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Electrolytes & Ions Formulas

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List of 25 Electrolytes & Ions Formulas

Electrolytes & Ions

1) Cell Potential given Electrochemical Work

$$\text{fx } E_{\text{cell}} = \left(\frac{w}{n \cdot [\text{Faraday}]} \right)$$

Open Calculator 

$$\text{ex } 0.077732\text{V} = \left(\frac{30\text{KJ}}{4 \cdot [\text{Faraday}]} \right)$$

2) Concentration of Hydronium ion using pH

$$\text{fx } C = 10^{-\text{pH}}$$

Open Calculator 

$$\text{ex } 1\text{E}^{-6}\text{mol/L} = 10^{-6}$$

3) Concentration of Hydronium Ion using pOH

$$\text{fx } C = 10^{\text{pOH}} \cdot k_w$$

Open Calculator 

$$\text{ex } 1\text{E}^{-6}\text{mol/L} = 10^8 \cdot 1\text{E}^{-14}$$



4) Fugacity of Anodic Electrolyte of Concentration Cell without Transference

$$\text{fx } f_1 = \frac{\frac{c_2 \cdot f_2}{c_1}}{\exp\left(\frac{\text{EMF} \cdot [\text{Faraday}]}{2 \cdot [\text{R}] \cdot \text{T}}\right)}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$\text{ex } 453.6371\text{Pa} = \frac{\frac{2.45\text{mol/L} \cdot 1878000\text{Pa}}{0.6\text{mol/L}}}{\exp\left(\frac{0.5\text{V} \cdot [\text{Faraday}]}{2 \cdot [\text{R}] \cdot 298\text{K}}\right)}$$

5) Fugacity of Cathodic Electrolyte of Concentration Cell without Transference

$$\text{fx } f_2 = \left(\exp\left(\frac{\text{EMF} \cdot [\text{Faraday}]}{2 \cdot [\text{R}] \cdot \text{T}}\right) \right) \cdot \left(\frac{c_1 \cdot f_1}{c_2} \right)$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$\text{ex } 1.9\text{E}^6\text{Pa} = \left(\exp\left(\frac{0.5\text{V} \cdot [\text{Faraday}]}{2 \cdot [\text{R}] \cdot 298\text{K}}\right) \right) \cdot \left(\frac{0.6\text{mol/L} \cdot 453.63\text{Pa}}{2.45\text{mol/L}} \right)$$

6) Fugacity of Electrolyte given Activities

$$\text{fx } f = \frac{\sqrt{a}}{c}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$\text{ex } 15.12184\text{Pa} = \frac{\sqrt{0.796\text{mol/kg}}}{0.059\text{mol/L}}$$



7) Ionic Activity given Molality of Solution 

$$fx \quad a = (\gamma \cdot m)$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)


$$ex \quad 0.795603 \text{mol/kg} = (0.1627 \cdot 4.89 \text{mol/kg})$$

8) Ionic Mobility 

$$fx \quad \mu = \frac{V}{x}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)


$$ex \quad 9.166667 \text{m}^2/\text{V} \cdot \text{s} = \frac{55 \text{m/s}}{6 \text{V/m}}$$

9) Ionic Product of Water 

$$fx \quad k_w = k_a \cdot k_b$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 1\text{E}^{-14} = 1\text{E}^{-4} \cdot 1\text{E}^{-10}$$

10) Number of Positive and Negative Ions of Concentration Cell with Transference 

$$fx \quad v_{\pm} = \left(\frac{t_{-} \cdot v_{-} \cdot [R] \cdot T}{EMF \cdot Z_{\pm} \cdot [\text{Faraday}]} \right) \cdot \ln \left(\frac{a_2}{a_1} \right)$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$ex \quad 81.35751 = \left(\frac{49 \cdot 110 \cdot [R] \cdot 298\text{K}}{0.5\text{V} \cdot 2 \cdot [\text{Faraday}]} \right) \cdot \ln \left(\frac{0.36 \text{mol/kg}}{0.2 \text{mol/kg}} \right)$$



11) pH of Salt of Weak Acid and Strong Base 

$$\text{fx } \text{pH} = \frac{\text{pK}_w + \text{pk}_a + \log 10(\text{C}_{\text{salt}})}{2}$$

Open Calculator 

$$\text{ex } 6 = \frac{14 + 4 + \log 10(1\text{E}^{-6}\text{mol/L})}{2}$$

12) pH of Salt of Weak Acid and Weak base 

$$\text{fx } \text{pH} = \frac{\text{pK}_w + \text{pk}_a - \text{pk}_b}{2}$$

Open Calculator 

$$\text{ex } 6 = \frac{14 + 4 - 6}{2}$$

13) pH of Salt of Weak Base and Strong Base 

$$\text{fx } \text{pH} = \frac{\text{pK}_w - \text{pk}_b - \log 10(\text{C}_{\text{salt}})}{2}$$

