Física III

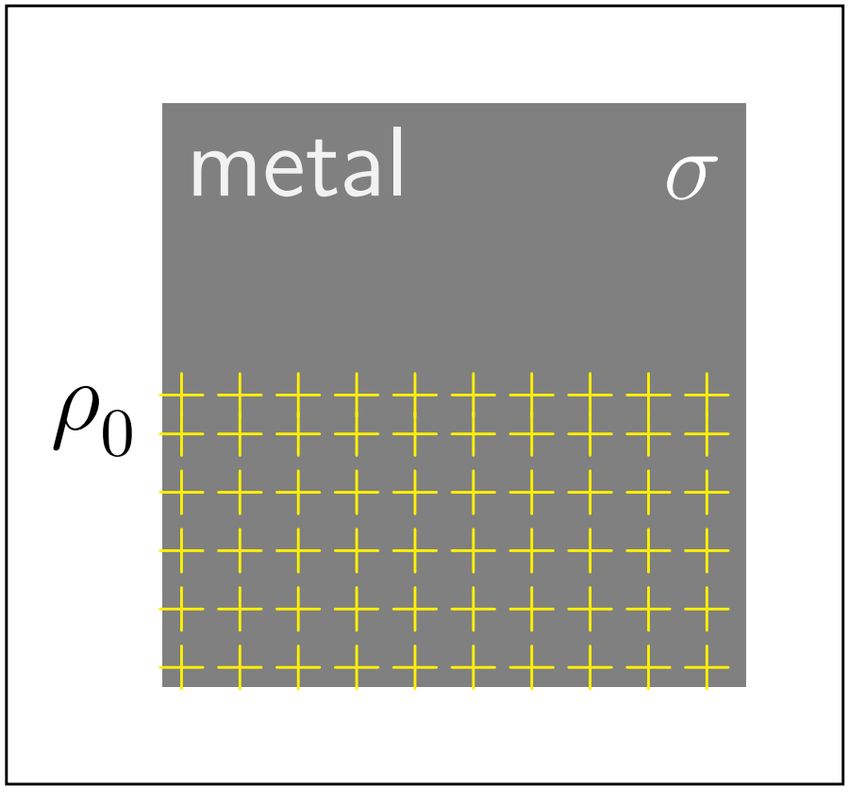
Aula *online 28/04/2020*

Capacitores

Pratique o que aprendeu:
Cargas em metal

$$\rho(0) = \rho_0$$

$$\rho(t) = \,?$$



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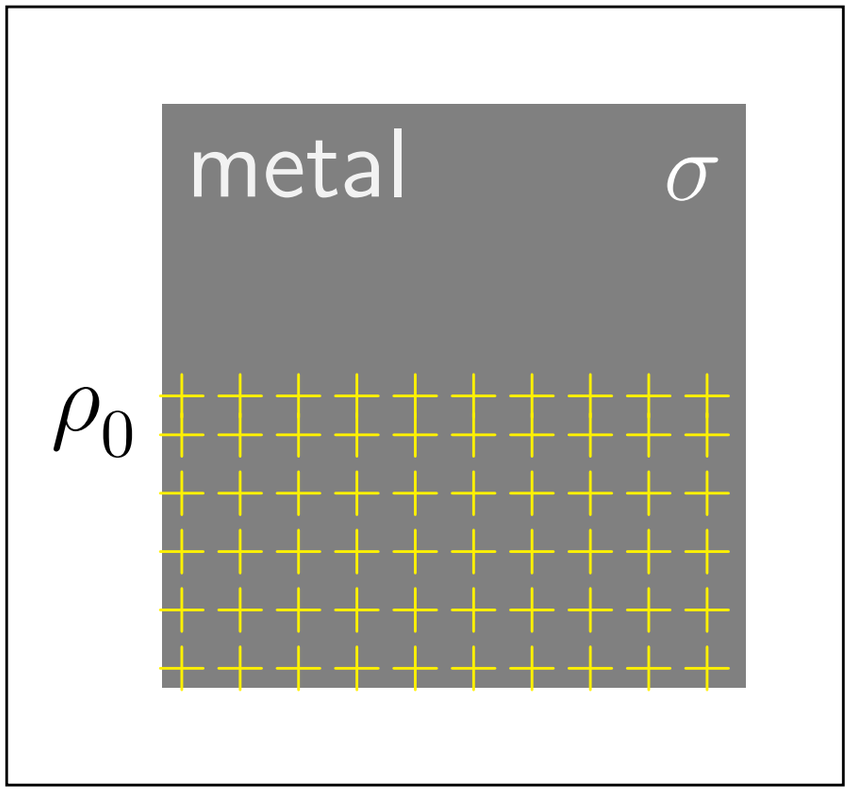

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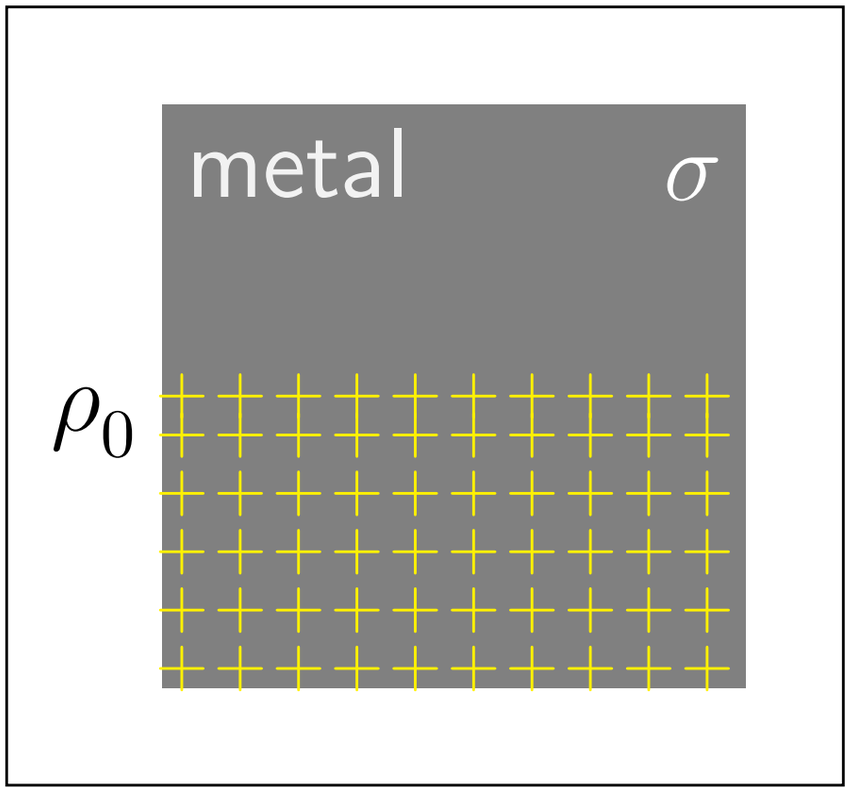

