Important Electronegativity Formulas PDF

Formulas
Examples
with Units

List of 36
Important Electronegativity Formulas

1) 100 percent Covalent Bond Energy as Arithmetic Mean Formula

Evaluate Formula

Formula

$$E_{A\text{-}B(cov)} = 0.5 \cdot \left(E_{A\text{-}A} + E_{B\text{-}B} \right)$$

Example with Units

$$23.5\,\text{J} = 0.5 \cdot \left(20\,\text{J} + 27\,\text{J} \right)$$

2) 100 percent Covalent Bond Energy as Geometric Mean Formula

Evaluate Formula

Formula

$$E_{A\text{-}B(cov)} = \sqrt{E_{A\text{-}A} \cdot E_{B\text{-}B}}$$

Example with Units

$$23.2379\,\text{J} = \sqrt{20\,\text{J} \cdot 27\,\text{J}}$$

3) 100 percent Covalent Bond Energy given Covalent Ionic Resonance Energy Formula

Evaluate Formula

Formula

$$E_{A\text{-}B(cov)} = E_{A\text{-}B} - \Delta$$

Example with Units

$$23.4\,\text{J} = 28.4\,\text{J} - 5\,\text{J}$$

4) Actual Bond Energy given Covalent Ionic Resonance Energy Formula

Evaluate Formula

Formula

$$E_{A\text{-}B} = \Delta + E_{A\text{-}B(cov)}$$

Example with Units

$$28.35\,\text{J} = 5\,\text{J} + 23.35\,\text{J}$$

5) Covalent Ionic Resonance Energy Formula

Evaluate Formula

Formula

$$\Delta = E_{A\text{-}B} - E_{A\text{-}B(cov)}$$

Example with Units

$$5.05\,\text{J} = 28.4\,\text{J} - 23.35\,\text{J}$$

6) Covalent Ionic Resonance Energy using Bond Energies Formula

Evaluate Formula

Formula

$$\Delta = E_{A\text{-}B} - \sqrt{E_{A\text{-}A} \cdot E_{B\text{-}B}}$$

Example with Units

$$5.1621\,\text{J} = 28.4\,\text{J} - \sqrt{20\,\text{J} \cdot 27\,\text{J}}$$

7) Fractional Charge Formula

Evaluate Formula

Formula

$$\delta = \frac{\mu}{e \cdot d}$$

Example with Units

$$0.2083 = \frac{10\text{E-}18\,\text{stC*cm}}{4.8\text{E-}10\,\text{stC} \cdot 10\,\text{A}}$$

8) Allred Rochow's Electronegativity Formulas

8.1) Allred Rochow's Electronegativity from Mulliken's Electronegativity Formula

Evaluate Formula

Formula

$$X_{A.R} = \left(0.336 \cdot X_M\right) - 0.2 - 0.744$$

Example with Units

$$6.448\,\text{J} = \left(0.336 \cdot 22\,\text{J}\right) - 0.2 - 0.744$$

8.2) Allred Rochow's Electronegativity from Pauling's Electronegativity Formula

Evaluate Formula

Formula

$$X_{A.R} = X_P - 0.744$$

Example with Units

$$6.496\,\text{J} = 7.24\,\text{J} - 0.744$$

8.3) Allred Rochow's Electronegativity given IE and EA Formula

Evaluate Formula

Formula

$$X_{A.R} = \left(\left(0.336 \cdot 0.5\right) \cdot \left(IE + E.A\right)\right) - 0.2 - 0.744$$

Example with Units

$$6.4984\,\text{J} = \left(\left(0.336 \cdot 0.5\right) \cdot \left(27.2\,\text{J} + 17.1\,\text{J}\right)\right) - 0.2 - 0.744$$

