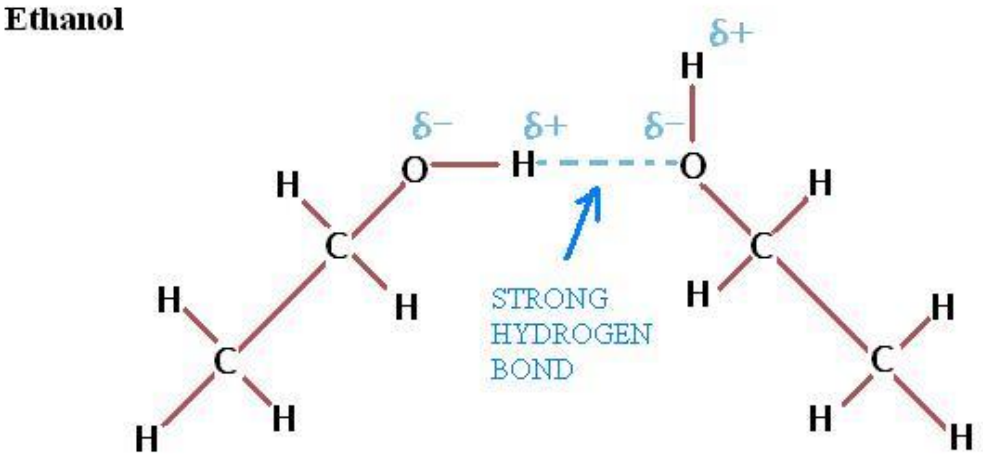
Each ions is still held strongly by a number of oppositely charged ions. A great deal of energy is required for a pair of oppositely charged ions to break away from the liquid ; so, boiling occurs only at a very high temperature. As an example is the b.p. of NaOH which is 1413 ^{o}C.



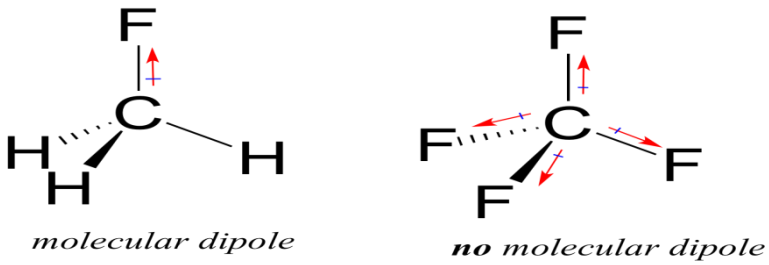
B- Non ionic compound:

in the liquid state the unit of a non- ionic compound is molecules, the weak intermolecular force here :

a- Intermolecular hydrogen bond :
Liquid whose molecules are held together by hydrogen bond are called associated liquids. Breaking these hydrogen bonds takes a considerable energy.



b- Dipole –dipole interaction force :
It takes place in polar molecules ; it's the attraction of the positive end of one polar molecules for the negative end of another polar molecule. Methyl fluoride has very polar C-F bond with a partial positive charge on the carbon and a partial negative charge on the fluorine atom :



molecular dipole ***no*** *molecular dipole*

C- Vander Waals forces :

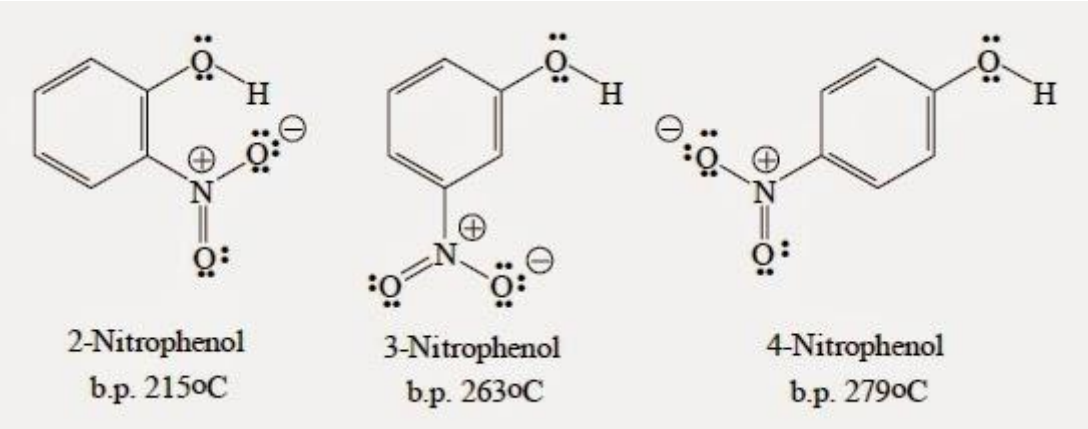
Van der waals forces , which are sometimes called induced polarizations or induced dipoles have a very short range act between portions of different non polar molecules that are in close contact , i.e, between the surface of molecules.

