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# Capacitor Formulas

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# List of 19 Capacitor Formulas

## Capacitor

## Capacitance

### 1) Capacitance

Open Calculator

fx $$C = K \cdot \frac{q}{V}$$

ex $$0.01125F = 4.5 \cdot \frac{0.3C}{120V}$$

### 2) Capacitance for Parallel Plate Capacitors with Dielectric between them

Open Calculator

fx $$C = \frac{\varepsilon \cdot K \cdot A_{plate}}{d}$$

ex $$0.036F = \frac{5 \cdot 4.5 \cdot 400mm^2}{250mm}$$

### 3) Capacitance of Cylindrical Capacitor

Open Calculator

fx $$C = \frac{K \cdot l}{2 \cdot [Coulomb] \cdot (r_2 - r_1)}$$

ex $$3.2E\hat{}\text{-}16F = \frac{4.5 \cdot 0.006mm}{2 \cdot [Coulomb] \cdot (7500mm - 2750mm)}$$

### 4) Capacitance of Parallel Plate Capacitor

Open Calculator

fx $$C_{\parallel} = \frac{K \cdot [\text{Permitivity-vacuum}] \cdot A_{plate}}{r}$$

ex $$1.3\text{E}\hat{}\text{-}14\text{F} = \frac{4.5 \cdot [\text{Permitivity-vacuum}] \cdot 400\text{mm}^2}{1200\text{mm}}$$

### 5) Capacitance of Spherical Capacitor

Open Calculator

fx $$C = \frac{K \cdot R_s \cdot a_{shell}}{[\text{Coulomb}] \cdot (a_{shell} - R_s)}$$

ex $$3.5\text{E}\hat{}\text{-}9\text{F} = \frac{4.5 \cdot 1300\text{mm} \cdot 1600\text{mm}}{[\text{Coulomb}] \cdot (1600\text{mm} - 1300\text{mm})}$$

### 6) Capacitor with Dielectric

Open Calculator

fx $$C = \frac{\varepsilon \cdot a \cdot A_{plate}}{d}$$

ex $$0.0192\text{F} = \frac{5 \cdot 2.4 \cdot 400\text{mm}^2}{250\text{mm}}$$

## Current Density

### 7) Current Density given Conductivity

Open Calculator

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

ex $$6\text{E}\hat{}\text{-}5\text{A/mm}^2 = 0.1\text{S/m} \cdot 600\text{V/m}$$

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

Open Calculator

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

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

### 9) Current Density given Resistivity

Open Calculator

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

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

## Energy Density and Energy Stored

### 10) Energy Density given Electric Field

Open Calculator

fx $$U = \frac{1}{2 \cdot \varepsilon \cdot E^2}$$

ex $$2.8E\hat{}\text{-}7J = \frac{1}{2 \cdot 5 \cdot (600 V/m)^2}$$

## 11) Energy Density in Electric Field

Open Calculator

fx $$U = \frac{1}{2} \cdot [\text{Permitivity-vacuum}] \cdot E^2$$

ex $$1.6\text{E}\hat{}\text{-}6\text{J} = \frac{1}{2} \cdot [\text{Permitivity-vacuum}] \cdot (600\text{V/m})^2$$

## 12) Energy Density in Electric Field given Free Space Permittivity

Open Calculator

fx $$U = \frac{1}{2 \cdot \varepsilon \cdot E^2}$$

ex $$2.8\text{E}\hat{}\text{-}7\text{J} = \frac{1}{2 \cdot 5 \cdot (600\text{V/m})^2}$$

