condition for liquefaction :→

Look at the vanderwaal's equation of state :→

$$\left(P + \frac{a}{V_m^2}\right)(V_m - b) = RT$$

[It is written for $n = 1$ mole. so $V = V_m$ also, V_m = molar volume]

In this equation,

'a' stands for intermolecular attraction and

'b' stands for volume occupied by the molecules.

→ Liquefaction occurs when attractive forces dominate i.e. at high pressure and low temperature

→ condition for critical point :→

Ahead in [redacted] P-V graphs we will see isotherms. (constant temperature [redacted] P-V curves.)

At the critical point the isotherm has a point of inflection

$$\left(\frac{\partial P}{\partial V}\right)_T = 0, \text{ also, } \left(\frac{\partial^2 P}{\partial V^2}\right)_T = 0$$

Using vanderwaal's equation, we get

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$T_c = \frac{8a}{27Rb}$

$P_c = \frac{a}{27b^2}$

$V_c = 3b.$

Write vanderwaal's equation of state for 1 mole as is written above, in that use $\left(\frac{\partial P}{\partial V}\right)_T = 0$ and $\left(\frac{\partial^2 P}{\partial V^2}\right)_T = 0$ to get these values of tempera-ture, pressure and volume

Note:→

Critical Temperature:→ The highest temperature at which a gas can be liquefied, after that whatever pressure we apply, the gas can't be liquefied.

Critical Pressure:→ The minimum Pressure at critical ~~temperature~~ temperature at which a gas can be liquefied.

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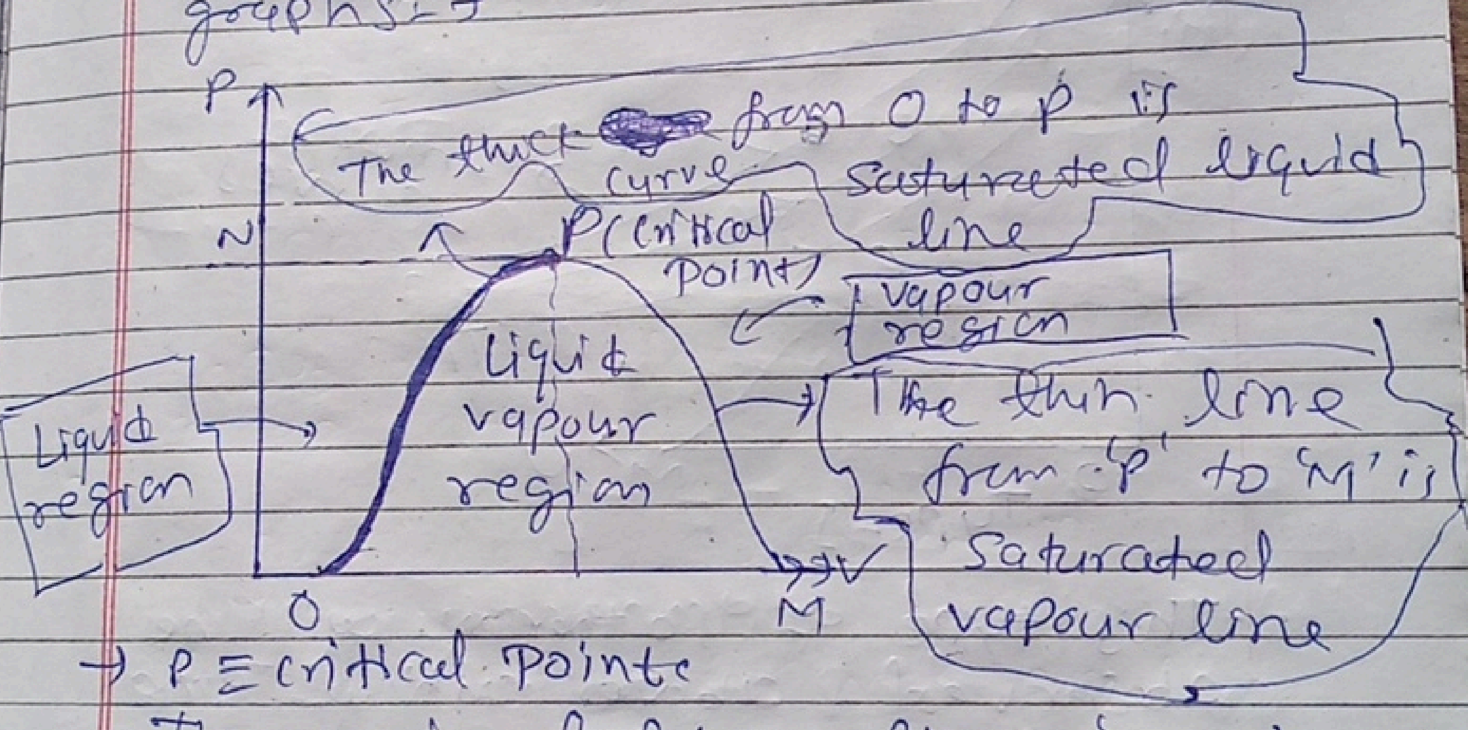
Critical volume :→ The volume occupied by 1 mole of a gas at critical temperature and critical pressure is called critical volume.

