Important Electrolytes & Ions Formulas PDF

Formulas
Examples
with Units

List of 25
Important Electrolytes & Ions Formulas

1) Cell Potential given Electrochemical Work Formula

Evaluate Formula

Formula

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

Example with Units

$$0.0777\,\text{V} = \left(\frac{30\,\text{KJ}}{4 \cdot 96485.3321}\right)$$

2) Concentration of Hydronium ion using pH Formula

Evaluate Formula

Formula

$$C = 10^{-pH}$$

Example with Units

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

3) Concentration of Hydronium Ion using pOH Formula

Evaluate Formula

Formula

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

Example with Units

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

4) Fugacity of Anodic Electrolyte of Concentration Cell without Transference Formula

Evaluate Formula

Formula

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

Example with Units

$$453.6371\,\text{Pa} = \frac{\frac{2.45\,\text{mol/L} \cdot 1878000\,\text{Pa}}{0.6\,\text{mol/L}}}{\exp\left(\frac{0.5\,\text{V} \cdot 96485.3321}{2 \cdot 8.3145 \cdot 298\,\text{K}}\right)}$$

5) Fugacity of Cathodic Electrolyte of Concentration Cell without Transference Formula

Evaluate Formula

Formula

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

Example with Units

$$1.9\text{E+}6\,\text{Pa} = \left(\exp\left(\frac{0.5\,\text{V} \cdot 96485.3321}{2 \cdot 8.3145 \cdot 298\,\text{K}}\right)\right) \cdot \left(\frac{0.6\,\text{mol/L} \cdot 453.63\,\text{Pa}}{2.45\,\text{mol/L}}\right)$$

6) Fugacity of Electrolyte given Activities Formula

Evaluate Formula

Formula

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

Example with Units

$$15.1218\,\text{Pa} = \frac{\sqrt{0.796\,\text{mol/kg}}}{0.059\,\text{mol/L}}$$

7) Ionic Activity given Molality of Solution Formula

Evaluate Formula

Formula

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

Example with Units

$$0.7956\,\text{mol/kg} = (0.1627 \cdot 4.89\,\text{mol/kg})$$

8) Ionic Mobility Formula

Evaluate Formula

Formula

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

Example with Units

$$9.1667\,\text{m}^2\text{/V*s} = \frac{55\,\text{m/s}}{6\,\text{V/m}}$$

9) Ionic Product of Water Formula

Evaluate Formula

Formula

$$k_w = k_a \cdot k_b$$

Example

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

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

Evaluate Formula

Formula

$$v\pm = \left(\frac{t_- \cdot v \cdot [R] \cdot T}{EMF \cdot Z\pm \cdot [Faraday]}\right) \cdot \ln\left(\frac{a_2}{a_1}\right)$$

Example with Units

$$81.3575 = \left(\frac{49 \cdot 110 \cdot 8.3145 \cdot 298\,\text{K}}{0.5\,\text{v} \cdot 2 \cdot 96485.3321}\right) \cdot \ln\left(\frac{0.36\,\text{mol/kg}}{0.2\,\text{mol/kg}}\right)$$

