

NEET/JEE • CHEMISTRY • SOLUTIONS • UNIT 1.6.2

Elevation of Boiling Point High

Why sucrose solution boils at 373.52K, not 373.15K.

The Mathematics of Boiling

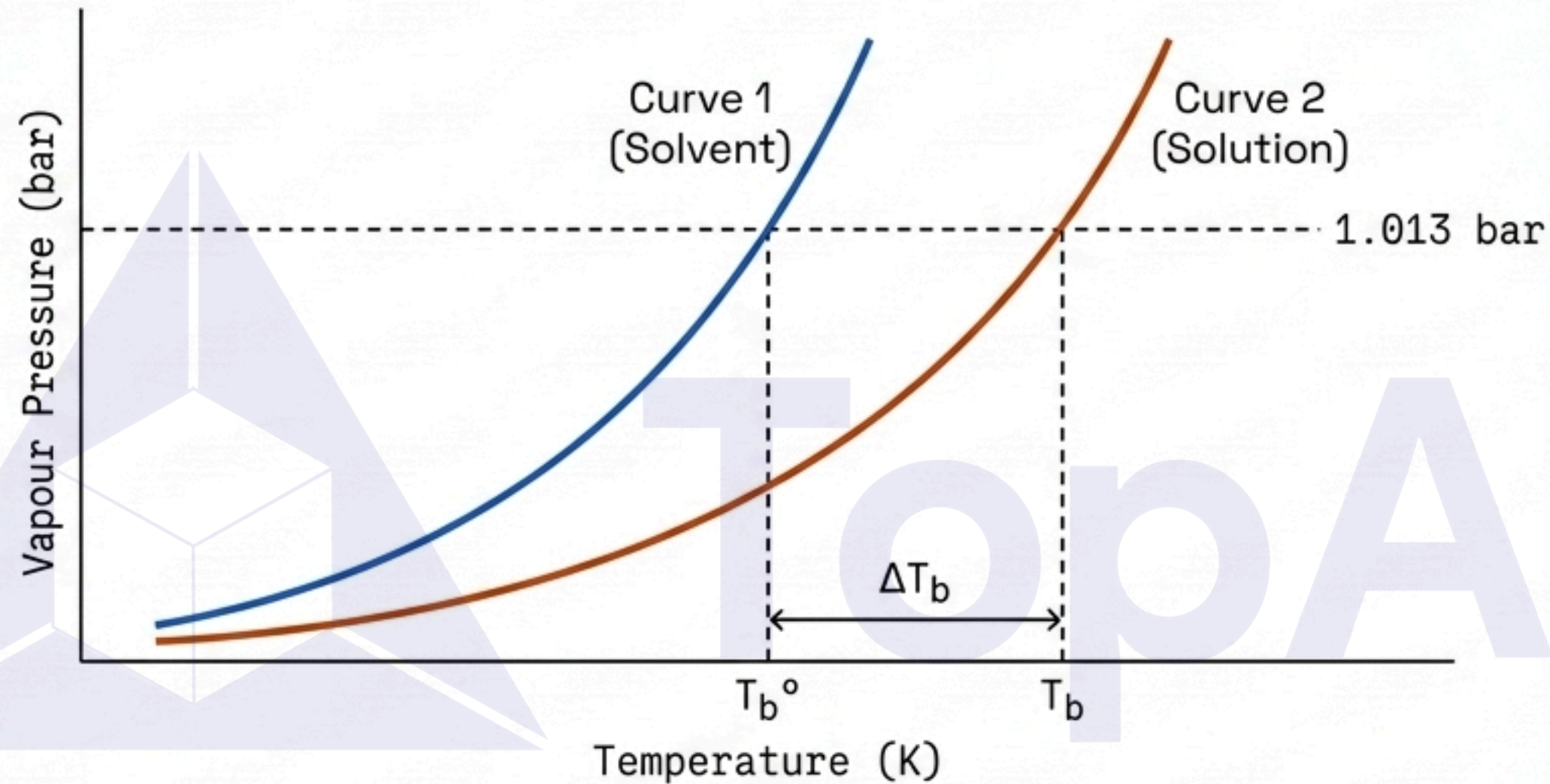
A non-volatile solute lowers the vapour pressure of a solvent. To reach 1 atm (1.013 bar) and boil, the solution requires more heat. The elevation (ΔT_b) is directly proportional to the molality (m) of the solute.

$$\Delta T_b = K_b \cdot m$$

$$M_2 = \frac{1000 \times w_2 \times K_b}{\Delta T_b \times w_1}$$

- K_b = Molal elevation constant ($K \text{ kg mol}^{-1}$)
- w_1 = Mass of solvent
- w_2 = Mass of solute
- M_2 = Molar mass of solute

Visualizing the Boiling Point Shift



✓ The Vapour Pressure Deficit

The solution's curve lies strictly below the pure solvent. You must heat it further to bridge the gap to 1.013 atmospheric pressure.



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$$E=mc^2$$



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Application: Calculating Molar Mass

Benzene has a K_b of $2.53 \text{ K kg mol}^{-1}$. When 1.80g of an unknown non-volatile solute is dissolved in 90g of benzene, the boiling point elevates by 0.88K . What is the molar mass of the solute?

Extract variables

$$w_2 = 1.80\text{g} \mid w_1 = 90\text{g} \mid K_b = 2.53 \mid \Delta T_b = 0.88\text{K}$$

Apply formula

$$M_2 = (1000 \times 1.8 \times 2.53) / (0.88 \times 90)$$

Solve

$$\mathbf{M_2 = 58 \text{ g/mol}}$$

 **Trap: Don't convert w_1 to kg — the formula's '1000' already does it.**

Master this trap! Examiners will give you solvent mass (w_1) in grams. Students often mistakenly convert this to kg (e.g., changing 90g to 0.09kg) while still using the expanded formula with the 1000 numerator.

If your formula has 1000 on top, w_1 goes in strictly AS GRAMS. Double-converting introduces a massive factor-of-1000 error to your molar mass.

The Ionic Exception

Watch out for Salts and Acids

The standard equation assumes a non-electrolyte (like glucose or urea) that stays whole. If the solute dissociates into ions (like NaCl or K₂SO₄), the number of particles multiplies.

$$\Delta T_b = i \cdot K_b \cdot m$$

Always check if van't Hoff's factor (*i*) applies. If the solute is ionic, calculate total moles of particles at equilibrium before solving. (See Concept 12).

Key Takeaways

- Apply $\Delta T_b = K_b \cdot m$ directly for dilute, non-electrolyte solutions to find the boiling point shift.
- Keep w_1 in grams when using the expanded M_2 formula – the 1000 factor automatically handles the kg conversion for molality.
- Check for the van't Hoff factor (i) whenever the solute is ionic; particles matter, not just molecules.



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