Before understanding graphs learn basics of the concerned graphs :→



→ P ≡ critical point

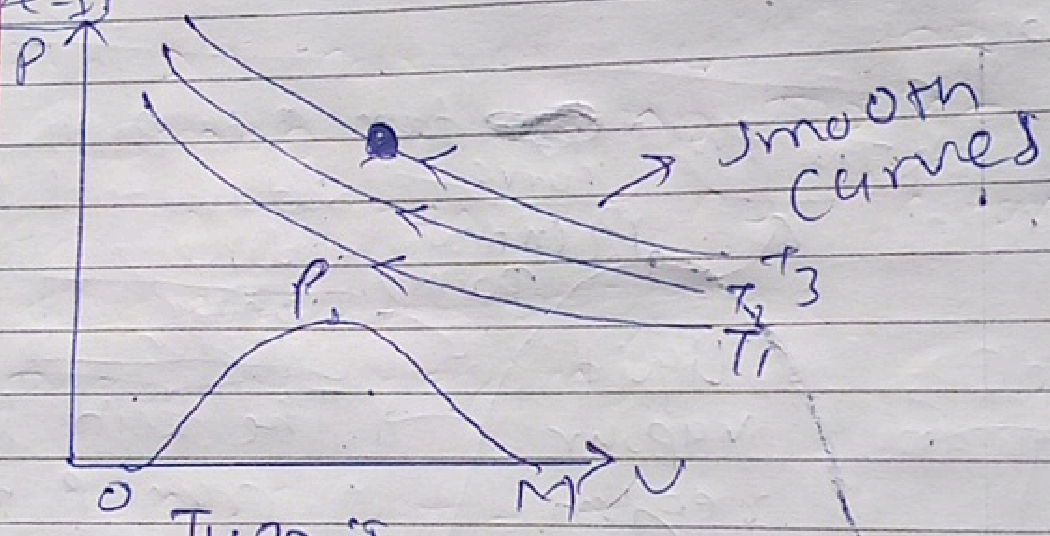
→ The region left to thick 'O-P' curve and below point 'P' is liquid region. (Do not count region OPM in it that is liquid vapour region)

→ The region right to thin PM curve and ~~and~~ above 'P' are vapour region.

→ The region between OPM curve and V-axis is liquid vapour region.

