Important Ionic Bonding Formulas PDF

Formulas
Examples
with Units

List of 42
Important Ionic Bonding Formulas

1) Charge of Ion given Ionic Potential Formula

Evaluate Formula

Formula

$$q = \varphi \cdot r_{ionic}$$

Example with Units

$$0.3\,\mathrm{C} = 300000\,\mathrm{V} \cdot 10000\,\mathrm{A}$$

2) Ionic Potential Formula

Evaluate Formula

Formula

$$\varphi = \frac{q}{r_{ionic}}$$

Example with Units

$$300000\,\mathrm{V} = \frac{0.3\,\mathrm{C}}{10000\,\mathrm{A}}$$

3) Radius of Ion given Ionic Potential Formula

Evaluate Formula

Formula

$$r_{ionic} = \frac{q}{\varphi}$$

Example with Units

$$10000\,\mathrm{A} = \frac{0.3\,\mathrm{C}}{300000\,\mathrm{V}}$$

4) Lattice Energy Formulas

4.1) Born Exponent using Born Lande Equation Formula

Evaluate Formula

Formula

$$n_{born} = \frac{1}{1 - \frac{-U \cdot 4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}{[\text{Avaga-no}] \cdot M \cdot \left([\text{Charge-e}]^2\right) \cdot z^+ \cdot z^-}}$$

Example with Units

$$0.9926 = \frac{1}{1 - \frac{-3500\,\mathrm{J/mol} \cdot 4 \cdot 3.1416 \cdot 8.9\mathrm{E}{-12}\,\mathrm{F/m} \cdot 60\,\mathrm{A}}{6\mathrm{E}{+23} \cdot 1.7 \cdot \left(1.6\mathrm{E}{-19}\,\mathrm{C}^2\right) \cdot 4\,\mathrm{C} \cdot 3\,\mathrm{C}}}$$

4.2) Born Exponent using Born-Lande equation without Madelung Constant Formula

Evaluate Formula

Formula

$$n_{born} = \frac{1}{1 - \frac{-U \cdot 4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}{[\text{Avaga-no}] \cdot N_{ions} \cdot 0.88 \cdot \left([\text{Charge-e}]^2\right) \cdot z^+ \cdot z^-}}$$

Example with Units

$$0.9929 = \frac{1}{1 - \frac{-3500\,\text{J/mol} \cdot 4 \cdot 3.1416 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 60\,\text{A}}{6\text{E+}23 \cdot 2 \cdot 0.88 \cdot \left(1.6\text{E-}19\,\text{C}^2\right) \cdot 4\,\text{C} \cdot 3\,\text{C}}}$$

4.3) Born Exponent using Repulsive Interaction Formula

Evaluate Formula

Formula

$$n_{born} = \frac{\log 10\left(\frac{B}{E_R}\right)}{\log 10}\left(r_0\right)$$

Example with Units

$$0.9926 = \frac{\log 10\left(\frac{40000}{5.8\text{E+}12\,\text{J}}\right)}{\log 10}\left(60\,\text{A}\right)$$

4.4) Constant depending on compressibility using Born-Mayer equation Formula

Evaluate Formula

Formula

$$\rho = \left(\left(\frac{U \cdot 4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}{[\text{Avaga-no}] \cdot M \cdot z^+ \cdot z^- \cdot \left([\text{Charge-e}]^2\right)}\right) + 1\right) \cdot r_0$$

Example with Units

$$60.4443\,\text{A} = \left(\left(\frac{3500\,\text{J/mol} \cdot 4 \cdot 3.1416 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 60\,\text{A}}{6\text{E+}23 \cdot 1.7 \cdot 4\,\text{C} \cdot 3\,\text{C} \cdot \left(1.6\text{E-}19\,\text{C}^2\right)}\right) + 1\right) \cdot 60\,\text{A}$$

