

# Important Current Electricity Formulas PDF



**Formulas  
Examples  
with Units**

**List of 30  
Important Current Electricity Formulas**

## 1) Basics of Current Electricity Formulas

### 1.1) Current Density given Electric Current and Area Formula

Formula

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

Example with Units

$$0.4023 \text{ A/mm}^2 = \frac{2.1 \text{ A}}{5.22 \text{ mm}^2}$$

Evaluate Formula 

### 1.2) Current Density given Resistivity Formula

Formula

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

Example with Units

$$35.2941 \text{ A/mm}^2 = \frac{600 \text{ V/m}}{0.017 \Omega \cdot \text{mm}}$$

Evaluate Formula 

### 1.3) Drift Speed Formula

Formula

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

Example with Units

$$2.6\text{E}+15 \text{ mm/s} = \frac{600 \text{ V/m} \cdot 0.05 \text{ s} \cdot 1.6\text{E}-19 \text{ C}}{2 \cdot 9.1\text{E}-31 \text{ kg}}$$

Evaluate Formula 

### 1.4) Drift Speed given Cross-Sectional Area Formula

Formula

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

Example with Units

$$1.9\text{E}+26 \text{ mm/s} = \frac{2.1 \text{ A}}{5 \cdot 1.6\text{E}-19 \text{ C} \cdot 14 \text{ mm}^2}$$

Evaluate Formula 

### 1.5) Electric Current given Charge and Time Formula

Formula

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

Example with Units

$$0.0038 \text{ A} = \frac{0.3 \text{ C}}{80 \text{ s}}$$

Evaluate Formula 

### 1.6) Electric Current given Drift Velocity Formula

Formula

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

Example with Units

$$1.6\text{E}-27 \text{ A} = 7 \cdot 1.6\text{E}-19 \text{ C} \cdot 14 \text{ mm}^2 \cdot 0.1 \text{ mm/s}$$

