Important Photon and Atomic Physics Formulas PDF

Formulas
Examples
with Units

List of 18
Important Photon and Atomic Physics Formulas

1) Atomic Structure Formulas

1.1) Angle between Incident Ray and Scattering Planes in X-ray Diffraction Formula

Evaluate Formula

Formula

$$\theta = a\sin\left(\frac{n_{order} \cdot \lambda_{x\text{-}ray}}{2 \cdot d}\right)$$

Example with Units

$$40.0052° = a\sin\left(\frac{2 \cdot 0.45\,nm}{2 \cdot 0.7\,nm}\right)$$

1.2) Energy in Nth Bohr's Orbit Formula

Evaluate Formula

Formula

$$E_n = -\frac{13.6 \cdot \left(Z^2\right)}{n_{level}^2}$$

Example with Units

$$-408.9906\,J = -\frac{13.6 \cdot \left(17^2\right)}{3.1^2}$$

1.3) Minimum Wavelength in X-ray Spectrum Formula

Evaluate Formula

Formula

$$\lambda_{min} = h \cdot 3 \cdot \frac{10^8}{1.60217662 \cdot 10^{-19} \cdot v}$$

Example with Units

$$1E{+}35\,nm = 6.63 \cdot 3 \cdot \frac{10^8}{1.60217662 \cdot 10^{-19} \cdot 120\,V}$$

1.4) Moseley's Law Formula

Evaluate Formula

Formula

$$v_{sqrt} = a \cdot (Z - b)$$

Example

$$15 = 3 \cdot (17 - 12)$$

1.5) Photon Energy in State Transition Formula

Evaluate Formula

Formula

$$E_\gamma = h \cdot v_{photon}$$

Example with Units

$$1E{+}36\,J = 6.63 \cdot 1.56E35\,Hz$$

1.6) Quantization of Angular Momentum Formula

Evaluate Formula

Formula

$$l_Q = \frac{n \cdot h}{2 \cdot \pi}$$

Example

$$22.0536 = \frac{20.9 \cdot 6.63}{2 \cdot 3.1416}$$

1.7) Radius of Nth Bohr's Orbit Formula

Evaluate Formula

Formula

$$r = \frac{n^2 \cdot 0.529 \cdot 10^{-10}}{Z}$$

Example with Units

$$1.4\text{E-}9\,\text{m} = \frac{20.9^2 \cdot 0.529 \cdot 10^{-10}}{17}$$

1.8) Spacing between Atomic Lattice Planes in X-ray Diffraction Formula

Evaluate Formula

Formula

$$d = \frac{n_{order} \cdot \lambda_{x\text{-}ray}}{2 \cdot \sin(\theta)}$$

Example with Units

$$0.7001\,\text{nm} = \frac{2 \cdot 0.45\,\text{nm}}{2 \cdot \sin(40°)}$$

1.9) Wavelength in X-ray Diffraction Formula

Evaluate Formula

Formula

$$\lambda_{x\text{-}ray} = \frac{2 \cdot d \cdot \sin(\theta)}{n_{order}}$$

Example with Units

$$0.45\,\text{nm} = \frac{2 \cdot 0.7\,\text{nm} \cdot \sin(40°)}{2}$$

1.10) Wavelength of Emitted Radiation for Transition between States Formula

Evaluate Formula

Formula

$$\lambda = \frac{1}{[Rydberg] \cdot Z^2 \cdot \left(\frac{1}{N_1^2} - \frac{1}{N_2^2}\right)}$$

Example with Units

$$2.1622\,\text{nm} = \frac{1}{1.1\text{E+}7\,1/\text{m} \cdot 17^2 \cdot \left(\frac{1}{2.4^2} - \frac{1}{6^2}\right)}$$

2) Photoelectric Effect Formulas

2.1) De Broglie Wavelength Formula

Evaluate Formula

Formula

$$\lambda = \frac{[hP]}{p}$$

Example with Units

$$2.1095\,\text{nm} = \frac{6.6\text{E-}34}{3.141\text{E-}25\,\text{kg*m/s}}$$

2.2) Maximum Kinetic Energy of Ejected Photo-Electron Formula

Evaluate Formula

Formula

$$K_{max} = [hP] \cdot v_{photon} - \phi$$

Example with Units

$$103.3667\,\text{J} = 6.6\text{E-}34 \cdot 1.56\text{E}35\,\text{Hz} - 9.4\text{E-}17\,\text{J}$$