4.5) Electrostatic Potential Energy between pair of Ions Formula

Evaluate Formula

Formula

$$E_{Pair} = \frac{-\left(q^2\right) \cdot \left([\text{Charge-e}]^2\right)}{4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}$$

Example with Units

$$-3.5\text{E-}21\,\text{J} = \frac{-\left(0.3\,\text{C}^2\right) \cdot \left(1.6\text{E-}19\,\text{C}^2\right)}{4 \cdot 3.1416 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 60\,\text{A}}$$

4.6) Lattice Energy using Born Lande Equation Formula

Evaluate Formula

Formula

$$U = -\frac{[\text{Avaga-no}] \cdot M \cdot z^{+} \cdot z^{-} \cdot \left([\text{Charge-e}]^2\right) \cdot \left(1 - \left(\frac{1}{n_{born}}\right)\right)}{4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}$$

Example with Units

$$3523.3429\,\text{J/mol} = -\frac{6E+23 \cdot 1.7 \cdot 4\,\text{C} \cdot 3\,\text{C} \cdot \left(1.6E\text{-}19\,\text{C}^2\right) \cdot \left(1 - \left(\frac{1}{0.9926}\right)\right)}{4 \cdot 3.1416 \cdot 8.9E\text{-}12\,\text{F/m} \cdot 60\,\text{A}}$$

4.7) Lattice Energy using Born-Lande equation using Kapustinskii Approximation Formula

Evaluate Formula

Formula

$$U = -\frac{[\text{Avaga-no}] \cdot N_{ions} \cdot 0.88 \cdot z^{+} \cdot z^{-} \cdot \left([\text{Charge-e}]^2\right) \cdot \left(1 - \left(\frac{1}{n_{born}}\right)\right)}{4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}$$

Example with Units

$$3647.6962\,\text{J/mol} = -\frac{6E+23 \cdot 2 \cdot 0.88 \cdot 4\,\text{C} \cdot 3\,\text{C} \cdot \left(1.6E\text{-}19\,\text{C}^2\right) \cdot \left(1 - \left(\frac{1}{0.9926}\right)\right)}{4 \cdot 3.1416 \cdot 8.9E\text{-}12\,\text{F/m} \cdot 60\,\text{A}}$$

4.8) Lattice Energy using Born-Mayer equation Formula

Evaluate Formula

Formula

$$U = \frac{-[\text{Avaga-no}] \cdot M \cdot z^{+} \cdot z^{-} \cdot \left([\text{Charge-e}]^2\right) \cdot \left(1 - \left(\frac{\rho}{r_0}\right)\right)}{4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}$$

Example with Units

$$3465.7632\,\text{J/mol} = \frac{-6E+23 \cdot 1.7 \cdot 4\,\text{C} \cdot 3\,\text{C} \cdot \left(1.6E\text{-}19\,\text{C}^2\right) \cdot \left(1 - \left(\frac{60.44\,\text{A}}{60\,\text{A}}\right)\right)}{4 \cdot 3.1416 \cdot 8.9E\text{-}12\,\text{F/m} \cdot 60\,\text{A}}$$

4.9) Lattice Energy using Kapustinskii equation Formula

Evaluate Formula

Formula

$$U_{Kapustinskii} = \frac{1.20200 \cdot \left(10^{-4}\right) \cdot N_{ions} \cdot z^{+} \cdot z^{-} \cdot \left(1 - \left(\frac{3.45 \cdot \left(10^{-11}\right)}{R_c + R_a}\right)\right)}{R_c + R_a}$$

Example with Units

$$246889.0155\,\text{J/mol} = \frac{1.20200 \cdot \left(10^{-4}\right) \cdot 2 \cdot 4\,\text{C} \cdot 3\,\text{C} \cdot \left(1 - \left(\frac{3.45 \cdot \left(10^{-11}\right)}{65\,\text{A} + 51.5\,\text{A}}\right)\right)}{65\,\text{A} + 51.5\,\text{A}}$$

