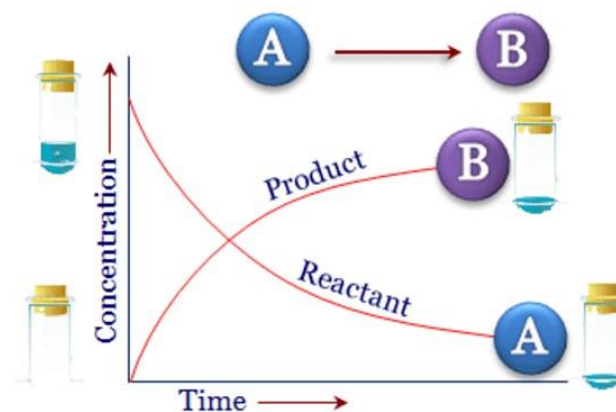


Phase Diagram

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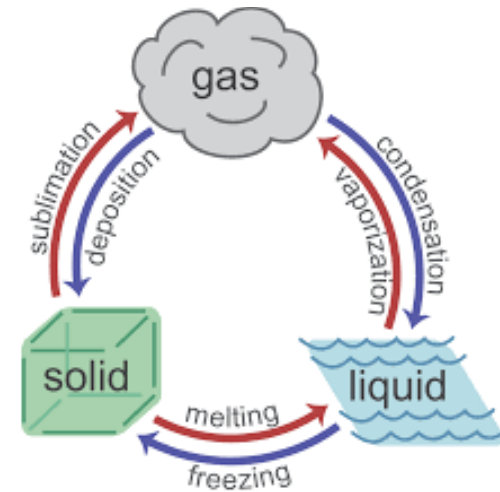


The contents of this presentation is prepared to provide a brief idea about the topics, details will be discussed in the classes.
Contents have been collected from multiple textbooks and internet.



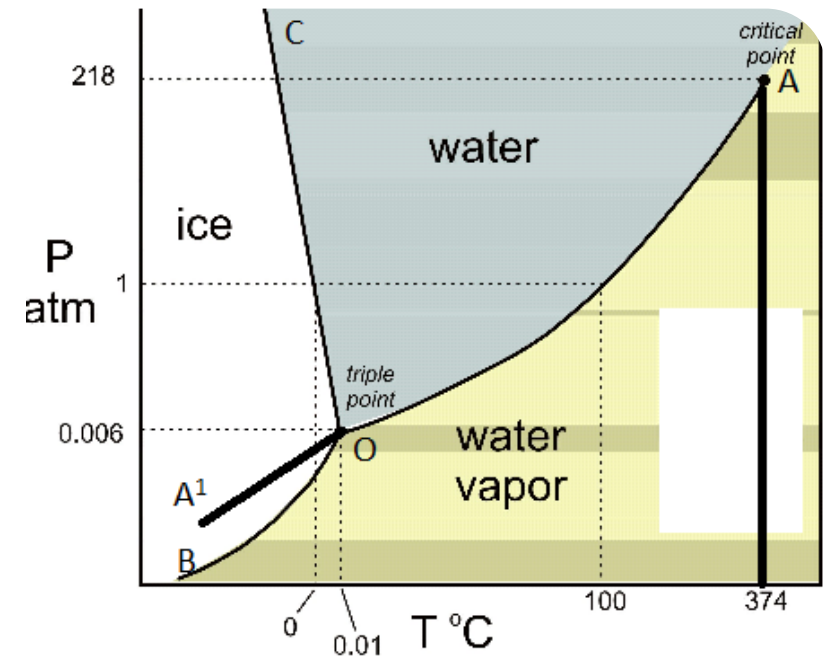
What is 'Phase (P)'?

- Phase is defined as the homogeneous, physically distinct and mechanically separable portion of a system, which is separated from other such parts of the system by definite boundary.
- Examples -
 - A system containing only liquid water is 1-phase system ($P = 1$)
 - A system containing liquid water and water vapour (a gas) is a 2-phase system ($P = 2$).
 - A system containing liquid water, water vapour and solid ice is a 3-phase system ($P = 3$).
- A system consisting of one phase only is called a homogeneous system.
- A system consisting of two or more phases is called a heterogeneous system.