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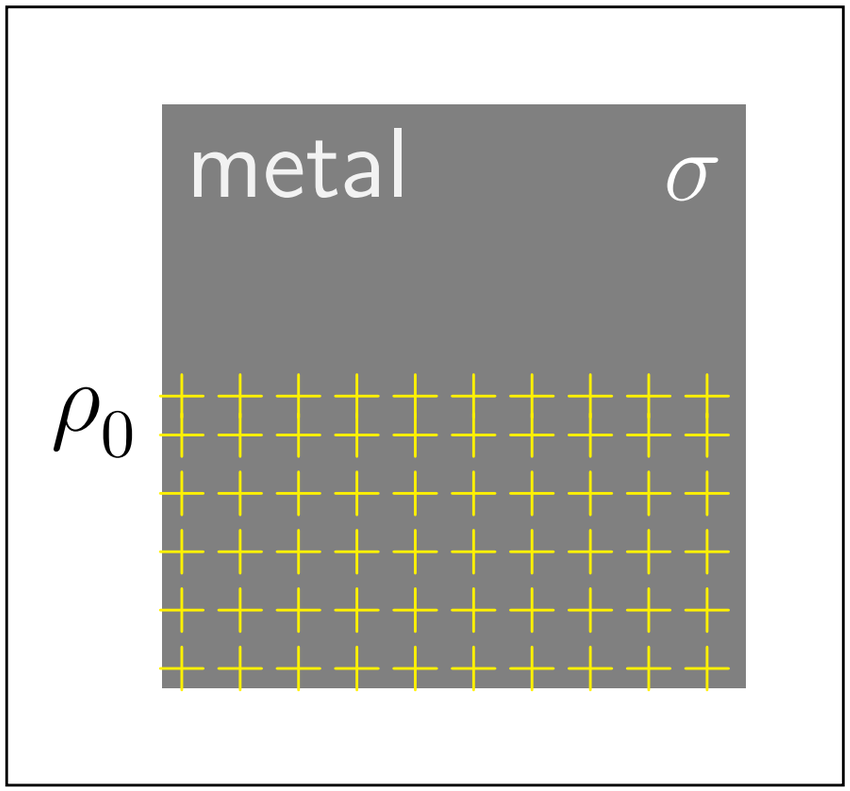

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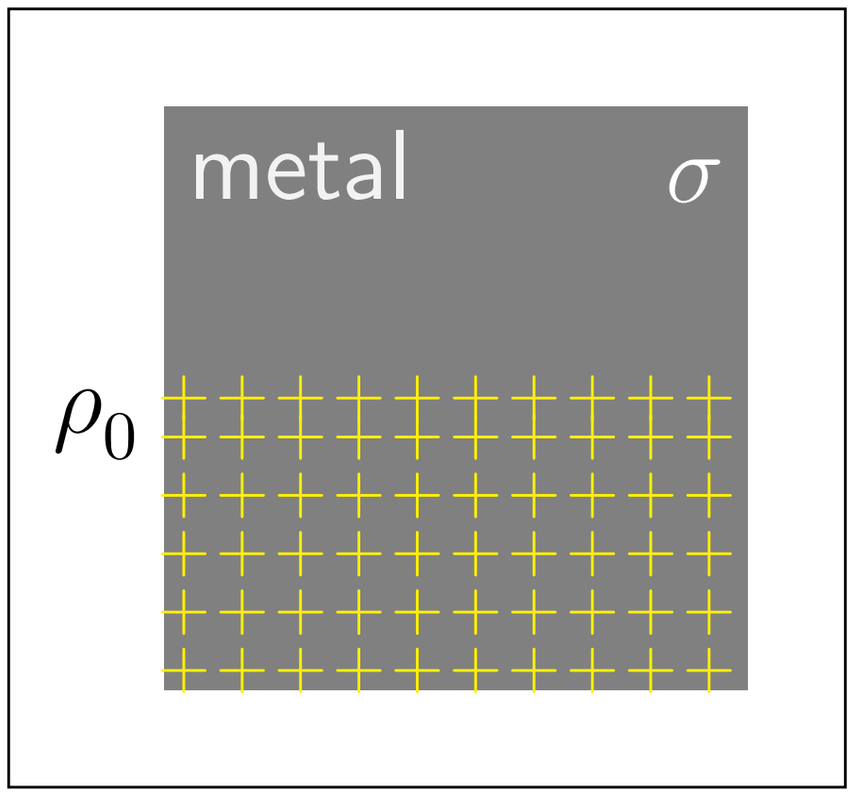