## 13) Energy Stored in Capacitor given Capacitance and Voltage

Open Calculator

fx $$U_e = \frac{1}{2} \cdot C \cdot V^2$$

ex $$28800\text{J} = \frac{1}{2} \cdot 4\text{F} \cdot (120\text{V})^2$$

## 14) Energy Stored in Capacitor given Charge and Capacitance

Open Calculator

fx $$U_e = \frac{q^2}{2 \cdot C}$$

ex $$0.01125\text{J} = \frac{(0.3\text{C})^2}{2 \cdot 4\text{F}}$$

### 15) Energy Stored in Capacitor given Charge and Voltage

Open Calculator

fx $$U_e = \frac{1}{2} \cdot q \cdot V$$

ex $$18J = \frac{1}{2} \cdot 0.3C \cdot 120V$$

### 16) Force between Parallel Plate Capacitors

Open Calculator

fx $$F = \frac{q^2}{2 \cdot C_{||} \cdot r}$$

ex $$0.075N = \frac{(0.3C)^2}{2 \cdot 0.5F \cdot 1200mm}$$

## Equivalent Capacitance

### 17) Equivalent Capacitance for Two Capacitors in Parallel

Open Calculator

fx $$C = C_1 + C_2$$

ex $$9F = 6F + 3F$$

### 18) Equivalent Capacitance for Two Capacitors in Series

Open Calculator

fx $$C = \frac{C_1 \cdot C_2}{C_1 + C_2}$$

ex $$2F = \frac{6F \cdot 3F}{6F + 3F}$$

## 19) Equivalent Resistance in Series

Open Calculator

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

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

# Variables Used

- **a** Constant a
- $A_{cond}$ Area of Conductor *(Square Millimeter)*
- $A_{plate}$ Area of Plates *(Square Millimeter)*
- $a_{shell}$ Radius of Shell *(Millimeter)*
- **C** Capacitance *(Farad)*
- $C_{\parallel}$ Parallel Plate Capacitance *(Farad)*
- $C_1$ Capacitance of Capacitor 1 *(Farad)*
- $C_2$ Capacitance of Capacitor 2 *(Farad)*
- **d** Distance between Deflecting Plates *(Millimeter)*
- **E** Electric Field *(Volt per Meter)*
- **E** Electric Field *(Volt per Meter)*
- **F** Force *(Newton)*
- **I** Electric Current *(Ampere)*
- **J** Electric Current Density *(Ampere per Square Millimeter)*
- **K** Dielectric Constant
- **l** Length of Cylinder *(Millimeter)*
- **q** Charge *(Coulomb)*
- **r** Distance between Two Masses *(Millimeter)*
- **R** Resistance *(Ohm)*
- $r_1$ Inner Radius of Cylinder *(Millimeter)*
- $r_2$ Outer Radius of Cylinder *(Millimeter)*
- $R_{eq}$ Equivalent Resistance *(Ohm)*

- $R_s$ Radius of Sphere *(Millimeter)*
- **U** Energy Density *(Joule)*
- $U_e$ Electrostatic Potential Energy *(Joule)*
- **V** Voltage *(Volt)*
- **ε** Permittivity
- **ρ** Resistivity *(Ohm Millimeter)*
- **σ** Conductivity *(Siemens per Meter)*
- **Ω** Final Resistance *(Ohm)*

# Constants, Functions, Measurements used

- Constant: **[Coulomb]**, 8.9875517923E9 Newton * Meter ^2 / Coulomb ^2
  *Coulomb constant*
- Constant: **[Permitivity-vacuum]**, 8.85E-12 Farad / Meter
  *Permittivity of vacuum*
- Measurement: **Length** in Millimeter (mm)
  *Length Unit Conversion*
- Measurement: **Electric Current** in Ampere (A)
  *Electric Current Unit Conversion*
- Measurement: **Area** in Square Millimeter (mm²)
  *Area Unit Conversion*
- Measurement: **Energy** in Joule (J)
  *Energy Unit Conversion*
- Measurement: **Electric Charge** in Coulomb (C)
  *Electric Charge Unit Conversion*
- Measurement: **Force** in Newton (N)
  *Force Unit Conversion*
- Measurement: **Capacitance** in Farad (F)
  *Capacitance 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: **Electric Conductivity** in Siemens per Meter (S/m)
  *Electric Conductivity Unit Conversion*

## Check other formula lists

- **Capacitor Formulas**
- **Electromagnetic Induction Formulas**
- **Electrostatics Formulas**
- **Magnetic Field due to Current Formulas**

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