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Photon and Atomic Physics Formulas

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List of 18 Photon and Atomic Physics Formulas

Photon and Atomic Physics

Atomic Structure

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

Open Calculator

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

ex $$40.0052^\circ = a\sin\left(\frac{2\cdot 0.45nm}{2\cdot 0.7nm}\right)$$

2) Energy in Nth Bohr's Orbit

Open Calculator

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

ex $$-408.990635J = -\frac{13.6\cdot\left((17)^2\right)}{(3.1)^2}$$

3) Minimum Wavelength in X-ray Spectrum

Open Calculator

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

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

4) Moseley's Law

Open Calculator

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

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

5) Photon Energy in State Transition

Open Calculator

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

ex $$1E\hat{}36J = 6.63 \cdot 1.56E35Hz$$

6) Quantization of Angular Momentum

Open Calculator

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

ex $$22.05362 = \frac{20.9 \cdot 6.63}{2 \cdot \pi}$$

7) Radius of Nth Bohr's Orbit

Open Calculator

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

ex $$1.4E\hat{}\text{-}9m = \frac{(20.9)^2 \cdot 0.529 \cdot 10^{-10}}{17}$$

8) Spacing between Atomic Lattice Planes in X-ray Diffraction

Open Calculator

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

ex $$0.700076nm = \frac{2 \cdot 0.45nm}{2 \cdot \sin(40^\circ)}$$

9) Wavelength in X-ray Diffraction

Open Calculator

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

ex $$0.449951nm = \frac{2 \cdot 0.7nm \cdot \sin(40^\circ)}{2}$$

10) Wavelength of Emitted Radiation for Transition between States

Open Calculator

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

ex $$2.162176\text{nm} = \frac{1}{[\text{Rydberg}] \cdot (17)^2 \cdot \left(\frac{1}{(2.4)^2} - \frac{1}{(6)^2}\right)}$$

Photoelectric Effect

11) De Broglie Wavelength

Open Calculator

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

ex $$2.109542\text{nm} = \frac{[hP]}{3.141E\text{^}\text{-}25\text{kg*m/s}}$$

12) Maximum Kinetic Energy of Ejected Photo-Electron

Open Calculator

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

ex $$103.3667\text{J} = [hP] \cdot 1.56E35\text{Hz} - 9.4E\text{^}\text{-}17\text{J}$$

13) Photon's Energy using Frequency

Open Calculator

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

ex $$103.3667\text{J} = [hP] \cdot 1.56E35\text{Hz}$$

14) Photon's Energy using Wavelength

Open Calculator

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

$$9.5E\hat{}\text{-}17J = \frac{[hP] \cdot [c]}{2.1nm}$$

15) Photon's Momentum using Energy

Open Calculator

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

$$3.1E\hat{}\text{-}25kg*m/s = \frac{9.41E\hat{}\text{-}17J}{[c]}$$

16) Photon's Momentum using Wavelength

Open Calculator

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

$$3.2E\hat{}\text{-}25kg*m/s = \frac{[hP]}{2.1nm}$$

17) Stopping Potential

Open Calculator

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

$$3.699082V = \frac{[hP] \cdot [c]}{[Charge\text{-}e]} \cdot \left(\frac{1}{2.1nm}\right) - \frac{9.4E\hat{}\text{-}17J}{[Charge\text{-}e]}$$

18) Threshold Frequency in Photoelectric Effect

Open Calculator

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

ex $$1.4E\hat{}17Hz = \frac{9.4E\hat{}\text{-}17J}{[hP]}$$

Variables Used

- **a** Constant A
- **b** Constant B
- **d** Interplanar Spacing *(Nanometer)*
- **E** Photon Energy *(Joule)*
- E_n Energy in nth Bohr's Unit *(Joule)*
- E_γ 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

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[Charge-e]**, 1.60217662E-19
  Charge of electron
- Constant: **[c]**, 299792458.0
  Light speed in vacuum
- Constant: **[hP]**, 6.626070040E-34
  Planck constant
- Constant: **[Rydberg]**, 10973731.6
  Rydberg Constant
- Function: **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.
- Function: **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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