Current Electricity Formulas

List of 30 Current Electricity Formulas

Current Electricity

Basics of Current Electricity

1) Current Density given Electric Current and Area

Open Calculator

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

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

2) Current Density given Resistivity

Open Calculator

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

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

3) Drift Speed

Open Calculator

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

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

4) Drift Speed given Cross-Sectional Area

Open Calculator

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

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

5) Electric Current given Charge and Time

Open Calculator

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

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

6) Electric Current given Drift Velocity

Open Calculator

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

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

7) Electric Field

Open Calculator

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

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

8) Electromotive Force when Battery is Charging

Open Calculator

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

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

9) Electromotive Force when Battery is Discharging

Open Calculator

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

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

Energy and Power

10) Heat Energy given Electric Potential Difference and Electric Current

Open Calculator

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

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

11) Heat Energy given Electric Potential Difference and Resistance

Open Calculator

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

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

12) Heat Generated through Resistance

Open Calculator

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

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

13) Power given Electric Current and Resistance

Open Calculator

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

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

14) Power given Electric Potential Difference and Electric Current

Open Calculator

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

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

15) Power given Electric Potential Difference and Resistance

Open Calculator

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

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

Resistance

16) Equivalent Resistance in Parallel

Open Calculator

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

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

17) Equivalent Resistance in Series

Open Calculator

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

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

18) Internal Resistance using Potentiometer

Open Calculator

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

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

19) Resistance

Open Calculator

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

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

20) Resistance of Wire

Open Calculator

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

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

21) Resistance on Stretching of Wire

Open Calculator

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

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

22) Resistivity of Material

Open Calculator

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

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

23) Temperature Dependence of Resistance

Open Calculator

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

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

Voltage and Current Measuring Instruments

24) Current in Potentiometer

Open Calculator

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

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

25) EMF of Unknown Cell using Potentiometer

Open Calculator

fx $$\varepsilon = \frac{\varepsilon' \cdot L}{l_2}$$

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

26) Metre Bridge

Open Calculator

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

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

27) Ohm's Law

Open Calculator

fx $$V = I \cdot R$$

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

28) Potential Difference through Voltmeter

Open Calculator

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

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

29) Potential Gradient through Potentiometer

Open Calculator

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

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

30) Shunt in Ammeter

Open Calculator

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

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

Variables Used

- **ΔT** Change in Temperature *(Kelvin)*
- **A** Cross-Sectional Area *(Square Millimeter)*
- **A_{cond}** Area of Conductor *(Square Millimeter)*
- **E** Electric Field *(Volt per Meter)*
- **e^-** Number of Electrons
- **I** Electric Current *(Ampere)*
- **I** Electric Current *(Ampere)*
- **I_G** Electric Current through Galvanometer *(Ampere)*
- **J** Electric Current Density *(Ampere per Square Millimeter)*
- **l** Length of Conductor *(Meter)*
- **L** Length *(Millimeter)*
- **l_2** 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_{eq}** Equivalent Resistance *(Ohm)*
- **R_G** Resistance through Galvanometer *(Ohm)*
- **R_{ref}** Resistance at Reference Temperature *(Ohm)*
- **R_{sh}** Shunt *(Ohm)*

- T_{Total} Total Time Taken *(Second)*
- **V** Voltage *(Volt)*
- V_B Electric Potential Diff through other Terminal *(Volt)*
- V_d Drift Speed *(Millimeter per Second)*
- $V_{electromotive}$ Electromotive Voltage *(Volt)*
- **x** Potential Gradient *(Volt per Meter)*
- **α** Temperature Coefficient of Resistance *(Per Degree Celsius)*
- **ΔV** Electric Potential Difference *(Volt)*
- **ΔV** Electric Potential Difference *(Volt)*
- **ε** Electromotive Force *(Volt)*
- **ε'** EMF of Unknown Cell using Potentiometer *(Volt)*
- **ρ** Resistivity *(Ohm Millimeter)*
- **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 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 (mm²)
  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/mm²)
  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 ($°C^{-1}$)
  Temperature Coefficient of Resistance Unit Conversion

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