VIVEKANANDA COLLEGE
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NAAC ACCREDITED 'A' GRADE

Topic: Phase Equilibrium

Course Title: CC-4/GE-4

Paper: 4

Unit: L-1

Semester: 4 (Gen)

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Name of the Department: Chemistry

Phase diagram and its different regions

Curve OA. It represents the equilibrium between liquid water and vapour at different temperatures. It is called the vapour pressure curve of water as it gives vapour pressure of water at different temperatures. At any given temperature, there is one and only one pressure at which water vapour is in equilibrium with liquid water. Similarly, for each vapour pressure, only one temperature can be maintained, thus, the degree of freedom is one or the system is univariant. This is also predicted by the phase rule : $F = C - P + 2 = 1 - 2 + 2 = 1$

At 373.16 K (100°C), the vapour pressure equals 101.3 k Pa (1 atm). Thus, 373.16 K is the boiling point of water. The curve OA has a natural upper limit at A, which is the critical temperature (647.16 K or 374°C), beyond which the liquid water is no longer distinguishable from the vapour phase.

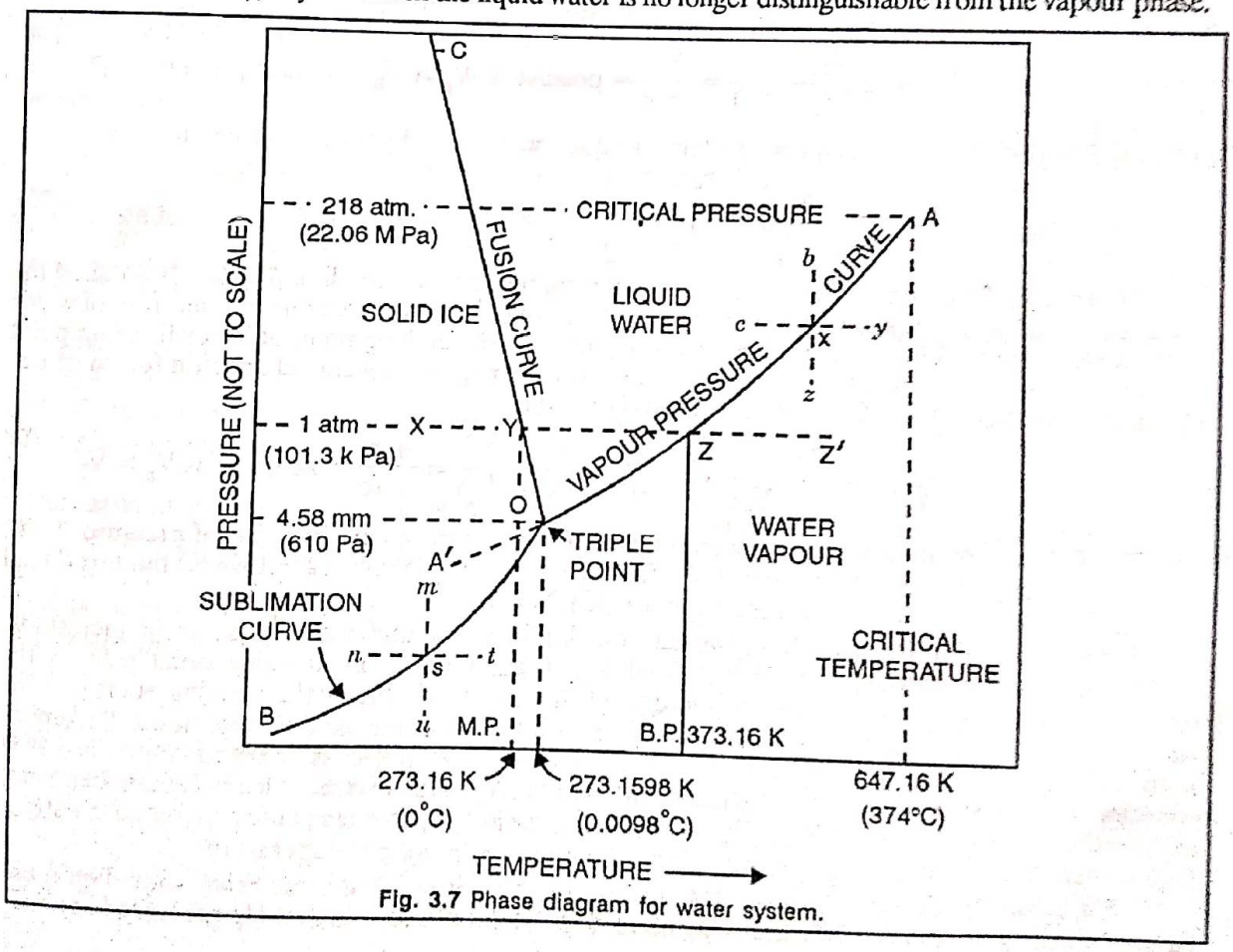

Fig. 3.7 Phase diagram for water system.

Triple Point. The point 'O' represents the co-existence of three phases–solid CO_2, liquid CO_2 and CO_2 gas in equilibrium. This is called triple point and is non-variant, *i.e.* $F = C-P+2 = 1-3+2 = 0$. The triple- point pressure and temperature of CO_2 are 5.11 atm and $-56.6°C$. It should be noted that liquid CO_2 is not stable at pressures below 5 atm. Therefore at constant 1 atmospheric pressure and at very low temperature as at '*x*', solid CO_2 when warmed will change to '*y*' where it would be gas, without melting to liquid state, *i.e.* sublimation to vapour would occur. In other words, solid CO_2 is dry under ordinary atmospheric pressure and, hence, given the name **"dry ice"**.

The phase diagram of CO_2 also reveals that at 25°C, if the pressure of CO_2 confined to a cylinder reaches 67 atm, liquid CO_2 will be formed. Hence, commercial cylinder of CO_2 contains liquid CO_2 and gas CO_2 in equilibrium at 25°C and about 67 atm.

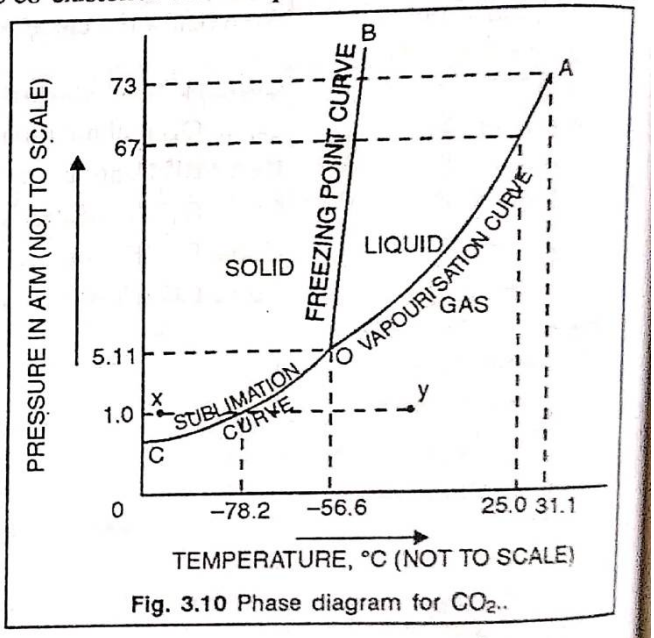

Fig. 3.10 Phase diagram for CO_2..