



# **Current Electricity Formulas**

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# **List of 30 Current Electricity Formulas**

# **Current Electricity**

# Basics of Current Electricity 🗗

1) Current Density given Conductivity

fx 
$$J = \sigma \cdot E$$

Open Calculator

$$\texttt{ex} \boxed{100.02 \text{A}/\text{mm}^2 = 1667 \text{S}/\text{m} \cdot 60 \text{V}/\text{mm}}$$

2) Current Density given Electric Current and Area

$$J = rac{I}{A_{cond}}$$

Open Calculator

$$ext{ex} 100 ext{A}/ ext{mm}^2 = rac{2.1 ext{A}}{0.0210 ext{mm}^2}$$

3) Current Density given Resistivity

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

Open Calculator 🗗

$$extstyle extstyle ext$$



#### 4) Drift Speed

 $extbf{V}_{ ext{d}} = rac{ ext{E} \cdot extbf{ au} \cdot ext{[Charge-e]}}{2 \cdot ext{[Mass-e]}}$ 

Open Calculator 🗗

 $oxed{ex} 2.6 ext{E^17mm/s} = rac{60 ext{V/mm} \cdot 0.05 ext{s} \cdot [ ext{Charge-e}]}{2 \cdot [ ext{Mass-e}]}$ 

# 5) Drift Speed given Cross-Sectional Area

 $V_{
m d} = rac{
m I}{
m e^{ ext{-}} \cdot [Charge-e] \cdot A}$ 

Open Calculator 🗗

 $2.6\mathrm{E^{1}7mm/s} = rac{2.1\mathrm{A}}{3.6\mathrm{E}9\cdot[\mathrm{Charge\text{-}e}]\cdot14\mathrm{mm}^2}$ 

### 6) Electric Current given Charge and Time

fx  $I=rac{
m q}{
m T_{Total}}$  ex  $2.102528 
m A=rac{35.6 
m C}{16.932 
m s}$ 

Open Calculator

7) Electric Current given Drift Velocity

 $\mathbf{K} \mathbf{I} = \mathbf{n} \cdot [ ext{Charge-e}] \cdot \mathbf{A} \cdot \mathbf{V}_{ ext{d}}$ 

Open Calculator 🗗



#### 8) Electromotive Force when Battery is Charging

fx  $V_{\mathrm{charging}} = \epsilon + I \cdot R$ 

Open Calculator 🚰

Open Calculator

- $\boxed{\textbf{ex}} 33.3 \text{V} = 1.8 \text{V} + 2.1 \text{A} \cdot 15 \Omega$
- 9) Electromotive Force when Battery is Discharging
  - len Battery is Discharging
- $extstyle{\textbf{ex}}$  -29.7 $extstyle{ extstyle V} = 1.8 extstyle{ extstyle V} 2.1 extstyle{ extstyle A} \cdot 15 \Omega$

 $ag{K} V_{
m discharging} = \epsilon - I \cdot R$ 

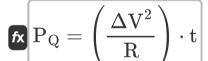
### **Energy and Power**

## fx $P_{\Omega} = \Delta V \cdot I \cdot T_{Total}$



- $\text{ex} \ 640.0296 \text{W} = 18 \text{V} \cdot 2.1 \text{A} \cdot 16.932 \text{s}$
- 11) Heat Energy given Electric Potential Difference and Resistance

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



Open Calculator 🗗

$$ext{ex} \ 640.008 ext{W} = \left(rac{(18 ext{V})^2}{15\Omega}
ight) \cdot 29.63$$



#### 12) Heat Generated through Resistance

 $\mathbf{f}\mathbf{x} = \mathbf{I}^2 \cdot \mathbf{R} \cdot \mathbf{T}_{\mathrm{Total}}$ 

Open Calculator

 $\texttt{ex} \ 1120.052 \texttt{J} = (2.1 \texttt{A})^2 \cdot 15\Omega \cdot 16.932 \texttt{s}$ 

