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# Current Electricity Formulas

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# List of 30 Current Electricity Formulas

## Current Electricity

### Basics of Current Electricity

#### 1) Current Density given Electric Current and Area

$$fx \quad J = \frac{I}{A_{\text{cond}}}$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

$$ex \quad 0.402299 \text{ A/mm}^2 = \frac{2.1 \text{ A}}{5.22 \text{ mm}^2}$$

#### 2) Current Density given Resistivity

$$fx \quad J = \frac{E}{\rho}$$

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\)](#)

$$ex \quad 35.29412 \text{ A/mm}^2 = \frac{600 \text{ V/m}}{0.017 \Omega \cdot \text{mm}}$$

#### 3) Drift Speed

$$fx \quad V_d = \frac{E \cdot \tau \cdot [\text{Charge-e}]}{2 \cdot [\text{Mass-e}]}$$

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d\_img.jpg\)](#)

$$ex \quad 2.6 \text{ E}^{15} \text{ mm/s} = \frac{600 \text{ V/m} \cdot 0.05 \text{ s} \cdot [\text{Charge-e}]}{2 \cdot [\text{Mass-e}]}$$




4) Drift Speed given Cross-Sectional Area 

$$\text{fx } V_d = \frac{I}{e^- \cdot [\text{Charge-e}] \cdot A}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)


$$\text{ex } 1.9E^{-26} \text{mm/s} = \frac{2.1A}{5 \cdot [\text{Charge-e}] \cdot 14\text{mm}^2}$$

5) Electric Current given Charge and Time 

$$\text{fx } I = \frac{q}{T_{\text{Total}}}$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$\text{ex } 0.00375A = \frac{0.3C}{80s}$$

6) Electric Current given Drift Velocity 

$$\text{fx } I = n \cdot [\text{Charge-e}] \cdot A \cdot V_d$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

$$\text{ex } 1.6E^{-27}A = 7 \cdot [\text{Charge-e}] \cdot 14\text{mm}^2 \cdot 0.1\text{mm/s}$$

7) Electric Field 

$$\text{fx } E = \frac{\Delta V}{l}$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

$$\text{ex } 20V/m = \frac{18V}{0.9m}$$



## 8) Electromotive Force when Battery is Charging

$$\text{fx } V_{\text{electromotive}} = \varepsilon + I \cdot R$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$\text{ex } 33.3\text{V} = 1.8\text{V} + 2.1\text{A} \cdot 15\Omega$$

## 9) Electromotive Force when Battery is Discharging

$$\text{fx } V_{\text{electromotive}} = \varepsilon - I \cdot R$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$\text{ex } -29.7\text{V} = 1.8\text{V} - 2.1\text{A} \cdot 15\Omega$$

## Energy and Power

### 10) Heat Energy given Electric Potential Difference and Electric Current

$$\text{fx } Q = \Delta V \cdot I \cdot T_{\text{Total}}$$

[Open Calculator !\[\]\(626ce8ac21792b9405bfddfea8e0c96a\_img.jpg\)](#)

$$\text{ex } 3024\text{W} = 18\text{V} \cdot 2.1\text{A} \cdot 80\text{s}$$

### 11) Heat Energy given Electric Potential Difference and Resistance

$$\text{fx } Q = \Delta V^2 \cdot \frac{T_{\text{Total}}}{R}$$

[Open Calculator !\[\]\(c1168d6a8b365d11e842ece304635fa7\_img.jpg\)](#)

$$\text{ex } 1728\text{W} = (18\text{V})^2 \cdot \frac{80\text{s}}{15\Omega}$$



## 12) Heat Generated through Resistance

$$\text{fx } Q = I^2 \cdot R \cdot T_{\text{Total}}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$\text{ex } 5292\text{W} = (2.1\text{A})^2 \cdot 15\Omega \cdot 80\text{s}$$

## 13) Power given Electric Current and Resistance

$$\text{fx } P = I^2 \cdot R$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)

$$\text{ex } 17.23857\text{W} = (.9577\text{A})^2 \cdot 18.7950\Omega$$

## 14) Power given Electric Potential Difference and Electric Current

$$\text{fx } P = \Delta V \cdot I$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$\text{ex } 17\text{W} = 17.75086\text{V} \cdot .9577\text{A}$$

## 15) Power given Electric Potential Difference and Resistance

$$\text{fx } P = \frac{\Delta V^2}{R}$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80\_img.jpg\)](#)

$$\text{ex } 16.76473\text{W} = \frac{(17.75086\text{V})^2}{18.7950\Omega}$$



## Resistance

### 16) Equivalent Resistance in Parallel

$$\text{fx } R_{\text{eq}} = \left( \frac{1}{R} + \frac{1}{\Omega} \right)^{-1}$$