8.4) Allred Rochow's Electronegativity of Element Formula

Evaluate Formula

Formula

$$X_{A.R} = \frac{0.359 \cdot Z^2}{r_{covalent}}$$

Example with Units

$$6.4457\,\text{J} = \frac{0.359 \cdot 25^2}{1.18\,\text{A}}$$

8.5) Allred Rochow's Electronegativity using Bond Energies Formula

Evaluate Formula

Formula

$$X_{A.R} = \sqrt{E_{(A-B)} - \sqrt{E_{A-A} \cdot E_{B-B}}} - 0.744$$

Example with Units

$$6.4832\,\text{J} = \sqrt{75.47\,\text{J} - \sqrt{20\,\text{J} \cdot 27\,\text{J}}} - 0.744$$

8.6) Covalent Radius from Allred Rochow's Electronegativity Formula

Evaluate Formula

Formula

$$r_{covalent} = \sqrt{\frac{0.359 \cdot Z}{X_{A.R}}}$$

Example with Units

$$1.1751\,\text{A} = \sqrt{\frac{0.359 \cdot 25}{6.5\,\text{J}}}$$

8.7) Effective Nuclear Charge from Allred Rochow's Electronegativity Formula

Evaluate Formula

Formula

$$Z = \frac{X_{A.R} \cdot r_{covalent} \cdot r_{covalent}}{0.359}$$

Example with Units

$$25.2106 = \frac{6.5\,\text{J} \cdot 1.18\,\text{A} \cdot 1.18\,\text{A}}{0.359}$$

8.8) Electron Affinity of Element using Allred Rochow's Electronegativity Formula

Evaluate Formula

Formula

$$E.A = \left(\left(X_{A.R} + 0.744 + 0.2 \right) \cdot \left(\frac{2}{0.336} \right) \right) - IE$$

Example with Units

$$17.1095\,\text{J} = \left(\left(6.5\,\text{J} + 0.744 + 0.2 \right) \cdot \left(\frac{2}{0.336} \right) \right) - 27.2\,\text{J}$$

8.9) Ionization Energy using Allred Rochow's Electronegativity Formula

Evaluate Formula

Formula

$$IE = \left(\left(X_{A.R} + 0.744 + 0.2 \right) \cdot \left(\frac{2}{0.336} \right) \right) - E.A$$

Example with Units

$$27.2095\,\text{J} = \left(\left(6.5\,\text{J} + 0.744 + 0.2 \right) \cdot \left(\frac{2}{0.336} \right) \right) - 17.1\,\text{J}$$

9) Mulliken's Electronegativity Formulas

9.1) Covalent Radius given Mulliken's Electronegativity Formula

Evaluate Formula

Formula

$$r_{covalent} = \sqrt{\frac{0.359 \cdot Z}{\left(0.336 \cdot X_M \right) - 0.2 - 0.744}}$$

Example with Units

$$1.1798\,\text{A} = \sqrt{\frac{0.359 \cdot 25}{\left(0.336 \cdot 22\,\text{J} \right) - 0.2 - 0.744}}$$

9.2) Effective Nuclear Charge given Mulliken's Electronegativity Formula

Evaluate Formula

Formula

$$Z = \frac{\left(\left(0.336 \cdot X_M \right) - 0.2 - 0.744 \right) \cdot \left(r_{covalent}^{\,2} \right)}{0.359}$$

Example with Units

$$25.0089 = \frac{\left(\left(0.336 \cdot 22\,\text{J} \right) - 0.2 - 0.744 \right) \cdot \left(1.18\,\text{A}^{\,2} \right)}{0.359}$$