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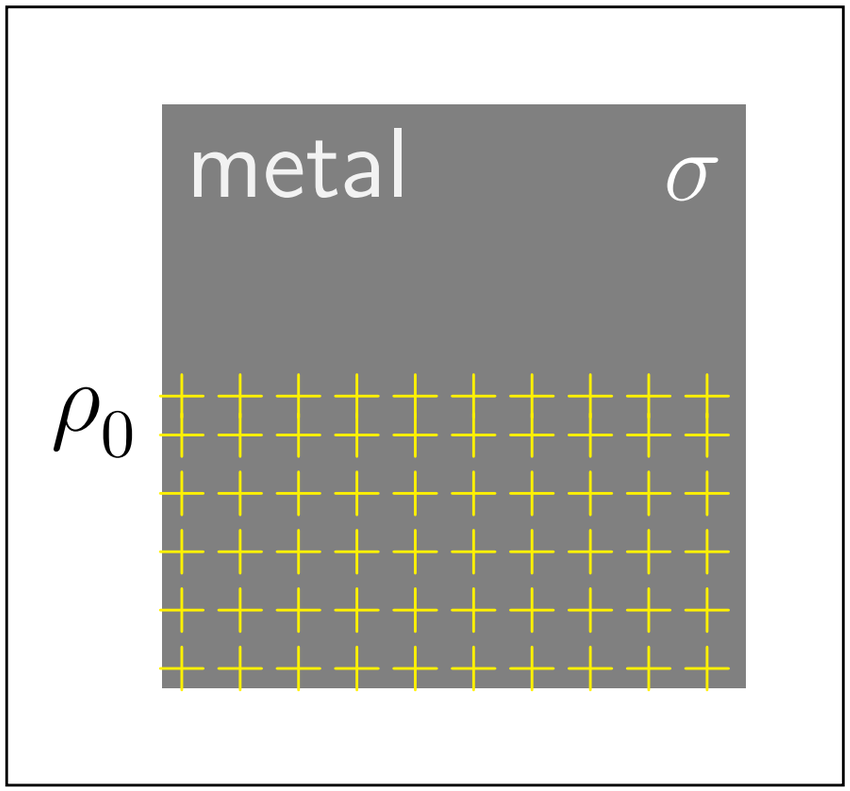

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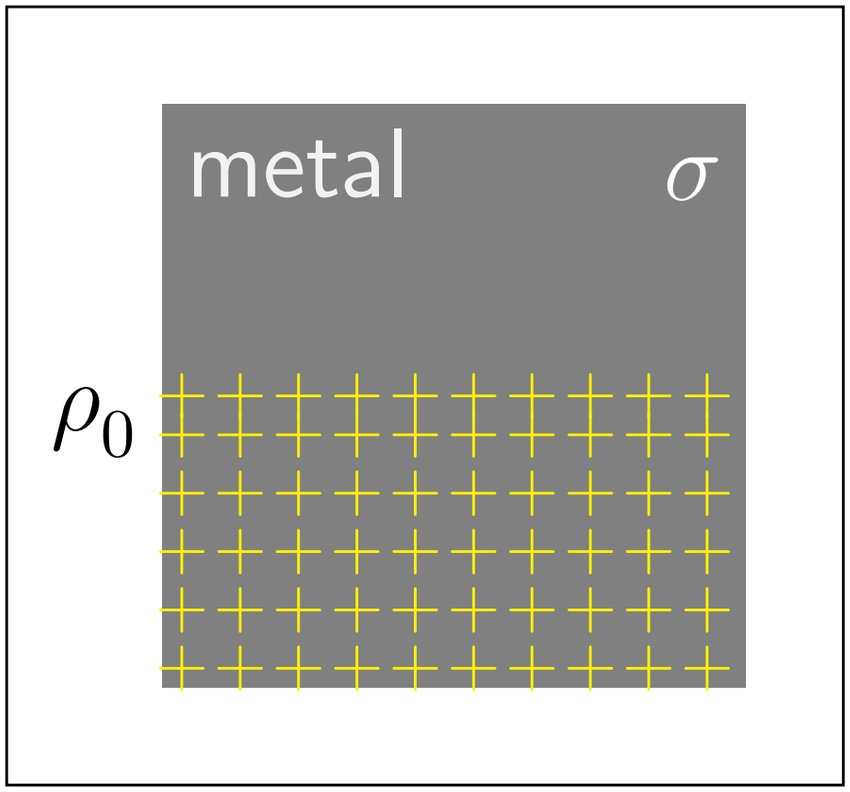

Pratique o que aprendeu:

Cargas em metal

$$\vec{\nabla} \cdot \vec{j} = \sigma \frac{\rho}{\epsilon_0}$$

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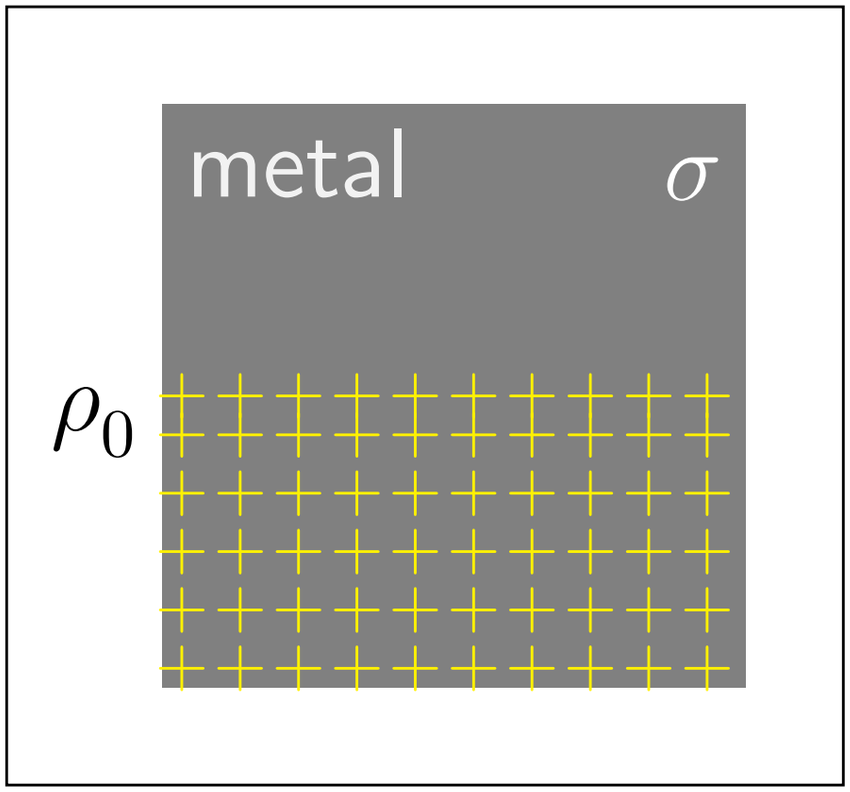