Evaluate Formula 



## 1.7) Electric Field Formula ↻

Formula

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

Example with Units

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

Evaluate Formula ↻

## 1.8) Electromotive Force when Battery is Charging Formula ↻

Formula

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

Example with Units

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

Evaluate Formula ↻

## 1.9) Electromotive Force when Battery is Discharging Formula ↻

Formula

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

Example with Units

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

Evaluate Formula ↻

## 2) Energy and Power Formulas ↻

### 2.1) Heat Energy given Electric Potential Difference and Electric Current Formula ↻

Formula

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

Example with Units

$$3024 \text{ w} = 18 \text{ v} \cdot 2.1 \text{ A} \cdot 80 \text{ s}$$

Evaluate Formula ↻

### 2.2) Heat Energy given Electric Potential Difference and Resistance Formula ↻

Formula

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

Example with Units

$$1728 \text{ w} = 18 \text{ v}^2 \cdot \frac{80 \text{ s}}{15 \Omega}$$

Evaluate Formula ↻

### 2.3) Heat Generated through Resistance Formula ↻

Formula

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

Example with Units

$$5292 \text{ w} = 2.1 \text{ A}^2 \cdot 15 \Omega \cdot 80 \text{ s}$$

Evaluate Formula ↻

### 2.4) Power given Electric Current and Resistance Formula ↻

Formula

$$P = I^2 \cdot R$$

Example with Units

$$17.2386 \text{ w} = .9577 \text{ A}^2 \cdot 18.7950 \Omega$$

Evaluate Formula ↻

### 2.5) Power given Electric Potential Difference and Electric Current Formula ↻

Formula

$$P = \Delta V \cdot I$$

Example with Units

$$17 \text{ w} = 17.75086 \text{ v} \cdot .9577 \text{ A}$$

Evaluate Formula ↻



## 2.6) Power given Electric Potential Difference and Resistance Formula

Formula

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

Example with Units

$$16.7647\text{w} = \frac{17.75086\text{v}^2}{18.7950\Omega}$$

Evaluate Formula 

## 3) Resistance Formulas

### 3.1) Equivalent Resistance in Parallel Formula

Formula

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

Example with Units

$$11.5385\Omega = \left( \frac{1}{15\Omega} + \frac{1}{50\Omega} \right)^{-1}$$

Evaluate Formula 

### 3.2) Equivalent Resistance in Series Formula

Formula

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

Example with Units

$$65\Omega = 15\Omega + 50\Omega$$

Evaluate Formula 

### 3.3) Internal Resistance using Potentiometer Formula

Formula

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

Example with Units

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

Evaluate Formula 

### 3.4) Resistance Formula

Formula

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

Example with Units

$$1.0929\Omega = \frac{0.017\Omega \cdot \text{mm} \cdot 0.9\text{m}}{14\text{mm}^2}$$

Evaluate Formula 

### 3.5) Resistance of Wire Formula

Formula

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

Example with Units

$$1.8214\Omega = 0.017\Omega \cdot \text{mm} \cdot \frac{1500\text{mm}}{14\text{mm}^2}$$

Evaluate Formula 

### 3.6) Resistance on Stretching of Wire Formula

Formula

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

Example with Units

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

Evaluate Formula 



### 3.7) Resistivity of Material Formula

Formula

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

Example with Units

$$2\text{E}+11\Omega\cdot\text{mm} = \frac{2 \cdot 9.1\text{E}-31\text{kg}}{7 \cdot 1.6\text{E}-19\text{C}^2 \cdot 0.05\text{s}}$$

Evaluate Formula 

### 3.8) Temperature Dependence of Resistance Formula

Formula

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

Example with Units

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

Evaluate Formula 

## 4) Voltage and Current Measuring Instruments Formulas

### 4.1) Current in Potentiometer Formula

Formula

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

Example with Units

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

Evaluate Formula 

### 4.2) EMF of Unknown Cell using Potentiometer Formula

Formula

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

Example with Units

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

Evaluate Formula 

### 4.3) Metre Bridge Formula

Formula

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

Example with Units

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

Evaluate Formula 

### 4.4) Ohm's Law Formula

Formula

$$V = I \cdot R$$

Example with Units

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

Evaluate Formula 

### 4.5) Potential Difference through Voltmeter Formula

Formula

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

Example with Units

$$38.25\text{v} = 1.5\text{A} \cdot 15\Omega + 1.5\text{A} \cdot 10.5\Omega$$

Evaluate Formula 

### 4.6) Potential Gradient through Potentiometer Formula

Formula

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

Example with Units

$$0.6667\text{v/m} = \frac{18\text{v} - 17\text{v}}{1500\text{mm}}$$

Evaluate Formula 



## 4.7) Shunt in Ammeter Formula

Formula

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

Example with Units

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















Evaluate Formula 



## Variables used in list of Current Electricity Formulas above

- $\Delta T$  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<sub>Total</sub>** Total Time Taken (Second)
- **V** Voltage (Volt)
- **V<sub>B</sub>** Electric Potential Diff through other Terminal (Volt)
- **V<sub>d</sub>** Drift Speed (Millimeter per Second)
- **V<sub>electromotive</sub>** Electromotive Voltage (Volt)
- **x** Potential Gradient (Volt per Meter)
- **α** Temperature Coefficient of Resistance (Per Degree Celsius)

## Constants, Functions, Measurements used in list of Current Electricity Formulas above

- **constant(s): [Charge-e]**, 1.60217662E-19  
Charge of electron
- **constant(s): [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 (Ω)  
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 (Ω\*mm)  
Electric Resistivity Unit Conversion 
- **Measurement: Temperature Coefficient of Resistance** in Per Degree Celsius (°C<sup>-1</sup>)  
Temperature Coefficient of Resistance Unit Conversion 









- $\Delta V$  Electric Potential Difference (Volt)
- $\Delta V$  Electric Potential Difference (Volt)
- $\epsilon$  Electromotive Force (Volt)
- $\epsilon$  EMF of Unknown Cell using Potentiometer (Volt)
- $\rho$  Resistivity (Ohm Millimeter)
- $\Omega$  Final Resistance (Ohm)
- $\tau$  Relaxation time (Second)



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