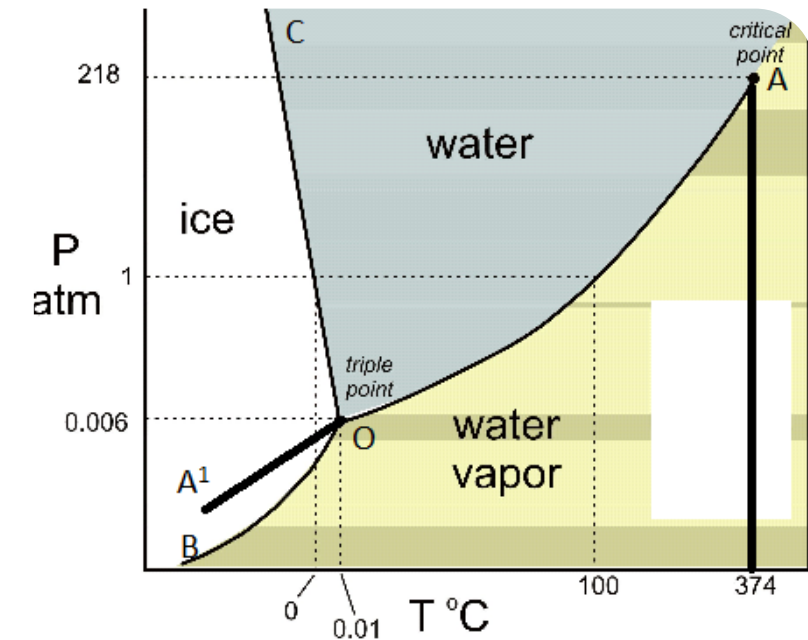
What is meant by 'Component (C)'?

- A component is a chemically independent constituent of a system. The number of components represents the minimum number of independent species required to define the composition of all phases of the system.
- Examples -
 - Water system has three phases - ice, water and water vapour. The composition of all the three phases can be expressed by one chemical individual H_2O . Thus water system has one component only.



What is meant by 'Degree of Freedom (F)'?

- Degree of Freedom is the least number of independent variables (temperature, pressure and composition) which must be specified so that the remaining variables are fixed automatically and the system is completely defined.
- A system with $F = 0$ is known as non-variant or have no degree of freedom
- A system with $F = 1$ is known as univariant or having one degree of freedom
- A system with $F = 2$ is known as bivariant or having two degree of freedom



Phase Rule & Phase Diagram

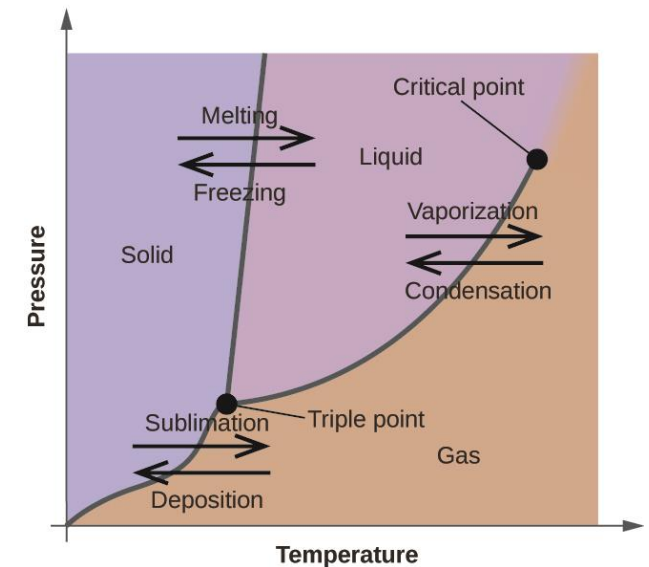
■ Phase Rule

$$F = C - P + 2$$

F = Degree of freedom; C = Number of Components; P = Number of Phases

■ Phase Diagram

- ✓ Phase diagram is a graphical representation of the physical states of a substance under different conditions of temperature and pressure.
- ✓ A typical phase diagram has **pressure on the y-axis** and **temperature on the x-axis**.