Open Calculator 

$$\text{ex } 5.5 = \frac{14 - 6 - \log 10(1\text{E}^{-6}\text{mol/L})}{2}$$

14) pH of Water using Concentration 

$$\text{fx } \text{pH} = -\log 10(\text{C})$$

Open Calculator 

$$\text{ex } 6 = -\log 10(1\text{E}^{-6}\text{mol/L})$$




15) pH Value of Ionic Product of Water 

$$\text{fx } \text{pH}_{\text{water}} = \text{pk}_a + \text{pk}_b$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$\text{ex } 10 = 4 + 6$$

16) pOH of Salt of Strong Base and Weak Acid 

$$\text{fx } \text{pOH} = 14 - \frac{\text{pk}_a + \text{pK}_w + \log 10(C_{\text{salt}})}{2}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

$$\text{ex } 8 = 14 - \frac{4 + 14 + \log 10(1\text{E}^{-6}\text{mol/L})}{2}$$

17) pOH of Salt of Weak Acid and Weak Base 

$$\text{fx } \text{pOH} = 14 - \frac{\text{pK}_w + \text{pk}_a - \text{pk}_b}{2}$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

$$\text{ex } 8 = 14 - \frac{14 + 4 - 6}{2}$$


18) pOH of Salt of Weak Base and Strong Base 

$$\text{fx } \text{pOH} = 14 - \frac{\text{pK}_w - \text{pk}_b - \log 10(C_{\text{salt}})}{2}$$

[Open Calculator !\[\]\(5abce1a84a655b073239ab33e1199487_img.jpg\)](#)

$$\text{ex } 8.5 = 14 - \frac{14 - 6 - \log 10(1\text{E}^{-6}\text{mol/L})}{2}$$



19) pOH of Strong acid and Strong base 

$$\text{fx } \text{pOH} = \frac{\text{pK}_w}{2}$$

Open Calculator 


$$\text{ex } 7 = \frac{14}{2}$$

20) pOH using Concentration of Hydroxide ion 

$$\text{fx } \text{pOH} = 14 + \log_{10}(C)$$

Open Calculator 

$$\text{ex } 8 = 14 + \log_{10}(1 \times 10^{-6} \text{ mol/L})$$

21) Quantity of Charges given Mass of Substance 

$$\text{fx } q = \frac{m_{\text{ion}}}{Z}$$

Open Calculator 

$$\text{ex } 0.254545C = \frac{5.6 \text{ g}}{22 \text{ g/C}}$$

22) Relation between pH and pOH 

$$\text{fx } \text{pH} = 14 - \text{pOH}$$

Open Calculator 

$$\text{ex } 6 = 14 - 8$$



23) Time required for Flowing of Charge given Mass and Time

$$\text{fx } t_{\text{tot}} = \frac{m_{\text{ion}}}{Z \cdot i_p}$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107_img.jpg\)](#)

$$\text{ex } 0.115702\text{s} = \frac{5.6\text{g}}{22\text{g/C} \cdot 2.2\text{A}}$$

24) Total Number of Ions of Concentration Cell with Transference given Valencies

$$\text{fx } v = \frac{\frac{\text{EMF} \cdot v_{\pm} \cdot Z_{\pm} \cdot [\text{Faraday}]}{t \cdot T \cdot [R]}}{\ln\left(\frac{a_2}{a_1}\right)}$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6_img.jpg\)](#)

$$\text{ex } 109.9898 = \frac{\frac{0.5\text{V} \cdot 81.35 \cdot 2 \cdot [\text{Faraday}]}{49 \cdot 298\text{K} \cdot [R]}}{\ln\left(\frac{0.36\text{mol/kg}}{0.2\text{mol/kg}}\right)}$$

25) Valencies of Positive and Negative Ions of Concentration Cell with Transference

$$\text{fx } Z_{\pm} = \left(\frac{t_{\pm} \cdot v_{\pm} \cdot [R] \cdot T}{\text{EMF} \cdot v_{\pm} \cdot [\text{Faraday}]} \right) \cdot \ln\left(\frac{a_2}{a_1}\right)$$

