Important Electrons & Holes Formulas PDF

Formulas
Examples
with Units

List of 18
Important Electrons & Holes Formulas

1) AC Conductance Formula

Evaluate Formula

Formula

$$G_s = \left(\frac{[Charge\text{-}e]}{[BoltZ] \cdot T}\right) \cdot I$$

Example with Units

$$0.0077\,\text{℧} = \left(\frac{1.6E\text{-}19\,\text{C}}{1.4E\text{-}23\,\text{J/K} \cdot 300\,\text{K}}\right) \cdot 0.2\,\text{mA}$$

2) Difference in Electron Concentration Formula

Evaluate Formula

Formula

$$\Delta N = N_1 - N_2$$

Example with Units

$$8000\,\text{1/m}^3 = 1.02e6\,\text{1/m}^3 - 1.012e6\,\text{1/m}^3$$

3) Electron Component Formula

Evaluate Formula

Formula

$$i_{en} = \left(\frac{i_{ep}}{Y}\right) - i_{ep}$$

Example

$$1.2675 = \left(\frac{5.07}{0.8}\right) - 5.07$$

4) Electron Current Density Formula

Evaluate Formula

Formula

$$J_e = J_T - J_h$$

Example with Units

$$0.03\,\text{A/m}^2 = 0.12\,\text{A/m}^2 - 0.09\,\text{A/m}^2$$

5) Electron Flux Density Formula

Evaluate Formula

Formula

$$\Phi_n = \left(\frac{L_e}{2 \cdot t}\right) \cdot \Delta N$$

Example with Units

$$0.0177\,\text{Wb/m}^2 = \left(\frac{25.47\,\mu\text{m}}{2 \cdot 5.75\,\text{s}}\right) \cdot 8000\,\text{1/m}^3$$

6) Electron in Region Formula

Evaluate Formula

Formula

$$n_{in} = \frac{n_{out}}{M_n}$$

Example

$$15 = \frac{60}{4}$$

7) Electron Multiplication Formula

Evaluate Formula

Formula

$$M_n = \frac{n_{out}}{n_{in}}$$

Example

$$4 = \frac{60}{15}$$

8) Electron Out of Region Formula

Evaluate Formula

Formula

$$n_{out} = M_n \cdot n_{in}$$

Example

$$60 = 4 \cdot 15$$

9) Hole Component Formula

Evaluate Formula

Formula

$$i_{ep} = i_{en} \cdot \frac{Y}{1 - Y}$$

Example

$$5.04 = 1.26 \cdot \frac{0.8}{1 - 0.8}$$

10) Hole Current Density Formula

Evaluate Formula

Formula

$$J_h = J_T - J_e$$

Example with Units

$$0.09\,\text{A/m}^2 = 0.12\,\text{A/m}^2 - 0.03\,\text{A/m}^2$$

11) Mean Free Path Formula

Evaluate Formula

Formula

$$L_e = \left(\frac{\Phi_n}{\Delta N}\right) \cdot 2 \cdot t$$

Example with Units

$$24.4375\,\mu\text{m} = \left(\frac{0.017\,\text{Wb/m}^2}{8000\,1/\text{m}^3}\right) \cdot 2 \cdot 5.75\,\text{s}$$

12) Mean Time Spend by Hole Formula

Evaluate Formula

Formula

$$\delta_p = g_{op} \cdot \tau_p$$

Example with Units

$$8120\,\text{s} = 2.9\text{e}19 \cdot 2.8\text{e-}16$$

13) Order of Diffraction Formula

Evaluate Formula

Formula

$$m = \frac{2 \cdot d \cdot \sin\left(\theta_i\right)}{\lambda}$$

Example with Units

$$7.2727 = \frac{2 \cdot 160\,\mu\text{m} \cdot \sin\left(30°\right)}{22\,\mu\text{m}}$$

14) Phi-dependent Wave Function Formula

Evaluate Formula

Formula

$$\Phi_m = \left(\frac{1}{\sqrt{2 \cdot \pi}}\right) \cdot \left(\exp\left(n_e \cdot \theta\right)\right)$$

Example with Units

$$6.1\text{E+}7 = \left(\frac{1}{\sqrt{2 \cdot 3.1416}}\right) \cdot \left(\exp\left(6 \cdot 180°\right)\right)$$