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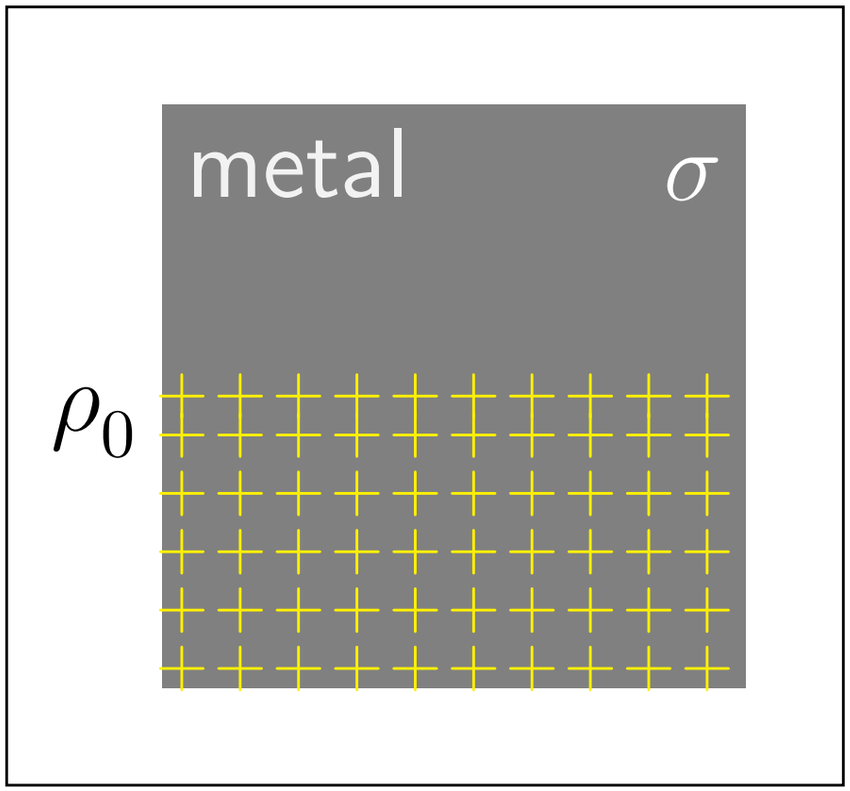

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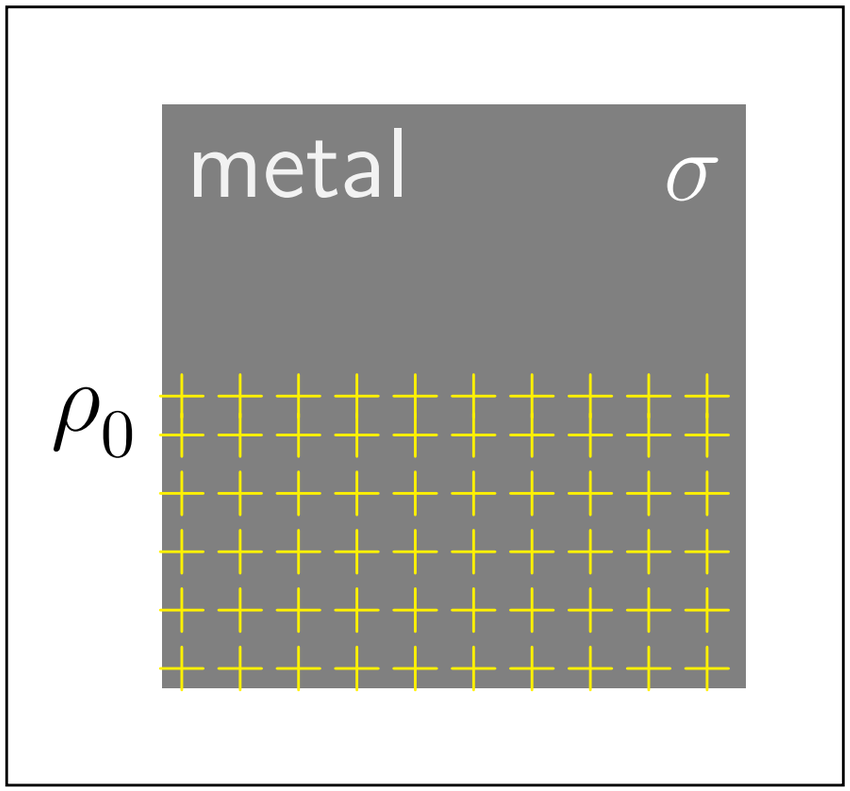