9.3) Electron Affinity of element using Mulliken's Electronegativity Formula

Evaluate Formula

Formula

$$E.A = \left(2 \cdot X_M \right) - IE$$

Example with Units

$$16.8\,\text{J} = \left(2 \cdot 22\,\text{J} \right) - 27.2\,\text{J}$$

9.4) Ionization Energy of element using Mulliken's Electronegativity Formula

Evaluate Formula

Formula

$$IE = \left(2 \cdot X_M\right) - E.A$$

Example with Units

$$26.9\,\text{J} = \left(2 \cdot 22\,\text{J}\right) - 17.1\,\text{J}$$

9.5) Mulliken's Electronegativity from Allred Rochow's Electronegativity Formula

Evaluate Formula

Formula

$$X_M = \frac{X_{A.R} + 0.744 + 0.2}{0.336}$$

Example with Units

$$22.1548\,\text{J} = \frac{6.5\,\text{J} + 0.744 + 0.2}{0.336}$$

9.6) Mulliken's Electronegativity from Pauling's Electronegativity Formula

Evaluate Formula

Formula

$$X_M = \frac{X_P + 0.2}{0.336}$$

Example with Units

$$22.1429\,\text{J} = \frac{7.24\,\text{J} + 0.2}{0.336}$$

9.7) Mulliken's Electronegativity given Bond Energies Formula

Evaluate Formula

Formula

$$X_M = \frac{\sqrt{E_{(A\text{-}B)} - \sqrt{E_{A\text{-}A} \cdot E_{B\text{-}B}}} + 0.2}{0.336}$$

Example with Units

$$22.1047\,\text{J} = \frac{\sqrt{75.47\,\text{J} - \sqrt{20\,\text{J} \cdot 27\,\text{J}}} + 0.2}{0.336}$$

9.8) Mulliken's Electronegativity given Effective Nuclear Charge and Covalent Radius Formula

Evaluate Formula

Formula

$$X_M = \frac{\left(\frac{0.359 \cdot Z}{r_{covalent}^2}\right) + 0.744 + 0.2}{0.336}$$

Example with Units

$$21.9932\,\text{J} = \frac{\left(\frac{0.359 \cdot 25}{1.18\,\text{A}^2}\right) + 0.744 + 0.2}{0.336}$$

9.9) Mulliken's Electronegativity of Element Formula

Evaluate Formula

Formula

$$X_M = 0.5 \cdot \left(IE + E.A\right)$$

Example with Units

$$22.15\,\text{J} = 0.5 \cdot \left(27.2\,\text{J} + 17.1\,\text{J}\right)$$

10) Pauling's Electronegativity Formulas

10.1) Covalent Ionic Resonance Energy using Pauling's Electronegativity Formula

Evaluate Formula

Formula

$$\Delta_p = X_P^2$$

Example with Units

$$52.4176\,\text{J} = 7.24\,\text{J}^2$$

10.2) Covalent Radius given Pauling's Electronegativity Formula

Evaluate Formula

Formula

$$r_{covalent} = \sqrt{\frac{0.359 \cdot Z}{X_P - 0.744}}$$

Example with Units

$$1.1754_{A} = \sqrt{\frac{0.359 \cdot 25}{7.24_{J} - 0.744}}$$

10.3) Effective Nuclear Charge given Pauling's Electronegativity Formula

Evaluate Formula

Formula

$$Z = \frac{\left(X_P - 0.744\right) \cdot \left(r_{covalent}^{2}\right)}{0.359}$$

Example with Units

$$25.1951 = \frac{\left(7.24_{J} - 0.744\right) \cdot \left(1.18_{A}^{2}\right)}{0.359}$$

10.4) Electron Affinity of element using Pauling's Electronegativity Formula

Evaluate Formula

Formula

$$E.A = \left(\left(X_P + 0.2\right) \cdot \left(\frac{2}{0.336}\right)\right) - IE$$

Example with Units

$$17.0857_{J} = \left(\left(7.24_{J} + 0.2\right) \cdot \left(\frac{2}{0.336}\right)\right) - 27.2_{J}$$

10.5) Ionization Energy of Element using Pauling's Electronegativity Formula

Evaluate Formula

Formula

$$IE = \left(\left(X_P + 0.2\right) \cdot \left(\frac{2}{0.336}\right)\right) - E.A$$

Example with Units

$$27.1857_{J} = \left(\left(7.24_{J} + 0.2\right) \cdot \left(\frac{2}{0.336}\right)\right) - 17.1_{J}$$

