



# **Important Formulas of Colligative Properties**

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## List of 22 Important Formulas of Colligative Properties

#### Important Formulas of Colligative Properties &

1) Boiling Point Elevation

fx  $\Delta T_b = K_b \cdot m$ 

Open Calculator

 $\mathbf{ex} \ 274.0629 \mathrm{K} = 0.51 \cdot 1.79 \mathrm{mol/kg}$ 

#### 2) Cryoscopic Constant given Depression in Freezing Point

 $\mathbf{k}_{\mathrm{f}} = rac{\Delta \mathrm{T_{\mathrm{f}}}}{\mathrm{i} \cdot \mathrm{m}}$ 

Open Calculator

=  $6.650705 \mathrm{K*kg/mol} = rac{12 \mathrm{K}}{1.008 \cdot 1.79 \mathrm{mol/kg}}$ 

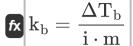
#### 3) Cryoscopic Constant given Latent Heat of Fusion

 $oldsymbol{ ext{fx}} egin{aligned} oldsymbol{ ext{k}}_{ ext{f}} &= rac{[ ext{R}] \cdot ext{T}_{ ext{f}}^2}{1000 \cdot ext{L}_{ ext{fusion}}} \end{aligned}$ 

Open Calculator



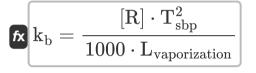
#### 4) Ebullioscopic Constant given Elevation in Boiling Point



Open Calculator 🗗

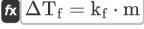
 $ext{ex} \ 0.548683 ext{K*kg/mol} = rac{0.99 ext{K}}{1.008 \cdot 1.79 ext{mol/kg}}$ 

#### 5) Ebullioscopic Constant using Latent Heat of Vaporization



Open Calculator

### 6) Freezing Point Depression 🖸



Open Calculator 🖸

#### 7) Osmotic Pressure for Non Electrolyte



Open Calculator

 $ext{ex} \ 2.47771 ext{Pa} = 0.001 ext{mol/L} \cdot [ ext{R}] \cdot 298 ext{K}$ 

#### 8) Osmotic Pressure given Concentration of Two Substances

$$\pi = (C_1 + C_2) \cdot [R] \cdot T$$

Open Calculator

 $(8.2E^-7mol/L + 1.89E^-7mol/L) \cdot [R] \cdot 298K$ 



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#### 9) Osmotic Pressure given Density of Solution

fx  $\pi = 
ho_{sol} \cdot [g] \cdot h$ 

Open Calculator 🖸

 $\mathbf{ex} \ 2.498734 \mathrm{Pa} = 0.049 \mathrm{g/L} \cdot [\mathrm{g}] \cdot 5.2 \mathrm{m}$ 

#### 10) Osmotic Pressure given Depression in Freezing Point

 $\pi = rac{\Delta H_{fusion} \cdot \Delta T_{f} \cdot T}{V_{m} \cdot \left(T_{fp}^{2}
ight)}$ 

Open Calculator

#### 11) Osmotic Pressure given Relative Lowering of Vapour Pressure

fx  $\pi = rac{\Delta \mathbf{p} \cdot [\mathrm{R}] \cdot \mathrm{T}}{\mathrm{V_{m}}}$ 

Open Calculator

 $oxed{ex} 2.496917 ext{Pa} = rac{0.052 \cdot [ ext{R}] \cdot 298 ext{K}}{51.6 ext{m}^3/ ext{mol}}$ 

#### 12) Osmotic Pressure given Vapour Pressure

fx  $\pi = rac{(\mathrm{p_o} - \mathrm{p}) \cdot [\mathrm{R}] \cdot \mathrm{T}}{\mathrm{V_m} \cdot \mathrm{p_o}}$ 