4.10) Lattice Energy using Lattice Enthalpy Formula

Evaluate Formula

Formula

$$U = \Delta H - \left(p_{LE} \cdot V_{m\_LE}\right)$$

Example with Units

$$3500\,\text{J/mol} = 21420\,\text{J/mol} - \left(800\,\text{Pa} \cdot 22.4\,\text{m}^3\text{/mol}\right)$$

4.11) Lattice Energy using Original Kapustinskii equation Formula

Evaluate Formula

Formula

$$U_{Kapustinskii} = \frac{\left(\left(\frac{[\text{Kapustinskii\_C}]}{1.20200}\right) \cdot 1.079\right) \cdot N_{ions} \cdot z^{+} \cdot z^{-}}{R_c + R_a}$$

Example with Units

$$222283.2618\,\text{J/mol} = \frac{\left(\left(\frac{0.0001}{1.20200}\right) \cdot 1.079\right) \cdot 2 \cdot 4\,\text{C} \cdot 3\,\text{C}}{65\,\text{A} + 51.5\,\text{A}}$$

4.12) Lattice Enthalpy using Lattice Energy Formula

Evaluate Formula

Formula

$$\Delta H = U + \left(p_{LE} \cdot V_{m\_LE}\right)$$

Example with Units

$$21420\,\text{J/mol} = 3500\,\text{J/mol} + \left(800\,\text{Pa} \cdot 22.4\,\text{m}^3\text{/mol}\right)$$

4.13) Minimum Potential Energy of Ion Formula

Evaluate Formula

Formula

$$E_{min} = \left(\frac{-\left(q^2\right) \cdot \left([\text{Charge-e}]^2\right) \cdot M}{4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}\right) + \left(\frac{B}{r_0^{\,n_{born}}}\right)$$

Example with Units

$$5.8\text{E}{+}12\,\text{J} = \left(\frac{-\left(0.3\,\text{C}^2\right) \cdot \left(1.6\text{E-}19\,\text{C}^2\right) \cdot 1.7}{4 \cdot 3.1416 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 60\,\text{A}}\right) + \left(\frac{40000}{60\,\text{A}^{0.9926}}\right)$$

4.14) Number of Ions using Kapustinskii Approximation Formula

Evaluate Formula

Formula

$$N_{ions} = \frac{M}{0.88}$$

Example

$$1.9318 = \frac{1.7}{0.88}$$

4.15) Outer Pressure of Lattice Formula

Evaluate Formula

Formula

$$p_{LE} = \frac{\Delta H - U}{V_{m\_LE}}$$

Example with Units

$$800\,\text{Pa} = \frac{21420\,\text{J/mol} - 3500\,\text{J/mol}}{22.4\,\text{m}^3\text{/mol}}$$

4.16) Repulsive Interaction Formula

Evaluate Formula

Formula

$$E_R = \frac{B}{r_0^{\,n_{born}}}$$

Example with Units

$$5.8E{+}12\,\text{J} = \frac{40000}{60\,\text{A}^{\,0.9926}}$$

4.17) Repulsive Interaction Constant Formula

Evaluate Formula

Formula

$$B = E_R \cdot \left(r_0^{\,n_{born}} \right)$$

Example with Units

$$40033.257 = 5.8E{+}12\,\text{J} \cdot \left(60\,\text{A}^{\,0.9926} \right)$$

4.18) Repulsive Interaction Constant given Madelung constant Formula

Evaluate Formula

Formula

$$B_M = \frac{M \cdot \left(q^2 \right) \cdot \left([\text{Charge-e}]^2 \right) \cdot \left(r_0^{\,n_{born} - 1} \right)}{4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot n_{born}}$$

Example with Units

$$4.1E{-}29 = \frac{1.7 \cdot \left(0.3\,\text{C}^2 \right) \cdot \left(1.6E{-}19\,\text{C}^2 \right) \cdot \left(60\,\text{A}^{\,0.9926 - 1} \right)}{4 \cdot 3.1416 \cdot 8.9E{-}12\,\text{F/m} \cdot 0.9926}$$

