

NEET/JEE • CHEMISTRY • SOLUTIONS • UNIT 1.4.1

Vapour Pressure of Liquid-Liquid Solutions **High**

Liquid composition and vapour composition are NOT the same number.

The Mathematics of Raoult's Law

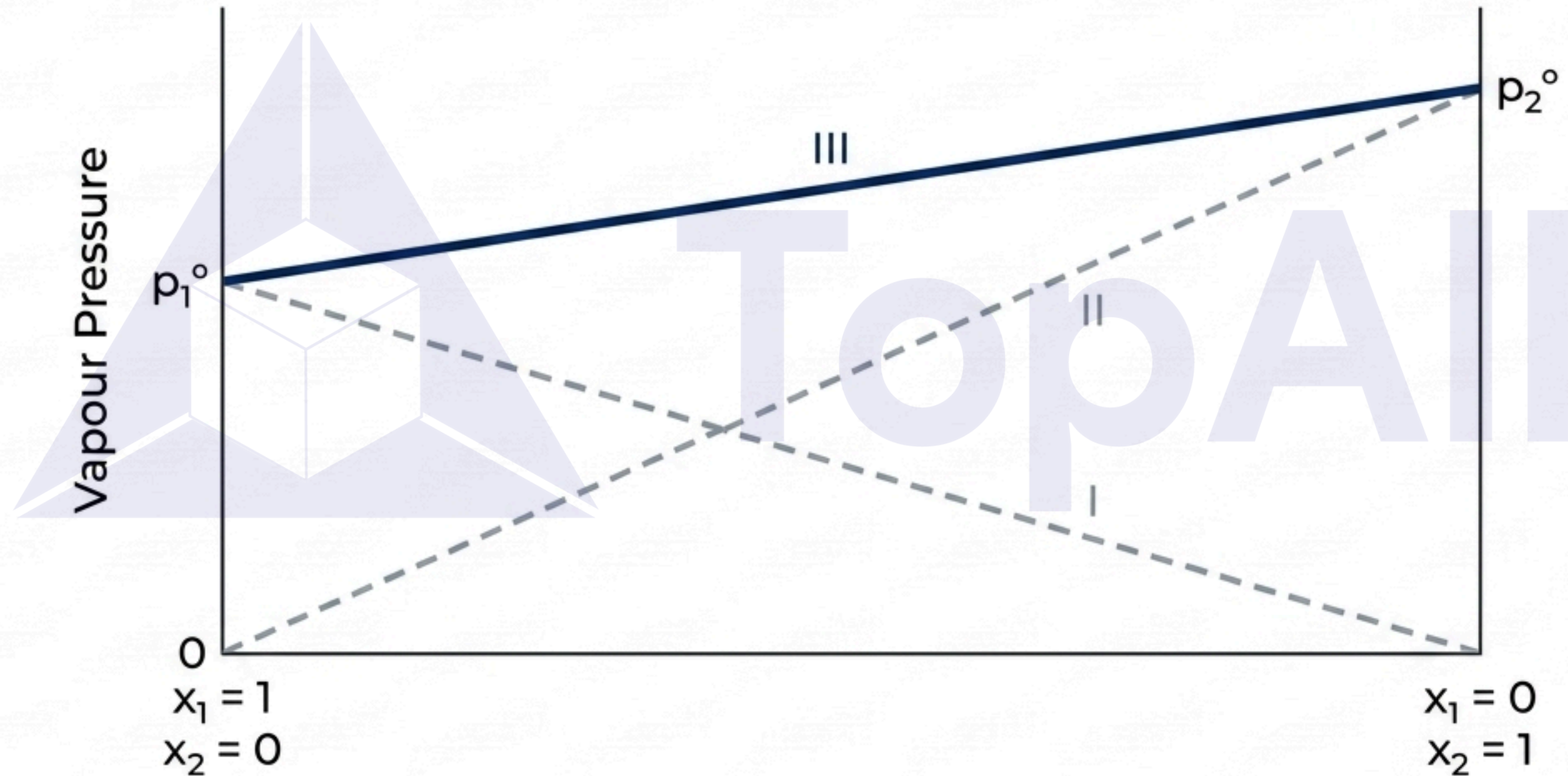
$$p_1 = p_1^\circ x_1 \quad ; \quad p_2 = p_2^\circ x_2$$

$$p_{\text{total}} = p_1^\circ + (p_2^\circ - p_1^\circ)x_2$$

$$y_i = p_i / p_{\text{total}}$$

*Where p° = pure vapour pressure, x = liquid mole fraction, y = vapour mole fraction.

Visualizing Partial vs. Total Pressure



Total vapour pressure varies linearly with the mole fraction of component 2.



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Let's Test Them Now.**

$$E=mc^2$$



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Application: NCERT Example 1.5

Mixture at 298K: CHCl_3 ($p^\circ=200$) + CH_2Cl_2 ($p^\circ=415$)

Step 1: Calculate Total Pressure (p_{total})

$$x_{\text{CH}_2\text{Cl}_2} = 0.688$$

$$p_{\text{total}} = 200 + (415 - 200)(0.688) = 347.9 \text{ mmHg}$$

Finding Vapour Composition (y)

Step 2: Apply Dalton's Law ($y_i = p_i / p_{\text{total}}$)

$$y_{\text{CH}_2\text{Cl}_2} = 285.5 / 347.9 = 0.82$$

$$y_{\text{CHCl}_3} = 62.4 / 347.9 = 0.18$$

$x = 0.688$ but $y = 0.82$ — NOT equal!

Master This Trap

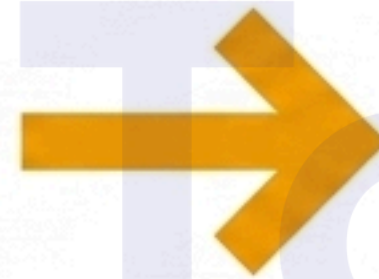
 **Trap: Stopping at x when the question asks for y .**

Vapour phase is ALWAYS richer in the more volatile component — always take the extra step $y_i = p_i / p_{\text{total}}$. Do not assume the liquid mole fraction is the final answer.

The Phase Shift

Liquid phase (x)

Driven by the physical amounts mixed.



**richer in the more
volatile component →**

Vapour phase (y)

Driven by partial pressures (Dalton's Law).

Unit 1.4.1 Summary

Key Takeaways

- Build p_{total} from p_1° , p_2° , and the liquid-phase mole fraction.
- Convert to vapour-phase mole fraction using $y_i = p_i/p_{\text{total}}$.
- Confirm the vapour is richer in the more volatile component.



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