Open Calculator

 $oxed{ex} 2.500278 ext{Pa} = rac{(2000 ext{Pa} - 1895.86 ext{Pa}) \cdot [ ext{R}] \cdot 298 ext{K}}{51.6 ext{m}^3/ ext{mol} \cdot 2000 ext{Pa}}$ 





### 13) Ostwald-Walker Dynamic Method for Relative Lowering of Vapour

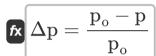
Pressure 🖸

$$\Delta ext{p} = rac{ ext{w}_ ext{B}}{ ext{w}_ ext{A} + ext{w}_ ext{B}}$$

Open Calculator 🗗

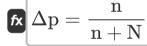
$$oxed{ex} 0.051953 = rac{0.548 \mathrm{g}}{10 \mathrm{g} + 0.548 \mathrm{g}}$$

#### 14) Relative Lowering of Vapour Pressure



Open Calculator

## 15) Relative Lowering of Vapour Pressure given Number of Moles for Concentrated Solution



Open Calculator

$$oxed{ex} 0.04943 = rac{0.52 ext{mol}}{0.52 ext{mol} + 10 ext{mol}}$$

## 16) Relative Lowering of Vapour Pressure given Number of Moles for Dilute Solution

$$\Delta p = \frac{n}{N}$$

Open Calculator

$$\boxed{\textbf{ex}} 0.052 = \frac{0.52 \mathrm{mol}}{10 \mathrm{mol}}$$

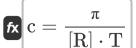






Open Calculator

### 17) Total Concentration of Particles using Osmotic Pressure



 $0.001009 ext{mol/L} = rac{2.5 ext{Pa}}{[ ext{R}] \cdot 298 ext{K}}$ 

18) Van't Hoff equation for Depression in Freezing Point of electrolyte

 $\Delta T_{
m f} = {
m i} \cdot {
m k_f} \cdot {
m m}$ 

Open Calculator

 $11.99873K = 1.008 \cdot 6.65K \cdot \frac{\text{kg}}{\text{mol}} \cdot 1.79 \cdot \frac{\text{mol}}{\text{kg}}$ 

19) Van't Hoff Equation for Elevation in Boiling Point of Electrolyte 🗗

fx  $\Delta T_{\mathrm{b}} = \mathrm{i} \cdot \mathrm{k_{\mathrm{b}}} \cdot \mathrm{m}$ 

Open Calculator

 $[0.923812K = 1.008 \cdot 0.512K*kg/mol \cdot 1.79mol/kg]$ 

 $\pi = i \cdot c \cdot R \cdot T$ 

Open Calculator 2

2.497393Pa =  $1.008 \cdot 0.001$ mol/L  $\cdot 8.314 \cdot 298$ K

20) Van't Hoff Osmotic Pressure for Electrolyte

21) Van't Hoff Osmotic Pressure for Mixture of Two Solutions

 $\pi = ((\mathrm{i}_1 \cdot \mathrm{C}_1) + (\mathrm{i}_2 \cdot \mathrm{C}_2)) \cdot [\mathrm{R}] \cdot \mathrm{T}$ 

Open Calculator

ex

2.656353Pa =  $((1.1 \cdot 8.2E^{-7} \text{mol/L}) + (0.9 \cdot 1.89E^{-7} \text{mol/L})) \cdot [R] \cdot 298K$ 







## 22) Van't Hoff Relative Lowering of Vapour Pressure given Molecular Mass and Molality



Open Calculator 🗗

$$3.2 \text{E}^{-5} = rac{1.008 \cdot 1.79 \text{mol/kg} \cdot 18 \text{g}}{1000}$$