### 13) Power given Electric Current and Resistance

fx  $P = I^2 \cdot R$ 

Open Calculator

 $\mathbf{ex} \left[ 66.15 \mathrm{W} = (2.1 \mathrm{A})^2 \cdot 15 \Omega \right]$ 

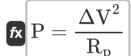
### 14) Power given Electric Potential Difference and Electric Current

fx  $P = V \cdot I$ 

Open Calculator

 $66.15W = 31.5V \cdot 2.1A$ 

#### 15) Power given Electric Potential Difference and Resistance



 $\mathbf{ex} \ 66.16296 \mathrm{W} = rac{(18 \mathrm{V})^2}{4.897 \Omega}$ 



Open Calculator

Open Calculator

Open Calculator

Open Calculator

# Resistance 🖸

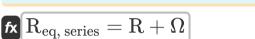
# 16) Equivalent Resistance in Parallel

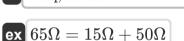
$$(1 1)^{-1}$$

$$ext{R}_{ ext{eq,parallel}} = \left(rac{1}{ ext{R}} + rac{1}{\Omega}
ight)^{-1}$$

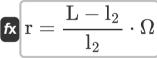
$$\boxed{11.53846\Omega = \left(\frac{1}{15\Omega} + \frac{1}{50\Omega}\right)^{-1}}$$

# 17) Equivalent Resistance in Series





# 18) Internal Resistance using Potentiometer



$$ag{12.5\Omega} = rac{1500 ext{mm} - 1200 ext{mm}}{1200 ext{mm}} \cdot 50\Omega$$

# 19) Resistance

$$m R = rac{
ho \cdot L_{conductor}}{A}$$

$$ag{15\Omega} = rac{0.6\Omega^* ext{mm} \cdot 350 ext{mm}}{14 ext{mm}^2}$$



Open Calculator 2

Open Calculator 2

Open Calculator

Open Calculator

# 20) Resistance of Wire

 $\left| \mathbf{R} \right| \mathbf{R} = 
ho \cdot rac{\mathbf{L}_{\mathrm{wire}}}{\mathbf{A}_{\mathrm{min}}}$ 

ex  $15\Omega=0.6\Omega^*\mathrm{mm}\cdot$  -

 $35 \mathrm{mm}$ 

# 21) Resistance on Stretching of Wire

 $m R = rac{\Omega \cdot L_{wire}^2}{\left(L_{f.wire}
ight)^2}$ 

 $ext{ex} 15.00045\Omega = rac{50\Omega \cdot (35 ext{mm})^2}{(63.9 ext{mm})^2}$ 

# 22) Resistivity of Material

 $ho_{ ext{material}} = rac{2 \cdot [ ext{Mass-e}]}{ ext{n} \cdot [ ext{Charge-e}]^2 \cdot au}$ 

# 23) Temperature Dependence of Resistance 🛂

- fx  $R = R_{
  m ref} \cdot (1 + lpha \cdot \Delta T)$ ex  $15.01375\Omega = 2.5\Omega \cdot (1 + 2.13\,^{\circ}\mathrm{C}^{-1} \cdot 2.35\mathrm{K})$







### Voltage and Current Measuring Instruments

### 24) Current in Potentiometer

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

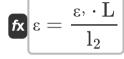
Open Calculator 🚰

$$= 2.1 \mathrm{A} = \frac{0.021 \mathrm{V/mm} \cdot 1500 \mathrm{mm}}{15\Omega}$$

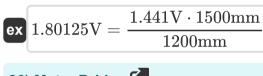
### 25) EMF of Unknown Cell using Potentiometer

 $35 \mathrm{mm}$ 

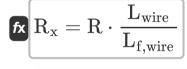
 $\overline{63.9}$ mm



Open Calculator



# 26) Metre Bridge



 $|\mathbf{ex}| 8.215962\Omega = 15\Omega \cdot \cdot$ 

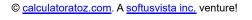
Open Calculator 🗗

Open Calculator

fx 
$$V = I \cdot R$$

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







#### 28) Potential Difference through Voltmeter G

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

Open Calculator

 $extbf{ex} \ 18.01236 ext{V} = 1.101 ext{A} \cdot 15\Omega + 1.101 ext{A} \cdot 1.36\Omega$ 

