# Title: Critical phenomena & Andrew's experiment

Course:B.Sc part 2 chemistry (Hons.)

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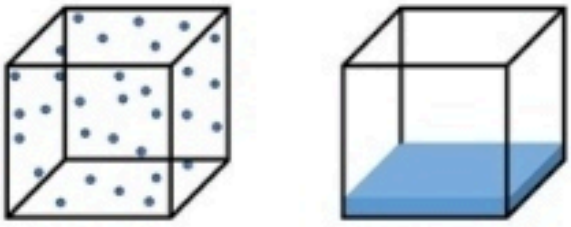
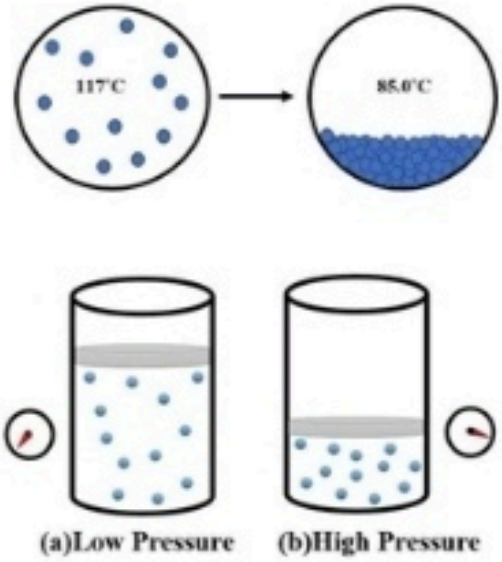
## CRITICAL PHENOMENA

- The essential condition for the liquefaction of the gas is described by the study of critical temperature, critical pressure and critical volume and their inter relationships.
- The decrease in volume can be effectively brought about by **lowering of temperature**, or by **increasing pressure** (or) by both.




**Critical temperature (Tc)**

It is defined as the characteristic temperature of a gas above which no liquefaction occurs although the pressure may be increased many fold. For instance $T_c$ of $CO_2$ is 31.1 °C.

**Critical pressure (Pc)**

It is defined as the minimum pressure required to liquefy 1 mole of a gas present at its critical temperature. For instance $P_c$ of $CO_2$ is 73 atm.

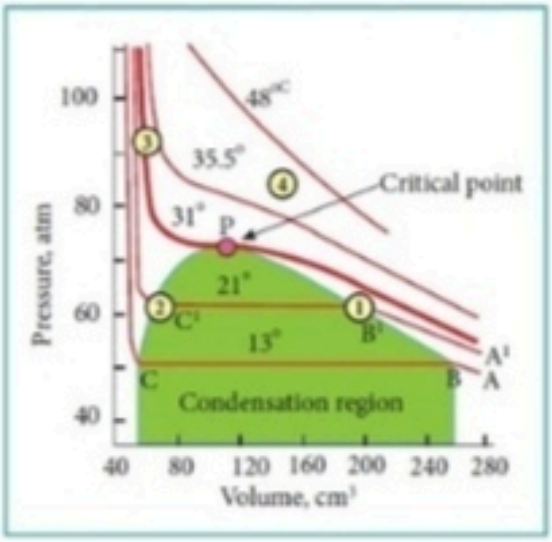
**Critical volume ($V_c$)**

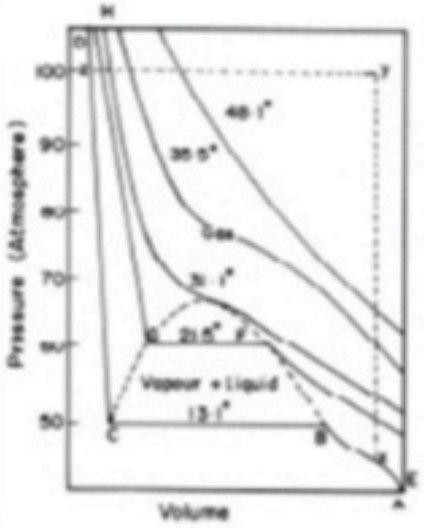
The volume occupied by 1 mole of a gas at its critical pressure and at critical temperature is the critical volume (Vc) of the gas. For instance $V_c$ of $CO_2$ is 95 $cm^3$.

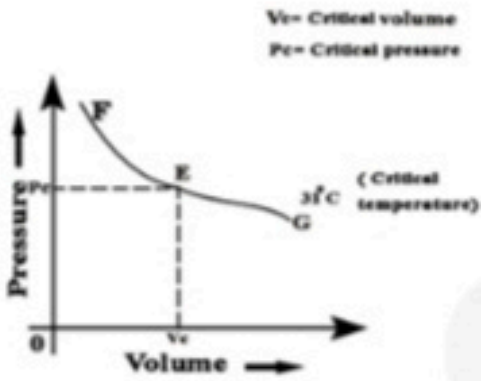
- A gas is said to be at its **critical state** when its pressure, volume and temperature are Pc, Vc and Tc.
- At the critical state, *the physical properties of the liquid and gaseous forms of the substance become identical and no distinction can be observed between the two.*
- The smooth merging between a gas and its liquid state at the critical state and the related phenomena are called **critical phenomenon**.

## Andrews' Experiments : The Isotherms of a Real Gas

- The importance of critical temperature of a gas was first discovered by Thomas Andrews in his experiments on pressure - volume isotherms of carbon dioxide gas at a series of temperature.
- The isotherm of carbon dioxide determined by him at different temperatures are shown below.




### CONTINUITY OF STATES:

A gas can be liquefied by sufficient compression at or below its critical temperature. *According to the principle of continuity of state, the liquid state does not represent a sharp and discontinuous transition from gaseous state, but is rather a continuation of the gaseous phase into the region of very strong intermolecular attractions and small volumes.*

- ***During this transition from gas to liquid, there has been never been more than one phase present at any time.***
- ***The change from gas to liquid must have occurred at P on the critical isotherm because the transition between the phases occurs continuously at the critical temperature.***
- ***This signifies the continuity between gaseous and liquid states.***