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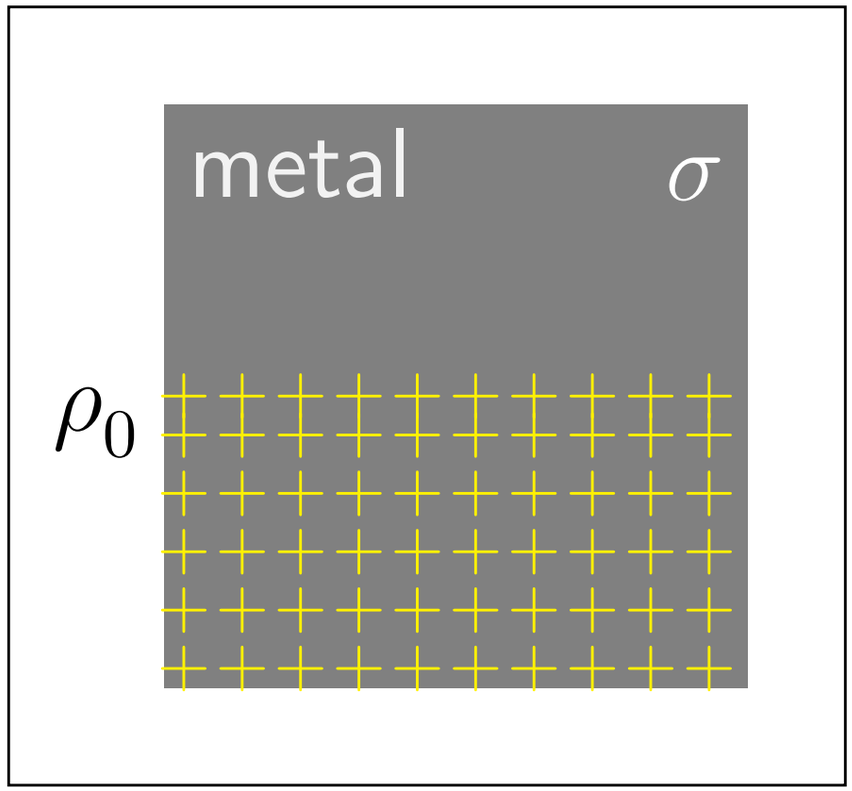

$$\rho = \rho_0 e^{-\frac{\sigma}{\epsilon_0} t}$$

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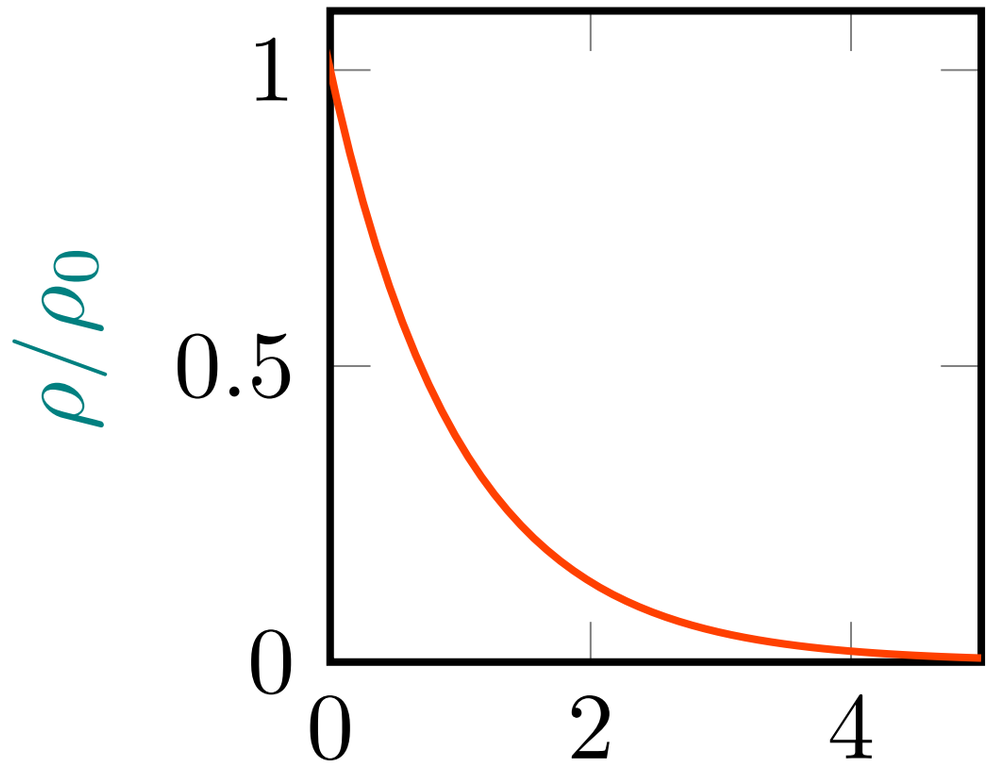