Isotherms:→ There will be three types of isotherms:→

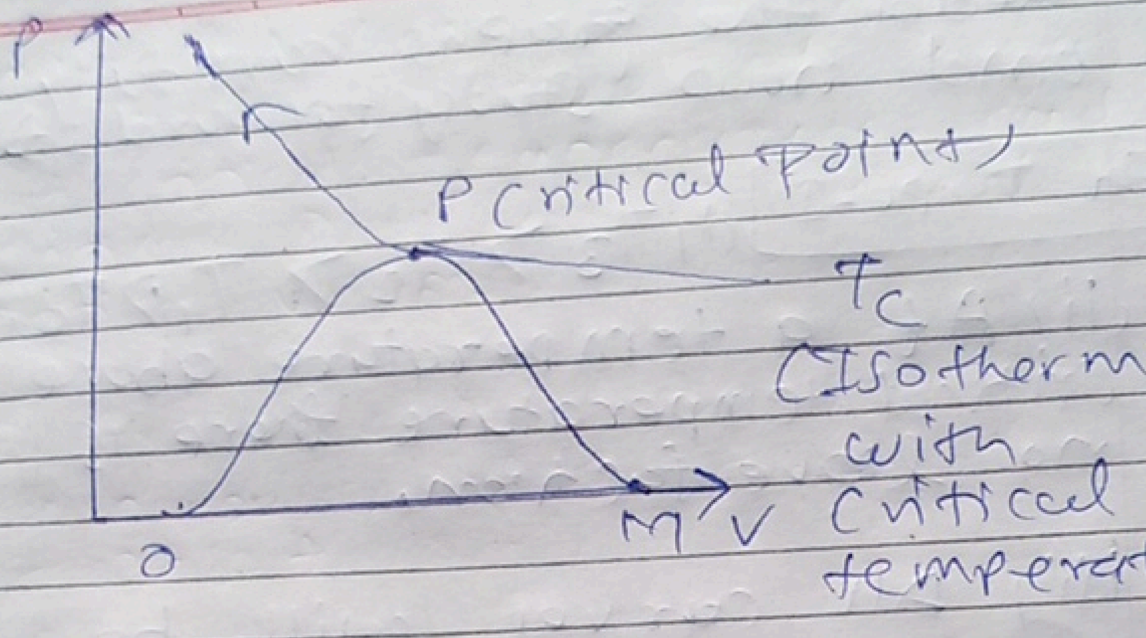
Type-I



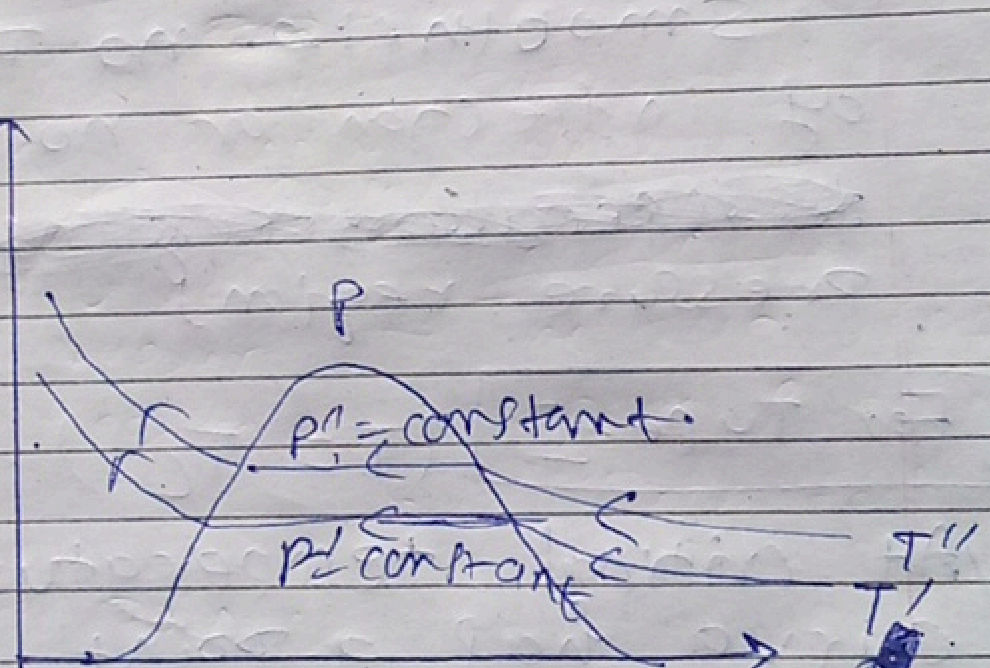
Type-I

This type of isotherms will be observed above critical temperature.

Type-II This type of isotherm is only one and it is observed only at critical temperature. It has a point of inflection at critical temperature



Type-III



This types of isotherms are observed below critical temperature. In OPM region the curves have constant pressure.

Read the graphs carefully and now study forward :→

[For Type-I] (i) $T_3 > T_2 > T_1 > T_c$.

(ii) At a temperature above critical temperature there is no liquefaction.

(iii) All curves will be smooth (i.e. no point of inflection or no constant [redacted] pressure region)

[For Type-II] ($T = T_c$)

(i) At critical temperature the curve has a point of inflection i.e. the slope of the curve changes at this point.

(ii) $T_C < T_1 < T_2 < T_3$.

[For type-III] [redacted]