2.3) Photon's Energy using Frequency Formula

Evaluate Formula

Formula

$$K_{max} = [hP] \cdot v_{photon}$$

Example with Units

$$103.3667\,\text{J} = 6.6\text{E-}34 \cdot 1.56\text{E}35\,\text{Hz}$$

2.4) Photon's Energy using Wavelength Formula

Evaluate Formula

Formula

$$E = \frac{[hP] \cdot [c]}{\lambda}$$

Example with Units

$$9.5E\text{-}17\,\text{J} = \frac{6.6E\text{-}34 \cdot 3E{+}8\,\text{m/s}}{2.1\,\text{nm}}$$

2.5) Photon's Momentum using Energy Formula

Evaluate Formula

Formula

$$p = \frac{E}{[c]}$$

Example with Units

$$3.1E\text{-}25\,\text{kg*m/s} = \frac{9.41E\text{-}17\,\text{J}}{3E{+}8\,\text{m/s}}$$

2.6) Photon's Momentum using Wavelength Formula

Evaluate Formula

Formula

$$p = \frac{[hP]}{\lambda}$$

Example with Units

$$3.2E\text{-}25\,\text{kg*m/s} = \frac{6.6E\text{-}34}{2.1\,\text{nm}}$$

2.7) Stopping Potential Formula

Evaluate Formula

Formula

$$V_0 = \frac{[hP] \cdot [c]}{[Charge\text{-}e]} \cdot \left(\frac{1}{\lambda}\right) - \frac{\phi}{[Charge\text{-}e]}$$

Example with Units

$$3.6991\,\text{V} = \frac{6.6E\text{-}34 \cdot 3E{+}8\,\text{m/s}}{1.6E\text{-}19\,\text{C}} \cdot \left(\frac{1}{2.1\,\text{nm}}\right) - \frac{9.4E\text{-}17\,\text{J}}{1.6E\text{-}19\,\text{C}}$$

2.8) Threshold Frequency in Photoelectric Effect Formula

Evaluate Formula

Formula

$$v_0 = \frac{\phi}{[hP]}$$

Example with Units

$$1.4E{+}17\,\text{Hz} = \frac{9.4E\text{-}17\,\text{J}}{6.6E\text{-}34}$$

Variables used in list of Photon and Atomic Physics Formulas above

- **a** Constant A
- **b** Constant B
- **d** Interplanar Spacing *(Nanometer)*
- **E** Photon Energy *(Joule)*
- E_n Energy in nth Bohr's Unit *(Joule)*
- E_y Photon Energy in State Transition *(Joule)*
- **h** Plancks Constant
- K_{max} Max Kinetic Energy *(Joule)*
- l_Q Quantization of Angular Momentum
- **n** Quantum Number
- N_1 Energy State n1
- N_2 Energy State n2
- n_{level} Number of Level in Orbit
- n_{order} Order of Reflection
- **p** Photon's Momentum *(Kilogram Meter per Second)*
- **r** Radius of nth Orbit *(Meter)*
- **v** Voltage *(Volt)*
- v_0 Threshold Frequency *(Hertz)*
- V_0 Stopping Potential *(Volt)*
- v_{photon} Frequency of Photon *(Hertz)*
- v_{sqrt} Moseley Law
- **Z** Atomic Number
- **θ** Angle b/w Incident and Reflected X-Ray *(Degree)*
- **λ** Wavelength *(Nanometer)*
- λ_{min} Minimum Wavelength *(Nanometer)*
- $\lambda_{x\text{-}ray}$ Wavelength of X-ray *(Nanometer)*
- **ϕ** Work Function *(Joule)*

Constants, Functions, Measurements used in list of Photon and Atomic Physics Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- constant(s): **[Charge-e]**, 1.60217662E-19 *Charge of electron*
- constant(s): **[c]**, 299792458.0 *Light speed in vacuum*
- constant(s): **[hP]**, 6.626070040E-34 *Planck constant*
- constant(s): **[Rydberg]**, 10973731.6 *Rydberg Constant*
- Functions: **asin**, asin(Number) *The inverse sine function, is a trigonometric function that takes a ratio of two sides of a right triangle and outputs the angle opposite the side with the given ratio.*
- Functions: **sin**, sin(Angle) *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- Measurement: **Length** in Meter (m) *Length Unit Conversion*
- Measurement: **Energy** in Joule (J) *Energy Unit Conversion*
- Measurement: **Angle** in Degree (°) *Angle Unit Conversion*
- Measurement: **Frequency** in Hertz (Hz) *Frequency Unit Conversion*
- Measurement: **Wavelength** in Nanometer (nm) *Wavelength Unit Conversion*
- Measurement: **Electric Potential** in Volt (V) *Electric Potential Unit Conversion*
- Measurement: **Momentum** in Kilogram Meter per Second (kg*m/s) *Momentum Unit Conversion*

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