[Open Calculator !\[\]\(950a62bbddad88d64435fd35607dfc42\_img.jpg\)](#)

$$\text{ex } 11.53846\Omega = \left( \frac{1}{15\Omega} + \frac{1}{50\Omega} \right)^{-1}$$

### 17) Equivalent Resistance in Series

$$\text{fx } R_{\text{eq}} = R + \Omega$$

[Open Calculator !\[\]\(73002692dd5e7a64e60946be3158e719\_img.jpg\)](#)

$$\text{ex } 65\Omega = 15\Omega + 50\Omega$$

### 18) Internal Resistance using Potentiometer

$$\text{fx } R = \frac{L - l_2}{l_2} \cdot \Omega$$

[Open Calculator !\[\]\(104fbf564e2e5a8fbd84f31656d114c7\_img.jpg\)](#)

$$\text{ex } 12.5\Omega = \frac{1500\text{mm} - 1200\text{mm}}{1200\text{mm}} \cdot 50\Omega$$

### 19) Resistance

$$\text{fx } R = \frac{\rho \cdot l}{A}$$

[Open Calculator !\[\]\(21226b58c700e5231ab98d27101bac58\_img.jpg\)](#)

$$\text{ex } 1.092857\Omega = \frac{0.017\Omega \cdot \text{mm} \cdot 0.9\text{m}}{14\text{mm}^2}$$



## 20) Resistance of Wire

$$\text{fx } R = \rho \cdot \frac{L}{A}$$

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5\_img.jpg\)](#)

$$\text{ex } 1.821429\Omega = 0.017\Omega \cdot \text{mm} \cdot \frac{1500\text{mm}}{14\text{mm}^2}$$

## 21) Resistance on Stretching of Wire

$$\text{fx } R = \frac{\Omega \cdot L^2}{(l_2)^2}$$

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5\_img.jpg\)](#)

$$\text{ex } 78.125\Omega = \frac{50\Omega \cdot (1500\text{mm})^2}{(1200\text{mm})^2}$$

## 22) Resistivity of Material

$$\text{fx } \rho = \frac{2 \cdot [\text{Mass-e}]}{n \cdot [\text{Charge-e}]^2 \cdot \tau}$$

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2\_img.jpg\)](#)

$$\text{ex } 2E^{11}\Omega \cdot \text{mm} = \frac{2 \cdot [\text{Mass-e}]}{7 \cdot [\text{Charge-e}]^2 \cdot 0.05\text{s}}$$

## 23) Temperature Dependence of Resistance

$$\text{fx } R = R_{\text{ref}} \cdot (1 + \alpha \cdot \Delta T)$$

[Open Calculator !\[\]\(06a315363e7801bba8c7489a6694af19\_img.jpg\)](#)

$$\text{ex } 1602.5\Omega = 2.5\Omega \cdot (1 + 16^\circ\text{C}^{-1} \cdot 40\text{K})$$



## Voltage and Current Measuring Instruments

### 24) Current in Potentiometer

$$\text{fx } I = \frac{x \cdot L}{R}$$

[Open Calculator !\[\]\(96cc62f861fdd6e50510c0224a756dff\_img.jpg\)](#)

$$\text{ex } 114\text{A} = \frac{1140\text{V/m} \cdot 1500\text{mm}}{15\Omega}$$

### 25) EMF of Unknown Cell using Potentiometer

$$\text{fx } \varepsilon = \frac{\varepsilon_1 \cdot L}{l_2}$$

[Open Calculator !\[\]\(f95dab70c751fda7d824b8b03650f7aa\_img.jpg\)](#)

$$\text{ex } 7.5\text{V} = \frac{6\text{V} \cdot 1500\text{mm}}{1200\text{mm}}$$

### 26) Metre Bridge

$$\text{fx } \Omega = R \cdot \frac{100 - L}{L}$$

[Open Calculator !\[\]\(e9474ce1d70442456f8fe9c393ea149c\_img.jpg\)](#)

$$\text{ex } 985\Omega = 15\Omega \cdot \frac{100 - 1500\text{mm}}{1500\text{mm}}$$