### 29) Potential Gradient through Potentiometer

 $\mathbf{x} = rac{\Delta \mathrm{V} - \mathrm{V_B}}{\mathrm{T_{I}}}$ 

Open Calculator

 $0.021 {
m V/mm} = rac{18 {
m V} - 13.5 {
m V}}{1500 {
m mm}}$ 

#### 30) Shunt in Ammeter 💪

 $\left| {
m R}_{
m sh} = {
m R}_{
m G} \cdot rac{{
m I}_{
m G}}{{
m I} - {
m I}_{
m G}} 
ight|$ 

Open Calculator 2

 $oxed{ex} 1.498859\Omega = 1.36\Omega \cdot rac{1.101 ext{A}}{2.1 ext{A} - 1.101 ext{A}}$ 



#### Variables Used

- Δ**T** Change in Temperature (*Kelvin*)
- A Cross-Sectional Area (Square Millimeter)
- Acond Area of Conductor (Square Millimeter)
- Awire Cross-Sectional Area of Wire (Square Millimeter)
- E Electric Field (Volt per Millimeter)
- e Number of Electrons
- I Electric Current (Ampere)
- I<sub>G</sub> Electric Current through Galvanometer (Ampere)
- J Electric Current Density (Ampere per Square Millimeter)
- L Length (Millimeter)
- **l**<sub>2</sub> Final Length (Millimeter)
- L<sub>conductor</sub> Length of Conductor (Millimeter)
- Lf.wire Final Length of Wire (Millimeter)
- Lwire Wire Length (Millimeter)
- n Number of Free Charge Particles per Unit Volume
- P Power (Watt)
- P<sub>O</sub> Heat Rate (Watt)
- **q** Charge (Coulomb)
- Q Heat Generated (Joule)
- r Internal Resistance (Ohm)
- R Electric Resistance (Ohm)
- Reg. series Equivalent Resistance in Series (Ohm)





- Reg.parallel Equivalent Resistance in Parallel (Ohm)
- R<sub>G</sub> Resistance through Galvanometer (Ohm)
- R<sub>p</sub> Resistance for Power (Ohm)
- R<sub>ref</sub> Resistance at Reference Temperature (Ohm)
- R<sub>sh</sub> Shunt (Ohm)
- R<sub>x</sub> Unknown Resistance (Ohm)
- t Time Period
- T<sub>Total</sub> Total Time Taken (Second)
- V Voltage (Volt)
- **V**<sub>B</sub> Electric Potential Diff through other Terminal (*Volt*)
- V<sub>charging</sub> Electromotive Voltage while Charging (Volt)
- Vd Drift Speed (Millimeter per Second)
- V<sub>discharging</sub> Electromotive Voltage while Discharging (Volt)
- **X** Potential Gradient (Volt per Millimeter)
- α Temperature Coefficient of Resistance (Per Degree Celsius)
- **ΔV** Electric Potential Difference (Volt)
- ε Electromotive Force (Volt)
- E EMF of Unknown Cell using Potentiometer (Volt)
- ρ Resistivity (Ohm Millimeter)
- ρ<sub>material</sub> Resistivity of Material (Ohm Millimeter)
- σ Conductivity (Siemens per Meter)
- **Ω** Final Resistance (Ohm)
- τ 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 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 (mm²)
   Area Unit Conversion
- Measurement: Speed in Millimeter per Second (mm/s)
   Speed Unit Conversion
- Measurement: Energy in Joule (J)
   Energy 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/mm²)





Surface Current Density Unit Conversion

- Measurement: Electric Field Strength in Volt per Millimeter (V/mm)

  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: Electric Conductivity in Siemens per Meter (S/m)

  Electric Conductivity Unit Conversion
- Measurement: Temperature Coefficient of Resistance in Per Degree Celsius (°C<sup>-1</sup>)

Temperature Coefficient of Resistance Unit Conversion





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