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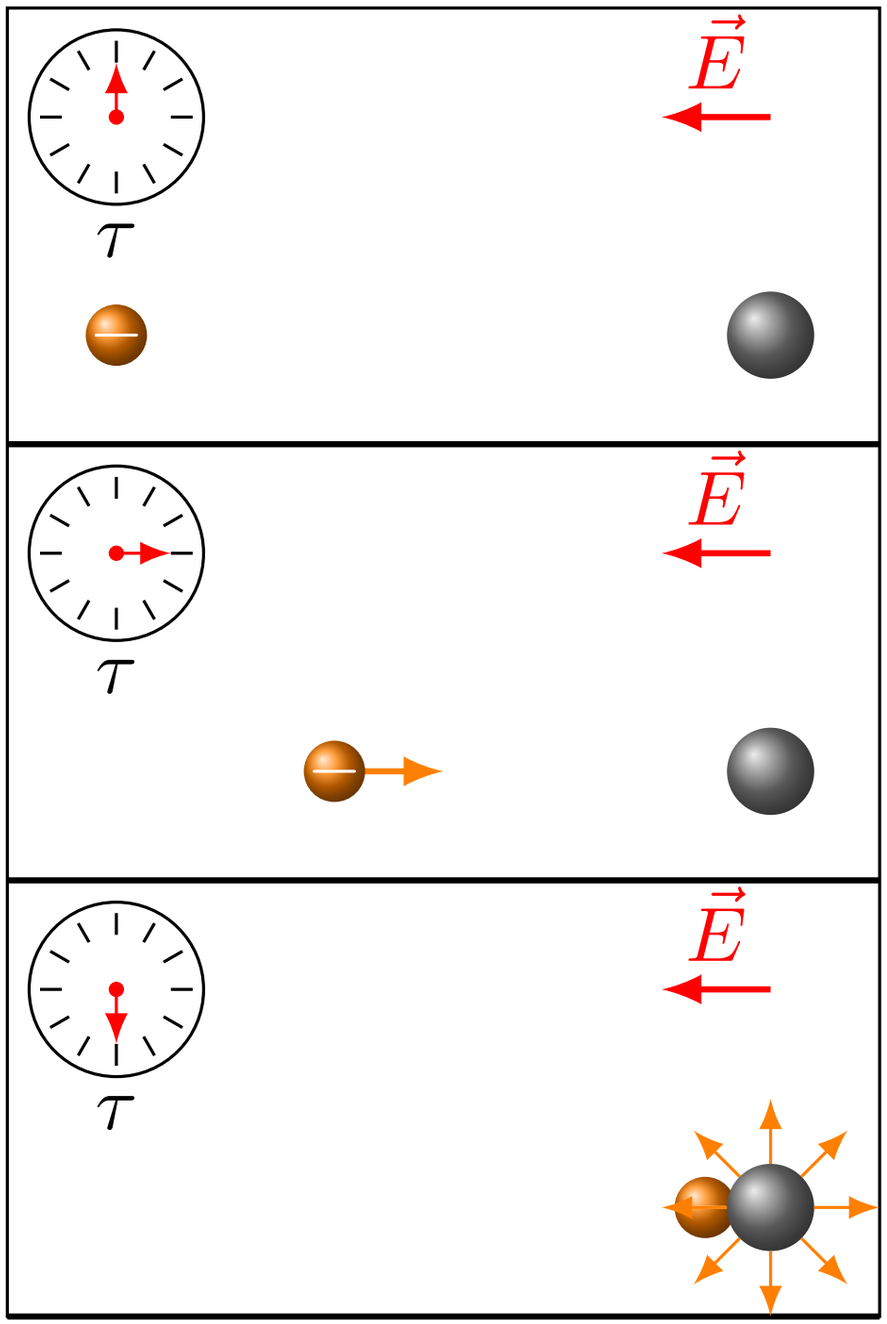
Pratique o que aprendeu:
Tempo de colisão

cobre

$\tau = ?$



Pratique o que aprendeu:
Tempo de colisão

Material	σ(S/m)
Cu	6×10^{7}
Fe	1×10^{7}
Água pura	5×10^{-6}
Borracha	1×10^{-14}

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$$j = \sigma E$$

$$j = \rho \frac{qE}{m} \frac{\tau}{2}$$

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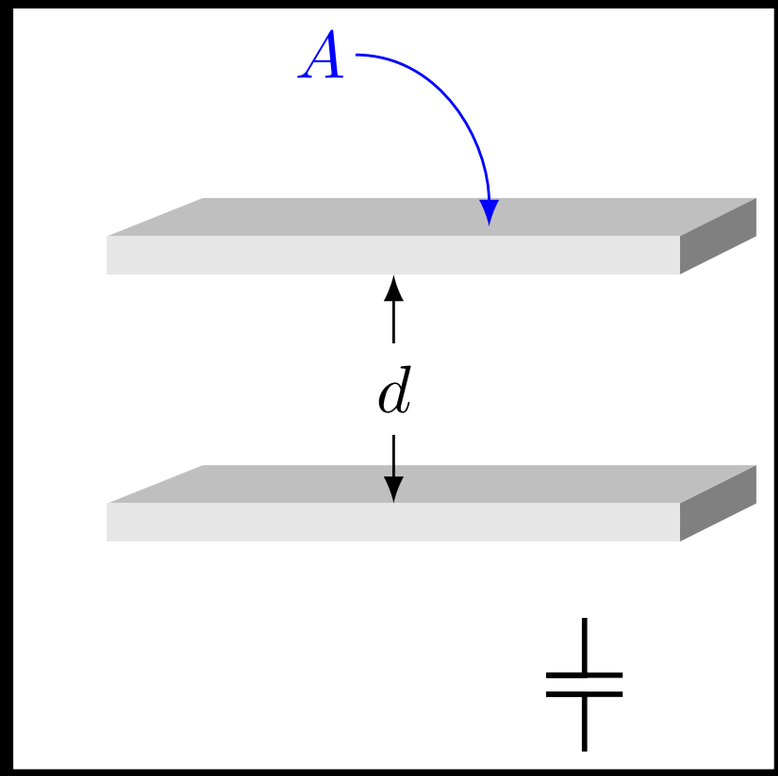
$$\left.\begin{aligned} \frac{q}{m} &= 1.8 \times 10^{11} \frac{\mathrm{C}}{\mathrm{kg}} \\ \rho &= 1.3 \times 10^{11} \frac{\mathrm{C}}{\mathrm{m}^3} \end{aligned}\right\} \quad \tau = 5 \times 10^{-15}\mathrm{s}$$