4.19) Repulsive Interaction Constant given Total Energy of Ion and Madelung Energy Formula

Evaluate Formula

Formula

$$B = \left(E_{total} - \left(E_M \right) \right) \cdot \left(r_0^{\,n_{born}} \right)$$

Example with Units

$$39964.2342 = \left(5.79E{+}12\,\text{J} - \left(-5.9E{-}21\,\text{J} \right) \right) \cdot \left(60\,\text{A}^{\,0.9926} \right)$$

4.20) Repulsive Interaction Constant using Total Energy of Ion Formula

Evaluate Formula

Formula

$$B = \left(E_{total} - \left(- \frac{M \cdot \left(q^2\right) \cdot \left([Charge\text{-}e]^2\right)}{4 \cdot \pi \cdot [Permitivity\text{-}vacuum] \cdot r_0} \right) \right) \cdot \left(r_0^{\,n_{born}} \right)$$

Example with Units

$$39964.2342 = \left(5.79E{+}12\,J - \left(- \frac{1.7 \cdot \left(0.3\,C^2\right) \cdot \left(1.6E{-}19\,C^2\right)}{4 \cdot 3.1416 \cdot 8.9E{-}12\,F/m \cdot 60\,A} \right) \right) \cdot \left(60\,A^{0.9926} \right)$$

4.21) Repulsive Interaction using Total Energy of Ion Formula

Evaluate Formula

Formula

$$E_R = E_{total} - \left(E_M \right)$$

Example with Units

$$5.8E{+}12\,J = 5.79E{+}12\,J - \left(-5.9E{-}21\,J \right)$$

4.22) Repulsive Interaction using Total Energy of ion given charges and distances Formula

Evaluate Formula

Formula

$$E_R = E_{total} - \frac{-\left(q^2\right) \cdot \left([Charge\text{-}e]^2\right) \cdot M}{4 \cdot \pi \cdot [Permitivity\text{-}vacuum] \cdot r_0}$$

Example with Units

$$5.8E{+}12\,J = 5.79E{+}12\,J - \frac{-\left(0.3\,C^2\right) \cdot \left(1.6E{-}19\,C^2\right) \cdot 1.7}{4 \cdot 3.1416 \cdot 8.9E{-}12\,F/m \cdot 60\,A}$$

4.23) Total Energy of Ion given Charges and Distances Formula

Evaluate Formula

Formula

$$E_{total} = \left(\frac{-\left(q^2\right) \cdot \left([Charge\text{-}e]^2\right) \cdot M}{4 \cdot \pi \cdot [Permitivity\text{-}vacuum] \cdot r_0} \right) + \left(\frac{B}{r_0^{\,n_{born}}} \right)$$

Example with Units

$$5.8E{+}12\,J = \left(\frac{-\left(0.3\,C^2\right) \cdot \left(1.6E{-}19\,C^2\right) \cdot 1.7}{4 \cdot 3.1416 \cdot 8.9E{-}12\,F/m \cdot 60\,A} \right) + \left(\frac{40000}{60\,A^{0.9926}} \right)$$

4.24) Total Energy of Ion in Lattice Formula

Evaluate Formula

Formula

$$E_{total} = E_M + E_R$$

Example with Units

$$5.8E{+}12\,J = -5.9E{-}21\,J + 5.8E{+}12\,J$$

4.25) Volume change of lattice Formula

Evaluate Formula

Formula

$$V_{m\_LE} = \frac{\Delta H - U}{p_{LE}}$$

Example with Units

$$22.4\,\mathrm{m^3/mol} = \frac{21420\,\mathrm{J/mol} - 3500\,\mathrm{J/mol}}{800\,\mathrm{Pa}}$$