### 27) Ohm's Law

$$\text{fx } V = I \cdot R$$

[Open Calculator !\[\]\(9db214d549b9aeebe72aa11d3a5c4b1a\_img.jpg\)](#)

$$\text{ex } 31.5\text{V} = 2.1\text{A} \cdot 15\Omega$$





## 28) Potential Difference through Voltmeter

$$fx \quad \Delta V = I_G \cdot R + I_G \cdot R_G$$

[Open Calculator !\[\]\(c3d993ca47bfe2a953c700506ce31fa0\_img.jpg\)](#)

$$ex \quad 38.25V = 1.5A \cdot 15\Omega + 1.5A \cdot 10.5\Omega$$

## 29) Potential Gradient through Potentiometer

$$fx \quad x = \frac{\Delta V - V_B}{L}$$

[Open Calculator !\[\]\(17413706fd4997a1a4bdf85c6864eee1\_img.jpg\)](#)

$$ex \quad 0.666667V/m = \frac{18V - 17V}{1500mm}$$

## 30) Shunt in Ammeter

$$fx \quad R_{sh} = R_G \cdot \frac{I_G}{I - I_G}$$

[Open Calculator !\[\]\(4b7a79268f6ba26c1471d4232fffa85a\_img.jpg\)](#)

$$ex \quad 26.25\Omega = 10.5\Omega \cdot \frac{1.5A}{2.1A - 1.5A}$$



## Variables Used











- $\Delta T$  Change in Temperature (Kelvin)
- **A** Cross-Sectional Area (Square Millimeter)
- **A<sub>cond</sub>** Area of Conductor (Square Millimeter)
- **E** Electric Field (Volt per Meter)
- **e<sup>-</sup>** Number of Electrons
- **I** Electric Current (Ampere)
- **I** Electric Current (Ampere)
- **I<sub>G</sub>** Electric Current through Galvanometer (Ampere)
- **J** Electric Current Density (Ampere per Square Millimeter)
- **l** Length of Conductor (Meter)
- **L** Length (Millimeter)
- **l<sub>2</sub>** Final Length (Millimeter)
- **n** Number of Free Charge Particles per Unit Volume
- **P** Power (Watt)
- **q** Charge (Coulomb)
- **Q** Heat Rate (Watt)
- **R** Resistance (Ohm)
- **R** Resistance (Ohm)
- **R<sub>eq</sub>** Equivalent Resistance (Ohm)
- **R<sub>G</sub>** Resistance through Galvanometer (Ohm)
- **R<sub>ref</sub>** Resistance at Reference Temperature (Ohm)
- **R<sub>sh</sub>** Shunt (Ohm)







- $T_{\text{Total}}$  Total Time Taken (Second)
- $V$  Voltage (Volt)
- $V_B$  Electric Potential Diff through other Terminal (Volt)
- $V_d$  Drift Speed (Millimeter per Second)
- $V_{\text{electromotive}}$  Electromotive Voltage (Volt)
- $x$  Potential Gradient (Volt per Meter)
- $\alpha$  Temperature Coefficient of Resistance (Per Degree Celsius)
- $\Delta V$  Electric Potential Difference (Volt)
- $\Delta V$  Electric Potential Difference (Volt)
- $\epsilon$  Electromotive Force (Volt)
- $\epsilon \cdot$  EMF of Unknown Cell using Potentiometer (Volt)
- $\rho$  Resistivity (Ohm Millimeter)
- $\Omega$  Final Resistance (Ohm)
- $\tau$  Relaxation time (Second)



## Constants, Functions, Measurements used









- **Constant:** [**Charge-e**], 1.60217662E-19  
*Charge of electron*
- **Constant:** [**Mass-e**], 9.10938356E-31  
*Mass of electron*
- **Measurement:** **Length** in Meter (m), Millimeter (mm)  
*Length Unit Conversion* 
- **Measurement:** **Time** in Second (s)  
*Time Unit Conversion* 
- **Measurement:** **Electric Current** in Ampere (A)  
*Electric Current Unit Conversion* 
- **Measurement:** **Temperature** in Kelvin (K)  
*Temperature Unit Conversion* 
- **Measurement:** **Area** in Square Millimeter (mm<sup>2</sup>)  
*Area Unit Conversion* 
- **Measurement:** **Speed** in Millimeter per Second (mm/s)  
*Speed Unit Conversion* 
- **Measurement:** **Electric Charge** in Coulomb (C)  
*Electric Charge Unit Conversion* 
- **Measurement:** **Power** in Watt (W)  
*Power Unit Conversion* 
- **Measurement:** **Electric Resistance** in Ohm ( $\Omega$ )  
*Electric Resistance Unit Conversion* 
- **Measurement:** **Surface Current Density** in Ampere per Square Millimeter (A/mm<sup>2</sup>)  
*Surface Current Density Unit Conversion* 



- **Measurement: Electric Field Strength** in Volt per Meter (V/m)  
*Electric Field Strength Unit Conversion* 
- **Measurement: Electric Potential** in Volt (V)  
*Electric Potential Unit Conversion* 
- **Measurement: Electric Resistivity** in Ohm Millimeter ( $\Omega \cdot \text{mm}$ )  
*Electric Resistivity Unit Conversion* 
- **Measurement: Temperature Coefficient of Resistance** in Per Degree Celsius ( $^{\circ}\text{C}^{-1}$ )  
*Temperature Coefficient of Resistance Unit Conversion* 



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