Capacitor

$A = 1\text{cm}^2$

$d = 0.1\text{mm}$



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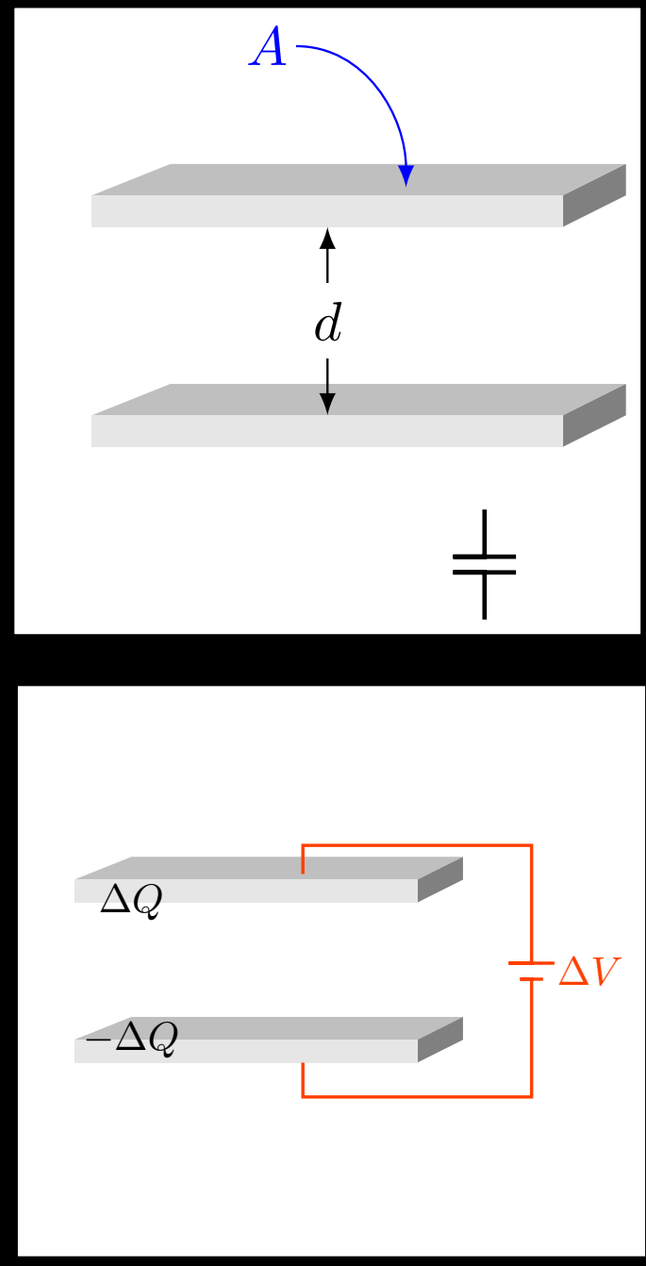

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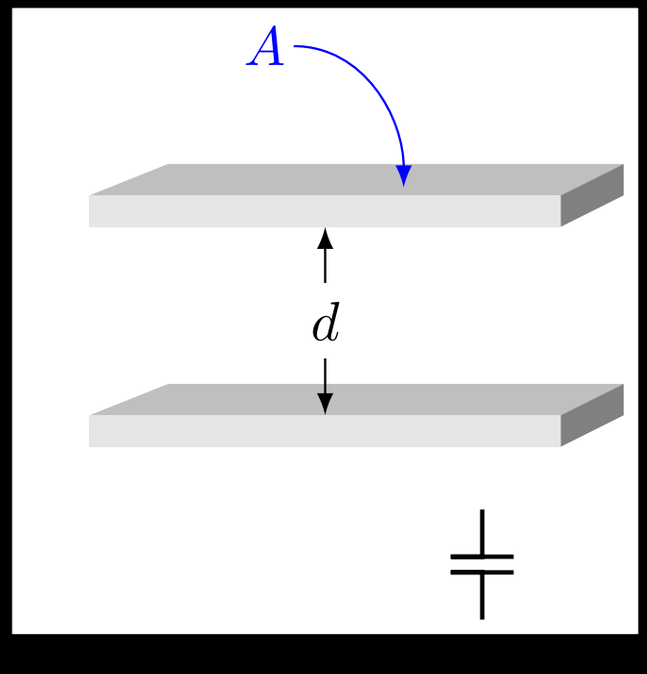
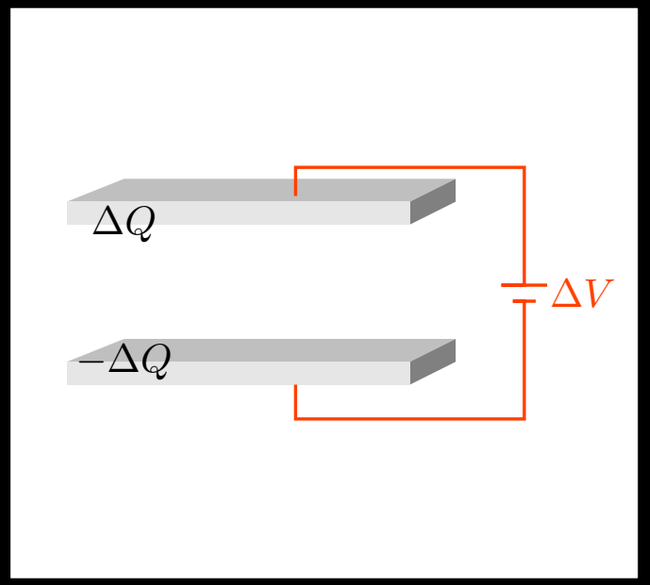
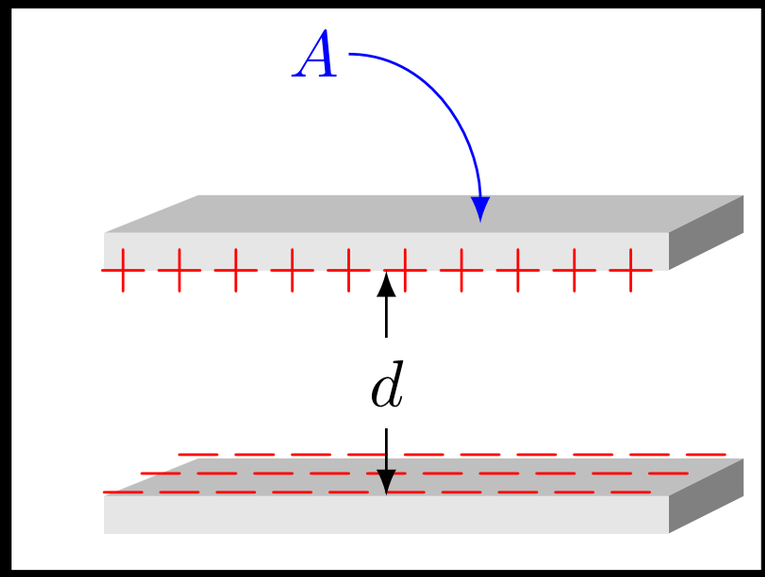
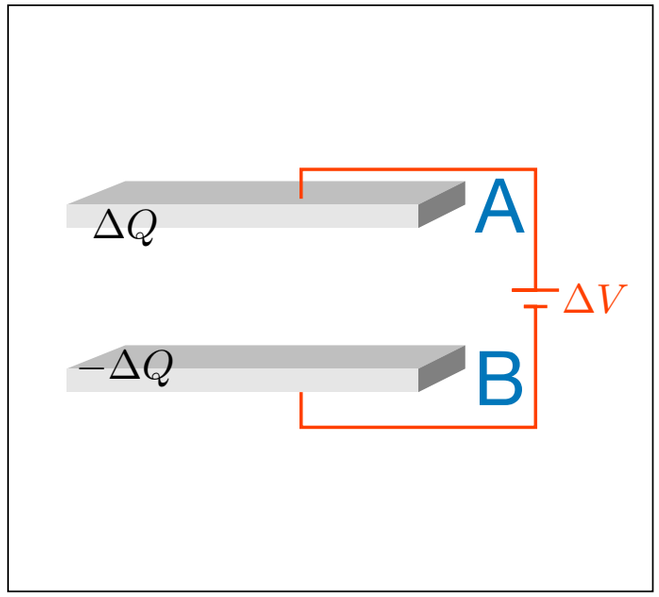