4.26) Distance of Closest Approach Formulas

4.26.1) Distance of Closest Approach using Born Lande equation Formula

Evaluate Formula

Formula

$$r_0 = -\frac{[\text{Avaga-no}] \cdot M \cdot z^{+} \cdot z^{-} \cdot \left([\text{Charge-e}]^2\right) \cdot \left(1 - \left(\frac{1}{n_{born}}\right)\right)}{4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot U}$$

Example with Units

$$60.4002\,\mathrm{A} = -\frac{6E{+}23 \cdot 1.7 \cdot 4\,\mathrm{C} \cdot 3\,\mathrm{C} \cdot \left(1.6E{-}19\,\mathrm{C}^2\right) \cdot \left(1 - \left(\frac{1}{0.9926}\right)\right)}{4 \cdot 3.1416 \cdot 8.9E{-}12\,\mathrm{F/m} \cdot 3500\,\mathrm{J/mol}}$$

4.26.2) Distance of Closest Approach using Born-Lande Equation without Madelung Constant Formula

Evaluate Formula

Formula

$$r_0 = -\frac{[\text{Avaga-no}] \cdot N_{ions} \cdot 0.88 \cdot z^{+} \cdot z^{-} \cdot \left([\text{Charge-e}]^2\right) \cdot \left(1 - \left(\frac{1}{n_{born}}\right)\right)}{4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot U}$$

Example with Units

$$62.5319\,\mathrm{A} = -\frac{6E{+}23 \cdot 2 \cdot 0.88 \cdot 4\,\mathrm{C} \cdot 3\,\mathrm{C} \cdot \left(1.6E{-}19\,\mathrm{C}^2\right) \cdot \left(1 - \left(\frac{1}{0.9926}\right)\right)}{4 \cdot 3.1416 \cdot 8.9E{-}12\,\mathrm{F/m} \cdot 3500\,\mathrm{J/mol}}$$

4.26.3) Distance of Closest Approach using Electrostatic Potential Formula

Evaluate Formula

Formula

$$r_0 = \frac{-\left(q^2\right) \cdot \left([\text{Charge-e}]^2\right)}{4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot E_{Pair}}$$

Example with Units

$$59.3529\,\mathrm{A} = \frac{-\left(0.3\,\mathrm{C}^2\right) \cdot \left(1.6E{-}19\,\mathrm{C}^2\right)}{4 \cdot 3.1416 \cdot 8.9E{-}12\,\mathrm{F/m} \cdot -3.5E{-}21\,\mathrm{J}}$$

4.26.4) Distance of Closest Approach using Madelung Energy Formula

Evaluate Formula

Formula

$$r_0 = -\frac{M \cdot \left(q^2\right) \cdot \left([\text{Charge-e}]^2\right)}{4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot E_M}$$

Example with Units

$$59.8559\,\text{A} = -\frac{1.7 \cdot \left(0.3\,\text{C}^2\right) \cdot \left(1.6\text{E-}19\,\text{C}^2\right)}{4 \cdot 3.1416 \cdot 8.9\text{E-}12\,\text{F/m} \cdot -5.9\text{E-}21\,\text{J}}$$

4.27) Madelung Constant Formulas

4.27.1) Madelung Constant given Repulsive Interaction Constant Formula

Evaluate Formula

Formula

$$M = \frac{B_M \cdot 4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot n_{born}}{\left(q^2\right) \cdot \left([\text{Charge-e}]^2\right) \cdot \left(r_0^{\,n_{born} - 1}\right)}$$

Example with Units

$$1.703 = \frac{4.1\text{E-}29 \cdot 4 \cdot 3.1416 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 0.9926}{\left(0.3\,\text{C}^2\right) \cdot \left(1.6\text{E-}19\,\text{C}^2\right) \cdot \left(60\,\text{A}^{0.9926 - 1}\right)}$$