The major factor in the magnitude of these force is the shape of the molecules. Highly branched molecules have a more spherical shape smaller van der waals attractions. Unbranched molecules have more surface area that can be involved in intermolecular interactions and higher van der waals attractions because they can pack closer.

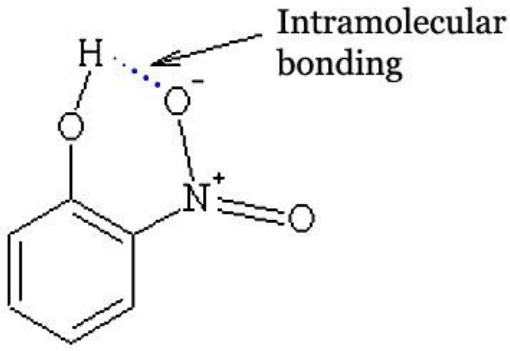
$CH_3CH_2CH_2CH_2CH_3$	$CH_3CH_2CHCH_3$	CH_3CCH_3
Pantane	2-Methylbutane	2,2-Dimethylpropane
b.p. 36 ^oC	b.p. 28 ^oC	b.p 9 ^oC

4- Intramolecular hydrogen bond :

It's much more important than an intermolecular hydrogen bond in determining the properties of the molecule.



2- Nitrophenol forms an intramolecular hydrogen bond between the hydrogen of the O-H bond and one of the oxygens in the NO_2 group. This intramolecular hydrogen bond prevents an intermolecular hydrogen bond from forming thus, boiling requires much less energy for the 2-nitrophenol isomer than for the 4-nitrophenol isomer



Because there are no strong intermolecular forces to be overcome in going from the liquid phase to the gas phase.

5- Branching :

In homologous series, with in the same m.wt, boiling point decrease as branching of the molecules increase & vice versa.

6- Presence of impurity :

pure liquid have sharp boiling points. While mixtures show a boiling point range. Presence of impurity raises the boiling point of particular liquid

determination of the boiling point of an unknown sample.

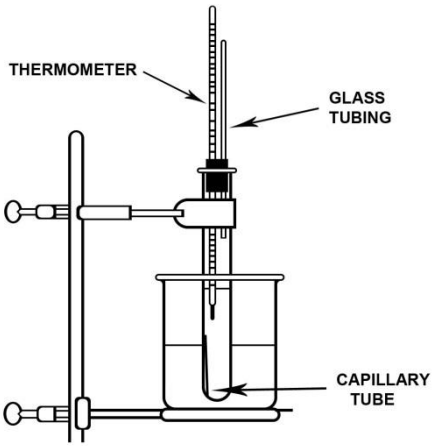
Aim of experiment

1- Identification of an unknown compound using it's boiling point.
2- Determination of purity of a Cpd. Using as physical property.

Procedure:

1- A 5 cm capillary tube closed from one end is inverted upside down &^ is attached to a thermometer by a rubber ring.

2- Place them in a clean & dry test tube containing a small quantity of a liquid whose boiling point is to be measured, the rubber ring should be above the surface of the liquid.
3- The whole assembly is to be placed in an oil bath.



Boiling point apparatus

4- Start heating with continuous stirring until a rapid stream of bubbles comes out of the capillary tube, inside the liquid.
5- Remove the flame & allow the oil bath to cool so that the bubble stream will become slower and slower as the temperature drops until a point is reached at which bubbling ceases & the liquid starts to raise inside the capillary tube.
6- Record this temperature as the boiling point of the liquid.