#### Variables Used

- C Molar Concentration of Solute (Mole per Liter)
- C<sub>1</sub> Concentration of Particle 1 (Mole per Liter)
- C<sub>2</sub> Concentration of Particle 2 (Mole per Liter)
- **h** Equilibrium Height (Meter)
- i Van't Hoff Factor
- i1 Van't Hoff Factor of Particle 1
- i2 Van't Hoff Factor of Particle 2
- **k**<sub>b</sub> Ebullioscopic Constant of Solvent (Kelvin Kilogram per Mole)
- K<sub>h</sub> Molal Boiling Point Elevation Constant
- **k**<sub>f</sub> Cryoscopic Constant (Kelvin Kilogram per Mole)
- L<sub>fusion</sub> Latent Heat of Fusion (Joule per Kilogram)
- Lvaporization Latent Heat of Vaporization (Joule per Kilogram)
- **m** Molality (Mole per Kilogram)
- M Molecular Mass Solvent (Gram)
- n Number of Moles of Solute (Mole)
- **N** Number of Moles of Solvent (Mole)
- p Vapour Pressure of Solvent in Solution (Pascal)
- **p**<sub>o</sub> Vapour Pressure of Pure Solvent (Pascal)
- R Universal Gas Constant
- **T** Temperature (Kelvin)
- **T**<sub>f</sub> Solvent Freezing Point for Cryoscopic Constant (Kelvin)
- T<sub>fp</sub> Solvent Freezing Point (Kelvin)
- T<sub>sbp</sub> Solvent BP given Latent Heat of Vaporization (Kelvin)





- **V<sub>m</sub>** Molar Volume (Cubic Meter per Mole)
- W<sub>△</sub> Loss of Mass in bulb set A (Gram)
- WB Loss of Mass in Bulb Set B (Gram)
- ΔH<sub>fusion</sub> Molar Enthalpy of Fusion (Kilojoule per Mole)
- Δp Relative Lowering of Vapour Pressure
- Δp<sub>Van't Hoff</sub> Colligative Pressure given Van't Hoff factor
- ΔT<sub>h</sub> Boiling Point Elevation (Kelvin)
- ΔT<sub>f</sub> Depression in Freezing Point (Kelvin)
- ΔT<sub>f</sub> Depression in Freezing Point (Kelvin)
- π Osmotic Pressure (Pascal)
- ρ<sub>sol</sub> Density of Solution (Gram per Liter)





#### Constants, Functions, Measurements used

- Constant: [g], 9.80665 Meter/Second<sup>2</sup>

  Gravitational acceleration on Earth
- Constant: [R], 8.31446261815324 Joule / Kelvin \* Mole Universal gas constant
- Measurement: Length in Meter (m)
   Length Unit Conversion
- Measurement: Weight in Gram (g)
   Weight Unit Conversion
- Measurement: Temperature in Kelvin (K)

  Temperature Unit Conversion
- Measurement: Amount of Substance in Mole (mol)

  Amount of Substance Unit Conversion
- Measurement: Pressure in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: Molar Concentration in Mole per Liter (mol/L)
   Molar Concentration Unit Conversion
- Measurement: Density in Gram per Liter (g/L)
   Density Unit Conversion
- Measurement: Latent Heat in Joule per Kilogram (J/kg)
   Latent Heat Unit Conversion
- Measurement: Molar Magnetic Susceptibility in Cubic Meter per Mole (m³/mol)
  - Molar Magnetic Susceptibility Unit Conversion
- Measurement: Molality in Mole per Kilogram (mol/kg)
   Molality Unit Conversion
- Measurement: Molar Enthalpy in Kilojoule per Mole (kJ/mol)
   Molar Enthalpy Unit Conversion





• Measurement: Cryoscopic Constant in Kelvin Kilogram per Mole (K\*kg/mol)

Cryoscopic Constant Unit Conversion





#### Check other formula lists

- Clausius-Clapeyron Equation Formulas
- Depression in Freezing Point Formulas
- Elevation in Boiling Point Formulas
- Immiscible Liquids Formulas

- Important Formulas of Clausius-Clapevron Equation
- Important Formulas of Colligative Properties
- Osmotic Pressure Formulas
- Relative Lowering of Vapour Pressure Formulas
- Van't Hoff Factor Formulas

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