4.27.2) Madelung Constant using Born Lande Equation Formula

Evaluate Formula

Formula

$$M = \frac{-U \cdot 4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}{\left(1 - \left(\frac{1}{n_{born}}\right)\right) \cdot \left([\text{Charge-e}]^2\right) \cdot [\text{Avaga-no}] \cdot z^+ \cdot z^-}$$

Example with Units

$$1.6887 = \frac{-3500\,\text{J/mol} \cdot 4 \cdot 3.1416 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 60\,\text{A}}{\left(1 - \left(\frac{1}{0.9926}\right)\right) \cdot \left(1.6\text{E-}19\,\text{C}^2\right) \cdot 6\text{E+}23 \cdot 4\,\text{C} \cdot 3\,\text{C}}$$

4.27.3) Madelung Constant using Born-Mayer equation Formula

Evaluate Formula

Formula

$$M = \frac{-U \cdot 4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}{[\text{Avaga-no}] \cdot z^+ \cdot z^- \cdot \left([\text{Charge-e}]^2\right) \cdot \left(1 - \left(\frac{\rho}{r_0}\right)\right)}$$

Example with Units

$$1.7168 = \frac{-3500\,\text{J/mol} \cdot 4 \cdot 3.1416 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 60\,\text{A}}{6\text{E+}23 \cdot 4\,\text{C} \cdot 3\,\text{C} \cdot \left(1.6\text{E-}19\,\text{C}^2\right) \cdot \left(1 - \left(\frac{60.44\,\text{A}}{60\,\text{A}}\right)\right)}$$

4.27.4) Madelung Constant using Kapustinskii Approximation Formula

Evaluate Formula

Formula

$$M = 0.88 \cdot N_{ions}$$

Example

$$1.76 = 0.88 \cdot 2$$

4.27.5) Madelung Constant using Madelung Energy Formula

Evaluate Formula

Formula

$$M = \frac{-\left(E_M\right) \cdot 4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}{\left(q^2\right) \cdot \left([\text{Charge-e}]^2\right)}$$

Example with Units

$$1.7041 = \frac{-\left(-5.9\text{E-}21\,\text{J}\right) \cdot 4 \cdot 3.1416 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 60\,\text{A}}{\left(0.3\,\text{C}^2\right) \cdot \left(1.6\text{E-}19\,\text{C}^2\right)}$$

4.27.6) Madelung Constant using Total Energy of Ion Formula

Evaluate Formula

Formula

$$M = \frac{\left(E_{tot} - \left(\frac{B_M}{r_0^{n_{born}}}\right)\right) \cdot 4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}{-\left(q^2\right) \cdot \left([\text{Charge-e}]^2\right)}$$

Example with Units

$$1.6954 = \frac{\left(7.02\text{E-}23\,\text{J} - \left(\frac{4.1\text{E-}29}{60\,\text{A}^{0.9926}}\right)\right) \cdot 4 \cdot 3.1416 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 60\,\text{A}}{-\left(0.3\,\text{C}^2\right) \cdot \left(1.6\text{E-}19\,\text{C}^2\right)}$$

4.27.7) Madelung Constant using Total Energy of Ion given Repulsive Interaction Formula

Evaluate Formula

Formula

$$M = \frac{\left(E_{tot} - E\right) \cdot 4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}{-\left(q^2\right) \cdot \left([\text{Charge-e}]^2\right)}$$

Example with Units

$$1.6925 = \frac{\left(7.02\text{E-}23\,\text{J} - 5.93\text{E-}21\,\text{J}\right) \cdot 4 \cdot 3.1416 \cdot 8.9\text{E-}12\,\text{F/m} \cdot 60\,\text{A}}{-\left(0.3\,\text{C}^2\right) \cdot \left(1.6\text{E-}19\,\text{C}^2\right)}$$

4.27.8) Madelung Energy Formula

Evaluate Formula

Formula

$$E_M = -\frac{M \cdot \left(q^2\right) \cdot \left([\text{Charge-e}]^2\right)}{4 \cdot \pi \cdot [\text{Permitivity-vacuum}] \cdot r_0}$$

