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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

Open Calculator

fx $\Delta T_b = K_b \cdot m$

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

2) Cryoscopic Constant given Depression in Freezing Point

Open Calculator

fx $k_f = \frac{\Delta T_f}{i \cdot m}$

ex $6.650705\text{K*kg/mol} = \frac{12\text{K}}{1.008 \cdot 1.79\text{mol/kg}}$

3) Cryoscopic Constant given Latent Heat of Fusion

Open Calculator

fx $k_f = \frac{[R] \cdot T_f^2}{1000 \cdot L_{fusion}}$

ex $6.2234\text{K*kg/mol} = \frac{[R] \cdot (500\text{K})^2}{1000 \cdot 334\text{J/kg}}$

4) Ebullioscopic Constant given Elevation in Boiling Point

Open Calculator

fx $$k_b = \frac{\Delta T_b}{i \cdot m}$$

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

5) Ebullioscopic Constant using Latent Heat of Vaporization

Open Calculator

fx $$k_b = \frac{[R] \cdot T_{sbp}^2}{1000 \cdot L_{vaporization}}$$

ex $$0.540419\text{K*kg/mol} = \frac{[R] \cdot (12.12\text{E^3K})^2}{1000 \cdot 2260000\text{J/kg}}$$

6) Freezing Point Depression

Open Calculator

fx $$\Delta T_f = k_f \cdot m$$

ex $$285.0535\text{K} = 6.65\text{K*kg/mol} \cdot 1.79\text{mol/kg}$$

7) Osmotic Pressure for Non Electrolyte

Open Calculator

fx $$\pi = c \cdot [R] \cdot T$$

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

8) Osmotic Pressure given Concentration of Two Substances

Open Calculator

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

ex $$2.500009\text{Pa} = (8.2\text{E^-7mol/L} + 1.89\text{E^-7mol/L}) \cdot [R] \cdot 298\text{K}$$

9) Osmotic Pressure given Density of Solution

Open Calculator

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

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

10) Osmotic Pressure given Depression in Freezing Point

Open Calculator

$$\pi = \frac{\Delta H_{fusion} \cdot \Delta T_f \cdot T}{V_m \cdot \left(T_{fp}^2\right)}$$

$$2.499504\text{Pa} = \frac{3.246\text{kJ/mol} \cdot 12\text{K} \cdot 298\text{K}}{51.6\text{m}^3\text{/mol} \cdot \left((300\text{K})^2\right)}$$

11) Osmotic Pressure given Relative Lowering of Vapour Pressure

Open Calculator

$$\pi = \frac{\Delta p \cdot [R] \cdot T}{V_m}$$

$$2.496917\text{Pa} = \frac{0.052 \cdot [R] \cdot 298\text{K}}{51.6\text{m}^3\text{/mol}}$$

12) Osmotic Pressure given Vapour Pressure

Open Calculator

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

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

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

Open Calculator

$$\Delta p = \frac{w_B}{w_A + w_B}$$

$$0.051953 = \frac{0.548g}{10g + 0.548g}$$

14) Relative Lowering of Vapour Pressure

Open Calculator

$$\Delta p = \frac{p_o - p}{p_o}$$

$$0.05207 = \frac{2000Pa - 1895.86Pa}{2000Pa}$$

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

Open Calculator

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

$$0.04943 = \frac{0.52mol}{0.52mol + 10mol}$$

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

Open Calculator

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

$$0.052 = \frac{0.52mol}{10mol}$$

17) Total Concentration of Particles using Osmotic Pressure

Open Calculator

fx $$c = \frac{\pi}{[R] \cdot T}$$

ex $$0.001009\text{mol/L} = \frac{2.5\text{Pa}}{[R] \cdot 298\text{K}}$$

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

Open Calculator

fx $$\Delta T_f = i \cdot k_f \cdot m$$

ex $$11.99873\text{K} = 1.008 \cdot 6.65\text{K*kg/mol} \cdot 1.79\text{mol/kg}$$

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

Open Calculator

fx $$\Delta T_b = i \cdot k_b \cdot m$$

ex $$0.923812\text{K} = 1.008 \cdot 0.512\text{K*kg/mol} \cdot 1.79\text{mol/kg}$$

20) Van't Hoff Osmotic Pressure for Electrolyte

Open Calculator

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

ex $$2.497393\text{Pa} = 1.008 \cdot 0.001\text{mol/L} \cdot 8.314 \cdot 298\text{K}$$

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

Open Calculator

fx $$\pi = ((i_1 \cdot C_1) + (i_2 \cdot C_2)) \cdot [R] \cdot T$$

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

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

Open Calculator

fx $$\Delta p_{\text{Van't Hoff}} = \frac{i \cdot m \cdot M}{1000}$$

ex $$3.2\text{E}\hat{}\text{-}5 = \frac{1.008 \cdot 1.79\text{mol/kg} \cdot 18\text{g}}{1000}$$

Variables Used

- **c** Molar Concentration of Solute *(Mole per Liter)*
- **C_1** Concentration of Particle 1 *(Mole per Liter)*
- **C_2** Concentration of Particle 2 *(Mole per Liter)*
- **h** Equilibrium Height *(Meter)*
- **i** Van't Hoff Factor
- **i_1** Van't Hoff Factor of Particle 1
- **i_2** Van't Hoff Factor of Particle 2
- **k_b** Ebullioscopic Constant of Solvent *(Kelvin Kilogram per Mole)*
- **K_b** Molal Boiling Point Elevation Constant
- **k_f** Cryoscopic Constant *(Kelvin Kilogram per Mole)*
- **L_{fusion}** Latent Heat of Fusion *(Joule per Kilogram)*
- **$L_{vaporization}$** 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_o** Vapour Pressure of Pure Solvent *(Pascal)*
- **R** Universal Gas Constant
- **T** Temperature *(Kelvin)*
- **T_f** Solvent Freezing Point for Cryoscopic Constant *(Kelvin)*
- **T_{fp}** Solvent Freezing Point *(Kelvin)*
- **T_{sbp}** Solvent BP given Latent Heat of Vaporization *(Kelvin)*

- V_m Molar Volume *(Cubic Meter per Mole)*
- w_A Loss of Mass in bulb set A *(Gram)*
- w_B Loss of Mass in Bulb Set B *(Gram)*
- ΔH_{fusion} Molar Enthalpy of Fusion *(Kilojoule per Mole)*
- Δp Relative Lowering of Vapour Pressure
- $\Delta p_{Van't\ Hoff}$ Colligative Pressure given Van't Hoff factor
- ΔT_b Boiling Point Elevation *(Kelvin)*
- ΔT_f Depression in Freezing Point *(Kelvin)*
- ΔT_f Depression in Freezing Point *(Kelvin)*
- π Osmotic Pressure *(Pascal)*
- ρ_{sol} Density of Solution *(Gram per Liter)*

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665 Meter/Second²
  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 (m^3/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-Clapeyron Equation
- Important Formulas of Colligative Properties
- Osmotic Pressure Formulas
- Relative Lowering of Vapour Pressure Formulas
- Van't Hoff Factor Formulas

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