Phase Rule for one Component System

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The least number of phases possible in any system is one. So according to the phase rule equation a one component system should have a maximum of two degree of freedom.

When $C = 1$, $P = 1$

Then $F = C - P + 2 = 1 - 1 + 2 = 2$

Hence a one component system requires a maximum of two variables to be fixed in order to define the system. The two variables are temperature and pressure.

In case of one component system phase diagram consists of area, curves or lines and points which provide the following information regarding the system

a) Point on a phase diagram represents a non-variant system.

b) Area represents the a bivarent system.

c) Curve or a line represents a univarant system.

Water and sulphur system are the example of one component system.

Hence the curve represents a univariant system. This explains that only one factor either temp. or pressure is sufficient to be fixed in order to define the system.

(ii) Curve OA :- It is known as sublimation curve of ice and gives the vapour pressure of solid ice at different temp. Along sublimation curve, the two phases ice and vapour exist together in equilibrium. The lower end of the curve OA extends to absolute zero (-273°C) where no vapour exists.

Area	Phase	Component
i) Area AOC	ice	H_2O
ii) Area COB	water	H_2O
iii) Area below BOA	vapour	H_2O

Thus for every area contains

$C = 1$ and $P = 1$

Therefore applying Phase rule

$$F = C - P + 2 = 1 - 1 + 2 = 2$$

Hence each area is a bivariant system. So it becomes necessary to specify both the temp. and pressure to define a one phase system.

The Phase diagram of the water system is shown above. The explanation of the Phase diagram of water system is as follows:-

① Curves:-

The Phase diagram of the water system consists of three stable curves and one metastable curve, which can be explained:-

V Curve OB :- The curve OB is known as Vapour Pressure curve of water system and tells about the vapour pressure of water at different temp. Along this curve, the two phases water and vapour exist together in equilibrium

At point D, the vapour pressure of water become equal to the atmospheric pressure (102°C) which represent the boiling point of water. The curve OB finishes at point B (temp. 374°C and pressure 218 atm) where the liquid water and vapour are indistinguishable and the system has only one phase. This point is called the critical point.

Applying the Phase rule on this curve,

$C = 1$ and $P = 2$

$F = C - P + 2 = 1 - 2 + 2 = 1$

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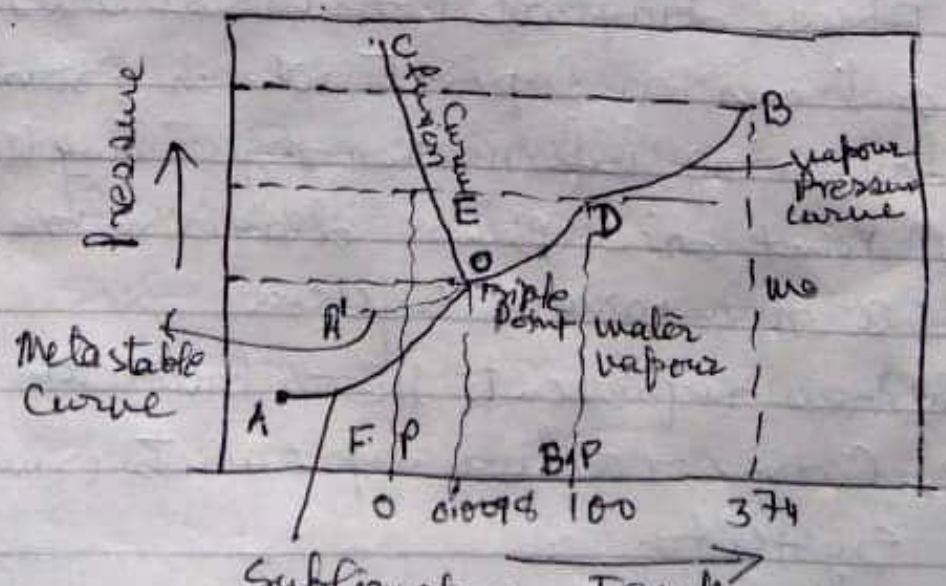
Water System

Water is a one component system which is chemically a single compound involved in the system. The three possible phases in this system are ice (solid), water (liquid) and vapour (gaseous Phases.

$$\text{ice} \rightleftharpoons \text{vapour}$$
$$\text{ice} \rightleftharpoons \text{water}$$
$$\text{water} \rightleftharpoons \text{vapour}$$

The existance of these equilibria at a particular stage depends upon the conditions of temp. and pressure which are the variables of the system. If the values of vapour pressures at ~~different~~ different temp. are plotted against the corresponding temp. the Phase diagram of the system is obtained.



Phase diagram of water system