Example with Units

$$-5.9E\text{-}21\,\text{J} = -\frac{1.7 \cdot \left(0.3\,\text{C}^2\right) \cdot \left(1.6E\text{-}19\,\text{C}^2\right)}{4 \cdot 3.1416 \cdot 8.9E\text{-}12\,\text{F/m} \cdot 60\,\text{A}}$$

4.27.9) Madelung Energy using Total Energy of Ion Formula

Evaluate Formula

Formula

$$E_M = E_{tot} - E$$

Example with Units

$$-5.9E\text{-}21\,\text{J} = 7.02E\text{-}23\,\text{J} - 5.93E\text{-}21\,\text{J}$$

4.27.10) Madelung Energy using Total Energy of Ion given Distance Formula

Evaluate Formula

Formula

$$E_M = E_{tot} - \left(\frac{B_M}{r_0^{\,n_{born}}}\right)$$

Example with Units

$$-5.9E\text{-}21\,\text{J} = 7.02E\text{-}23\,\text{J} - \left(\frac{4.1E\text{-}29}{60\,\text{A}^{0.9926}}\right)$$

Variables used in list of Ionic Bonding Formulas above

- **B** Repulsive Interaction Constant
- **B_M** Repulsive Interaction Constant given M
- **E** Repulsive Interaction between Ions *(Joule)*
- **E_M** Madelung Energy *(Joule)*
- **E_{min}** Minimum Potential Energy of Ion *(Joule)*
- **E_{Pair}** Electrostatic Potential Energy between Ion Pair *(Joule)*
- **E_R** Repulsive Interaction *(Joule)*
- **E_{tot}** Total energy of Ion in an Ionic Crystal *(Joule)*
- **E_{total}** Total Energy of Ion *(Joule)*
- **M** Madelung Constant
- **n_{born}** Born Exponent
- **N_{ions}** Number of Ions
- **p_{LE}** Pressure Lattice Energy *(Pascal)*
- **q** Charge *(Coulomb)*
- **r_0** Distance of Closest Approach *(Angstrom)*
- **R_a** Radius of Anion *(Angstrom)*
- **R_c** Radius of Cation *(Angstrom)*
- **r_{ionic}** Ionic Radius *(Angstrom)*
- **U** Lattice Energy *(Joule per Mole)*
- **$U_{Kapustinskii}$** Lattice Energy for Kapustinskii Equation *(Joule per Mole)*
- **V_{m_LE}** Molar Volume Lattice Energy *(Cubic Meter per Mole)*
- **z^-** Charge of Anion *(Coulomb)*
- **z^+** Charge of Cation *(Coulomb)*
- **ΔH** Lattice Enthalpy *(Joule per Mole)*
- **ρ** Constant Depending on Compressibility *(Angstrom)*
- **φ** Ionic Potential *(Volt)*

Constants, Functions, Measurements used in list of Ionic Bonding Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- constant(s): **[Avaga-no]**, 6.02214076E+23
  Avogadro's number
- constant(s): **[Charge-e]**, 1.60217662E-19
  Charge of electron
- constant(s): **[Kapustinskii_C]**, 1.20200E-4
  Kapustinskii constant
- constant(s): **[Permitivity-vacuum]**, 8.85E-12
  Permittivity of vacuum
- 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.
- Measurement: **Length** in Angstrom (A)
  Length Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Energy** in Joule (J)
  Energy Unit Conversion
- Measurement: **Electric Charge** in Coulomb (C)
  Electric Charge Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion
- Measurement: **Molar Magnetic Susceptibility** in Cubic Meter per Mole (m^3/mol)
  Molar Magnetic Susceptibility Unit Conversion
- Measurement: **Molar Enthalpy** in Joule per Mole (J/mol)
  Molar Enthalpy Unit Conversion

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- **Percentage decrease**
- **HCF of three numbers**
- **Multiply fraction**

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