[Open Calculator !\[\]\(4688aadfd656ded00cd6bdfae55089a9_img.jpg\)](#)

$$\text{ex } 2.000185 = \left(\frac{49 \cdot 110 \cdot [R] \cdot 298\text{K}}{0.5\text{V} \cdot 81.35 \cdot [\text{Faraday}]} \right) \cdot \ln\left(\frac{0.36\text{mol/kg}}{0.2\text{mol/kg}}\right)$$



Variables Used








- **a** Ionic Activity (Mole per Kilogram)
- **a₁** Anodic Ionic Activity (Mole per Kilogram)
- **a₂** Cathodic Ionic Activity (Mole per Kilogram)
- **c** Actual Concentration (Mole per Liter)
- **C** Hydronium Ion Concentration (Mole per Liter)
- **C₁** Anodic Concentration (Mole per Liter)
- **C₂** Cathodic Concentration (Mole per Liter)
- **C_{salt}** Concentration of Salt (Mole per Liter)
- **E_{cell}** Cell Potential (Volt)
- **EMF** EMF of Cell (Volt)
- **f** Fugacity (Pascal)
- **f₁** Anodic Fugacity (Pascal)
- **f₂** Cathodic Fugacity (Pascal)
- **i_p** Electric Current (Ampere)
- **k_a** Constant of Ionization of Acids
- **k_b** Constant Of Ionization Of Bases
- **k_w** Ionic Product of Water
- **m** Molality (Mole per Kilogram)
- **m_{ion}** Mass of Ions (Gram)
- **n** Moles of Electron Transferred
- **pH** Negative Log of Hydronium Concentration
- **pH_{water}** Negative Log of H⁺ Conc. for Ionic Pdt. of H₂O










- pk_a Negative Log of Acid Ionization Constant
- pk_b Negative Log of Base Ionization Constant
- pK_w Negative Log of Ionic Product of Water
- pOH Negative Log of Hydroxyl Concentration
- q Charge (*Coulomb*)
- T Temperature (*Kelvin*)
- t_- Transport Number of Anion
- t_{tot} Total Time Taken (*Second*)
- V Speed of Ions (*Meter per Second*)
- v_{\pm} Number of Positive and Negative Ions
- w Work Done (*Kilojoule*)
- x Potential Gradient (*Volt per Meter*)
- Z Electrochemical Equivalent of Element (*Gram Per Coulomb*)
- Z_{\pm} Valencies of Positive and Negative Ions
- γ Activity Coefficient
- μ Ionic Mobility (*Square Meter per Volt per Second*)
- v Total number of Ions



Constants, Functions, Measurements used

- **Constant:** **[Faraday]**, 96485.33212 Coulomb / Mole
Faraday constant
- **Constant:** **[R]**, 8.31446261815324 Joule / Kelvin * Mole
Universal gas constant
- **Function:** **exp**, exp(Number)
Exponential function
- **Function:** **ln**, ln(Number)
Natural logarithm function (base e)
- **Function:** **log10**, log10(Number)
Common logarithm function (base 10)
- **Function:** **sqrt**, sqrt(Number)
Square root function
- **Measurement:** **Weight** in Gram (g)
Weight Unit Conversion 
- **Measurement:** **Time** in Second (s)
Time Unit Conversion 
- **Measurement:** **Electric Current** in Ampere (A)
Electric Current Unit Conversion 
- **Measurement:** **Temperature** in Kelvin (K)
Temperature Unit Conversion 
- **Measurement:** **Pressure** in Pascal (Pa)
Pressure Unit Conversion 
- **Measurement:** **Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement:** **Energy** in Kilojoule (KJ)
Energy Unit Conversion 



- **Measurement: Electric Charge** in Coulomb (C)
Electric Charge Unit Conversion 
- **Measurement: Electric Field Strength** in Volt per Meter (V/m)
Electric Field Strength Unit Conversion 
- **Measurement: Electric Potential** in Volt (V)
Electric Potential Unit Conversion 
- **Measurement: Molar Concentration** in Mole per Liter (mol/L)
Molar Concentration Unit Conversion 
- **Measurement: Molality** in Mole per Kilogram (mol/kg)
Molality Unit Conversion 
- **Measurement: Mobility** in Square Meter per Volt per Second ($\text{m}^2/\text{V}\cdot\text{s}$)
Mobility Unit Conversion 
- **Measurement: Electrochemical Equivalent** in Gram Per Coulomb (g/C)
Electrochemical Equivalent Unit Conversion 



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- [Activity of Electrolytes Formulas](#)
- [Concentration of Electrolyte Formulas](#)
- [Conductance and Conductivity Formulas](#)
- [Debye Huckel Limiting Law Formulas](#)
- [Degree of Dissociation Formulas](#)
- [Dissociation Constant Formulas](#)
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