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Colligative properties and van t Hoff factor

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

Result	Formula	Units or note
Relative lowering	(p* - P) / p* = x(solute) for a non-electrolyte; about i x(solute) for a dilute electrolyte Valid when: non-volatile solute; second form only for a dilute electrolyte	dimensionless
Boiling point elevation	dTb = i Kb m Valid when: dilute solution, non-volatile solute; m in mol per kg solvent	K (Kb in K kg mol^-1)
Freezing point depression	dTf = i Kf m Valid when: dilute solution, solid solvent separates on freezing; m in mol per kg	K (Kf in K kg mol^-1)
Osmotic pressure	pi = i C R T Valid when: dilute solution, T in kelvin, C in mol per L; R matches units	atm with R = 0.0821 L atm mol^-1 K^-1, C in mol L^-1, T in K
Molar mass from dTf	M = Kf w 1000 / (dTf W) Valid when: non-electrolyte, w g solute in W g solvent, dilute solution	g mol^-1 with w and W in g
Molar mass from osmotic pressure	M = w R T / (pi V) Valid when: dilute solution, T in kelvin, V in litres, pi in atm for this R	g mol^-1 (V in L)
van't Hoff factor	i = observed / calculated = normal M / observed M Valid when: same colligative property compared observed with calculated	dimensionless
Dissociation	i = 1 + (n - 1) a Valid when: solute dissociates into n ions; a is fraction dissociated	a between 0 and 1
Association	i = 1 - (1 - 1/n) a; dimer i = 1 - a/2 Valid when: n molecules associate into one; a is fraction associated	a between 0 and 1

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/chemistry/solutions/colligative-properties-and-van-t-hoff-factor

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