15) Quantum State Formula

Evaluate Formula

Formula

$$E_n = \frac{n^2 \cdot \pi^2 \cdot [hP]^2}{2 \cdot M \cdot L^2}$$

Example with Units

$$8.2\text{E-}24\,\text{eV} = \frac{2^2 \cdot 3.1416^2 \cdot 6.6\text{E-}34^2}{2 \cdot 1.34\text{e-}5\,\text{kg} \cdot 7\text{e-}10^2}$$

16) Radius of Nth Orbit of Electron Formula

Evaluate Formula

Formula

$$r_n = \frac{[Coulomb] \cdot n^2 \cdot [hP]^2}{M \cdot [Charge\text{-}e]^2}$$

Example with Units

$$4.6\text{E-}8\,\mu\text{m} = \frac{9\text{E+}9 \cdot 2^2 \cdot 6.6\text{E-}34^2}{1.34\text{e-}5\,\text{kg} \cdot 1.6\text{E-}19\,\text{C}^2}$$

17) Total Carrier Current Density Formula

Evaluate Formula

Formula

$$J_T = J_e + J_h$$

Example with Units

$$0.12\,\text{A/m}^2 = 0.03\,\text{A/m}^2 + 0.09\,\text{A/m}^2$$

18) Wave Function Amplitude Formula

Evaluate Formula

Formula

$$A_w = \sqrt{\frac{2}{L}}$$

Example

$$53452.2484 = \sqrt{\frac{2}{7\text{e-}10}}$$

Variables used in list of Electrons & Holes Formulas above

- A_w Amplitude of Wave Function
- **d** Grafting Space *(Micrometer)*
- E_n Energy in Quantum State *(Electron-Volt)*
- g_{op} Optical Generation Rate
- G_s AC Conductance *(Mho)*
- **I** Electric Current *(Milliampere)*
- i_{en} Electron Component
- i_{ep} Hole Component
- J_e Electron Current Density *(Ampere per Square Meter)*
- J_h Hole Current Density *(Ampere per Square Meter)*
- J_T Total Carrier Current Density *(Ampere per Square Meter)*
- **L** Potential Well Length
- L_e Mean Free Path Electron *(Micrometer)*
- **m** Order of Diffraction
- **M** Mass of Particle *(Kilogram)*
- M_n Electron Multiplication
- **n** Quantum Number
- N_1 Electron Concentration 1 *(1 per Cubic Meter)*
- N_2 Electron Concentration 2 *(1 per Cubic Meter)*
- n_e Wave Quantum Number
- n_{in} Number of Electron in Region
- n_{out} Number of Electron Out of Region
- r_n Radius of nth Orbit of Electron *(Micrometer)*
- **t** Time *(Second)*
- **T** Temperature *(Kelvin)*
- **Y** Emitter Injection Efficiency
- δ_p Mean Time Spend by Hole *(Second)*
- **ΔN** Difference in Electron Concentration *(1 per Cubic Meter)*
- **θ** Wave Function Angle *(Degree)*

Constants, Functions, Measurements used in list of Electrons & Holes Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- constant(s): **[BoltZ]**, 1.38064852E-23 *Boltzmann constant*
- constant(s): **[Charge-e]**, 1.60217662E-19 *Charge of electron*
- constant(s): **[Coulomb]**, 8.9875E+9 *Coulomb constant*
- constant(s): **[hP]**, 6.626070040E-34 *Planck 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: **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.*
- 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 Micrometer (µm) *Length Unit Conversion*
- Measurement: **Weight** in Kilogram (kg) *Weight Unit Conversion*
- Measurement: **Time** in Second (s) *Time Unit Conversion*
- Measurement: **Electric Current** in Milliampere (mA) *Electric Current Unit Conversion*
- Measurement: **Temperature** in Kelvin (K) *Temperature Unit Conversion*
- Measurement: **Energy** in Electron-Volt (eV) *Energy Unit Conversion*
- Measurement: **Angle** in Degree (°) *Angle Unit Conversion*
- Measurement: **Electric Conductance** in Mho (℧) *Electric Conductance Unit Conversion*

- θ_i Incident Angle *(Degree)*
- λ Wavelength of Ray *(Micrometer)*
- τ_p Majority Carrier Decay
- Φ_m Φ Dependent Wave Function
- Φ_n Electron Flux Density *(Weber per Square Meter)*

- Measurement: **Magnetic Flux Density** in Weber per Square Meter (Wb/m²)
  Magnetic Flux Density Unit Conversion
- Measurement: **Surface Current Density** in Ampere per Square Meter (A/m²)
  Surface Current Density Unit Conversion
- Measurement: **Carrier Concentration** in 1 per Cubic Meter (1/m³)
  Carrier Concentration Unit Conversion

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