11) pH of Salt of Weak Acid and Strong Base Formula

Evaluate Formula

Formula

$$pH = \frac{pK_w + pk_a + \log10\left(C_{salt}\right)}{2}$$

Example with Units

$$6.1228 = \frac{14 + 4 + \log10\left(1.76E\text{-}6\,\text{mol/L}\right)}{2}$$

12) pH of Salt of Weak Acid and Weak base Formula

Evaluate Formula

Formula

$$pH = \frac{pK_w + pk_a - pk_b}{2}$$

Example

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

13) pH of Salt of Weak Base and Strong Base Formula

Evaluate Formula

Formula

$$pH = \frac{pK_w - pk_b - \log10\left(C_{salt}\right)}{2}$$

Example with Units

$$5.3772 = \frac{14 - 6 - \log10\left(1.76E\text{-}6\,mol/L\right)}{2}$$

14) pH of Water using Concentration Formula

Evaluate Formula

Formula

$$pH = -\log10\left(C\right)$$

Example with Units

$$6 = -\log10\left(1E\text{-}6\,mol/L\right)$$

15) pH Value of Ionic Product of Water Formula

Evaluate Formula

Formula

$$pH_{water} = pk_a + pk_b$$

Example

$$10 = 4 + 6$$

16) pOH of Salt of Strong Base and Weak Acid Formula

Evaluate Formula

Formula

$$pOH = 14 - \frac{pk_a + pK_w + \log10\left(C_{salt}\right)}{2}$$

Example with Units

$$7.8772 = 14 - \frac{4 + 14 + \log10\left(1.76E\text{-}6\,mol/L\right)}{2}$$

17) pOH of Salt of Weak Acid and Weak Base Formula

Evaluate Formula

Formula

$$pOH = 14 - \frac{pK_w + pk_a - pk_b}{2}$$

Example

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

18) pOH of Salt of Weak Base and Strong Base Formula

Evaluate Formula

Formula

$$pOH = 14 - \frac{pK_w - pk_b - \log10\left(C_{salt}\right)}{2}$$

Example with Units

$$8.6228 = 14 - \frac{14 - 6 - \log10\left(1.76E\text{-}6\,mol/L\right)}{2}$$

19) pOH of Strong acid and Strong base Formula

Evaluate Formula

Formula

$$pOH = \frac{pK_w}{2}$$

Example

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

20) pOH using Concentration of Hydroxide ion Formula

Evaluate Formula

Formula

$$pOH = 14 + \log10\left(C\right)$$

Example with Units

$$8 = 14 + \log10\left(1E\text{-}6\,mol/L\right)$$

21) Quantity of Charges given Mass of Substance Formula

Evaluate Formula

Formula

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

Example with Units

$$0.2545\,\text{C} = \frac{5.6\,\text{g}}{22\,\text{g/C}}$$

22) Relation between pH and pOH Formula

Evaluate Formula

Formula

$$pH = 14 - pOH$$

Example

$$6 = 14 - 8$$

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

Evaluate Formula

Formula

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

Example with Units

$$0.1157\,\text{s} = \frac{5.6\,\text{g}}{22\,\text{g/C} \cdot 2.2\,\text{A}}$$

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

Evaluate Formula

Formula

$$\nu = \frac{\frac{EMF \cdot \nu\pm \cdot Z\pm \cdot [Faraday]}{t_- \cdot T \cdot [R]}}{\ln\left(\frac{a_2}{a_1}\right)}$$

Example with Units

$$109.9898 = \frac{\frac{0.5\,\text{V} \cdot 81.35 \cdot 2 \cdot 96485.3321}{49 \cdot 298\,\text{K} \cdot 8.3145}}{\ln\left(\frac{0.36\,\text{mol/kg}}{0.2\,\text{mol/kg}}\right)}$$

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

Evaluate Formula

Formula

$$Z\pm = \left(\frac{t_- \cdot \nu \cdot [R] \cdot T}{EMF \cdot \nu\pm \cdot [Faraday]}\right) \cdot \ln\left(\frac{a_2}{a_1}\right)$$

Example with Units

$$2.0002 = \left(\frac{49 \cdot 110 \cdot 8.3145 \cdot 298\,\text{K}}{0.5\,\text{V} \cdot 81.35 \cdot 96485.3321}\right) \cdot \ln\left(\frac{0.36\,\text{mol/kg}}{0.2\,\text{mol/kg}}\right)$$

Variables used in list of Electrolytes & Ions Formulas above

- **a** Ionic Activity *(Mole per Kilogram)*
- a_1 Anodic Ionic Activity *(Mole per Kilogram)*
- a_2 Cathodic Ionic Activity *(Mole per Kilogram)*
- **c** Actual Concentration *(Mole per Liter)*
- **C** Hydronium Ion Concentration *(Mole per Liter)*
- c_1 Anodic Concentration *(Mole per Liter)*
- c_2 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)*
- f_1 Anodic Fugacity *(Pascal)*
- f_2 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 H_2O
- 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±** Number of Positive and Negative Ions

Constants, Functions, Measurements used in list of Electrolytes & Ions Formulas above

- constant(s): **[Faraday]**, 96485.33212
  Faraday constant
- constant(s): **[R]**, 8.31446261815324
  Universal gas constant
- Functions: **exp**, exp(Number)
  n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- Functions: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- Functions: **log10**, log10(Number)
  The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.
- Functions: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- 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

- **w** Work Done *(Kilojoule)*
- **x** Potential Gradient *(Volt per Meter)*
- **Z** Electrochemical Equivalent of Element *(Gram Per Coulomb)*
- **Z±** Valencies of Positive and Negative Ions
- **γ** Activity Coefficient
- **μ** Ionic Mobility *(Square Meter per Volt per Second)*
- **ν** Total number of Ions

- 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 (m²/V*s)
  Mobility Unit Conversion
- Measurement: **Electrochemical Equivalent** in Gram Per Coulomb (g/C)
  Electrochemical Equivalent Unit Conversion

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