10.6) Pauling's Electronegativity from Allred Rochow's Electronegativity Formula

Evaluate Formula

Formula

$$X_P = X_{A.R} + 0.744$$

Example with Units

$$7.244_{J} = 6.5_{J} + 0.744$$

10.7) Pauling's Electronegativity from Mulliken's Electronegativity Formula

Evaluate Formula

Formula

$$X_P = \left(0.336 \cdot X_M\right) - 0.2$$

Example with Units

$$7.192_{J} = \left(0.336 \cdot 22_{J}\right) - 0.2$$

10.8) Pauling's Electronegativity given Bond Energies Formula

Evaluate Formula

Formula

$$X_P = \sqrt{E_{(A-B)} - \left(\sqrt{E_{A-A} \cdot E_{B-B}}\right)}$$

Example with Units

$$7.2272_{J} = \sqrt{75.47_{J} - \left(\sqrt{20_{J} \cdot 27_{J}}\right)}$$

10.9) Pauling's Electronegativity given Effective Nuclear Charge and Covalent Radius Formula

Evaluate Formula

Formula

$$X_P = \left(\frac{0.359 \cdot Z^2}{r_{covalent}}\right) + 0.744$$

Example with Units

$$7.1897_{J} = \left(\frac{0.359 \cdot 25}{1.18_{A}^2}\right) + 0.744$$

10.10) Pauling's Electronegativity given IE and EA Formula

Evaluate Formula

Formula

$$X_p = \left(\left(\frac{0.336}{0.5}\right) \cdot \left(IE + E.A\right)\right) - 0.2$$

Example with Units

$$29.5696_{J} = \left(\left(\frac{0.336}{0.5}\right) \cdot \left(27.2_{J} + 17.1_{J}\right)\right) - 0.2$$

10.11) Pauling's Electronegativity given Individual Electronegativities Formula

Evaluate Formula

Formula

$$X = \left|X_A - X_B\right|$$

Example with Units

$$0.2_{J} = \left|3.6_{J} - 3.8_{J}\right|$$

Variables used in list of Electronegativity Formulas above

- **d** Bond Length of Diatomic Molecule *(Angstrom)*
- **e** Charge of electron in Statcoulomb *(Statcoulomb)*
- $E_{(A-B)}$ Actual Bond Energy given Electronegativity *(Joule)*
- E_{A-A} Bond Energy of A_2 Molecule *(Joule)*
- E_{A-B} Actual Bond Energy *(Joule)*
- $E_{A-B(cov)}$ 100% Covalent Bond Energy *(Joule)*
- E_{B-B} Bond Energy of B_2 Molecule *(Joule)*
- **E.A** Electron Affinity *(Joule)*
- **IE** Ionization Energy *(Joule)*
- $r_{covalent}$ Covalent Radius *(Angstrom)*
- **X** X_p given Individual Electronegativities *(Joule)*
- X_A Electronegativity of Element A *(Joule)*
- $X_{A.R}$ Allred-Rochow's Electronegativity *(Joule)*
- X_B Electronegativity of Element B *(Joule)*
- X_M Mulliken's Electronegativity *(Joule)*
- X_p Pauling's Electronegativity given I.E and E.A *(Joule)*
- X_P Pauling's Electronegativity *(Joule)*
- **Z** Effective Nuclear Charge
- **δ** Charge Fraction
- **Δ** Covalent Ionic Resonance Energy *(Joule)*
- Δ_p Covalent Ionic Resonance Energy for X_p *(Joule)*
- **μ** Dipole Moment *(Statcoulomb Centimeter)*

Constants, Functions, Measurements used in list of Electronegativity Formulas above

- Functions: **abs**, abs(Number)
  The absolute value of a number is its distance from zero on the number line. It's always a positive value, as it represents the magnitude of a number without considering its direction.
- 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: **Length** in Angstrom (A)
  Length Unit Conversion
- Measurement: **Energy** in Joule (J)
  Energy Unit Conversion
- Measurement: **Electric Charge** in Statcoulomb (stC)
  Electric Charge Unit Conversion
- Measurement: **Electric Dipole Moment** in Statcoulomb Centimeter (stC*cm)
  Electric Dipole Moment Unit Conversion

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