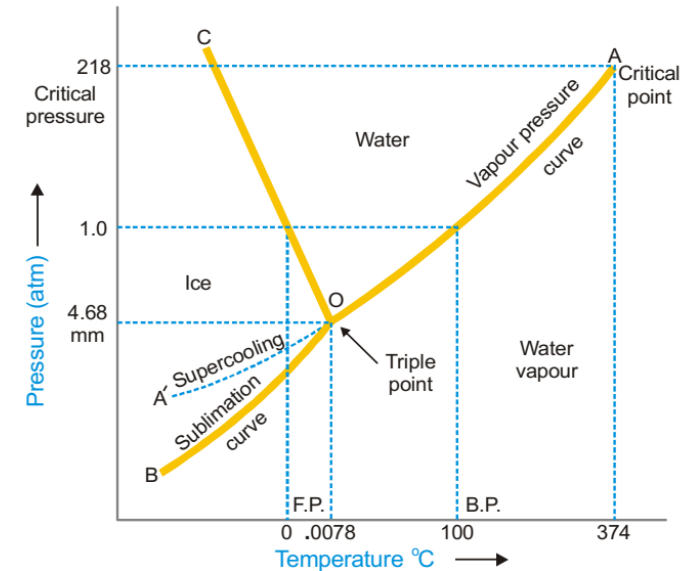
Phase Diagram for Water System

■ Regions or Areas

- ✓ The diagram is divided into three regions or areas labelled as solid, liquid and vapour/gas represented by BOC, COA and AOB, respectively.
- ✓ Each area shows the conditions of temperature and pressure under which the respective phase can exist.
- ✓ For each regions/areas, component = 1; phase = 1

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

- ✓ Thus, each area of the phase diagram represents a **bivariant** system.



Phase Diagram for Water System

■ Lines or Curves

✓ The lines or curves shows the conditions of equilibrium between **any two of the three phases**.

✓ OC is solid/liquid curve; Solid \rightleftharpoons Liquid

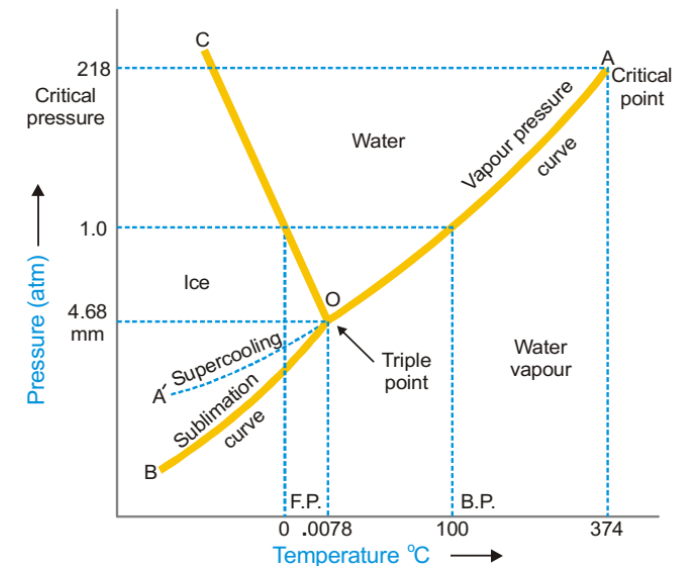
✓ OA is liquid/vapour curve; Liquid \rightleftharpoons Vapour

✓ OB is solid/vapour curve; Solid \rightleftharpoons Vapour

✓ For each regions/areas, component = 1; phase = 2

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

✓ Thus, each curve of the phase diagram represents a **univariant** system.



Phase Diagram for Water System

■ Triple Point

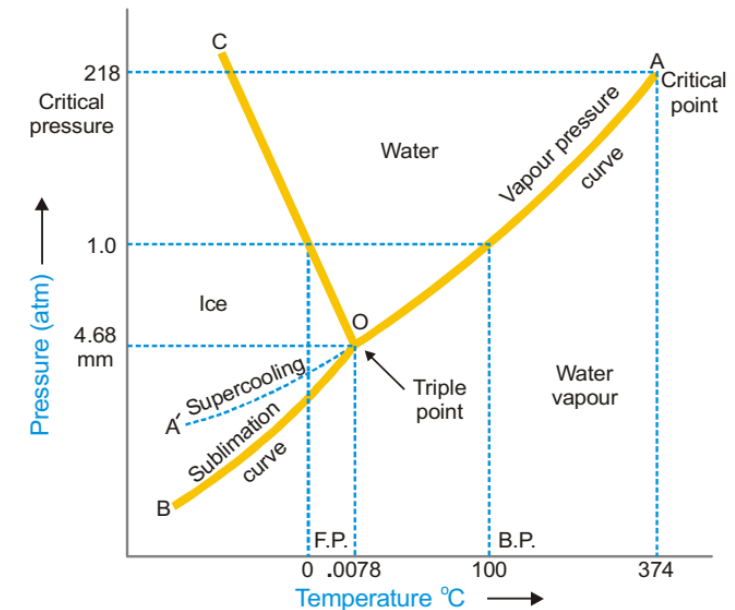
- ✓ A **triple point** shows the conditions under which **all the three phases** (solid, liquid, vapour) can coexist in equilibrium.



- ✓ For each regions/areas, component = 1; phase = 3

$$F = C - P + 2 = 1 - 3 + 2 = 0$$

- ✓ Thus, triple point of the phase diagram represents a **non-variant** system.



Thank You