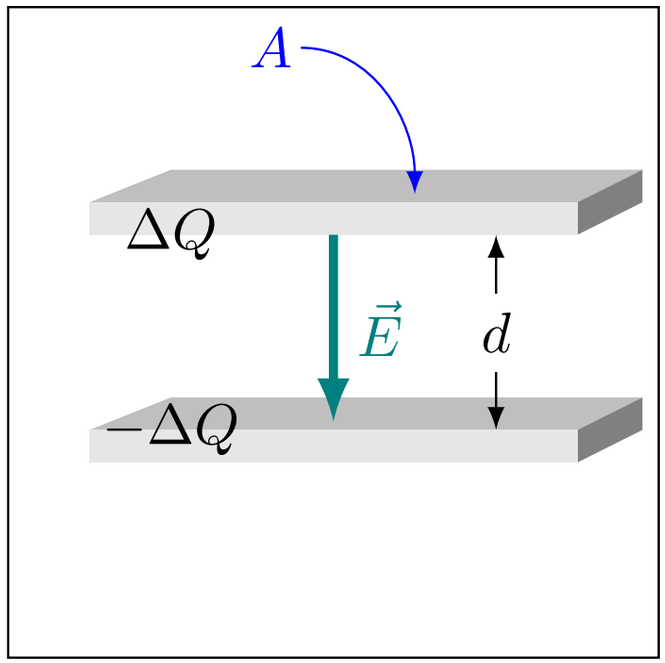




Capacitor

$$V_A - V_B = -\int_B^A \vec{E} \cdot \mathrm{d}\vec{r}$$

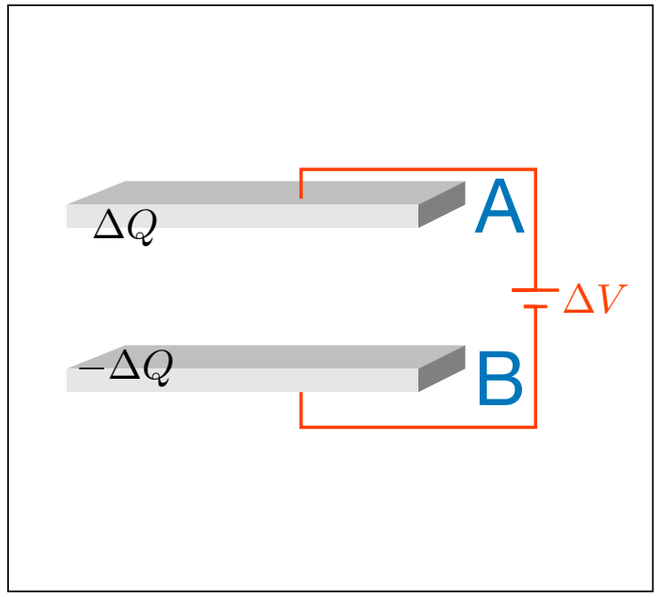


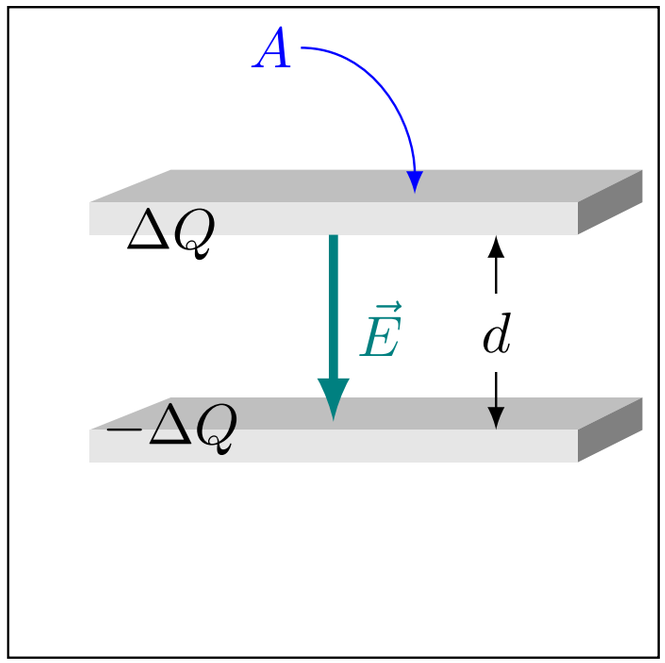


Capacitor

$$V_A - V_B = -\int_B^A \vec{E} \cdot \mathrm{d}\vec{r}$$

$$\Delta V = \int_A^B \vec{E} \cdot \mathrm{d}\vec{r}$$



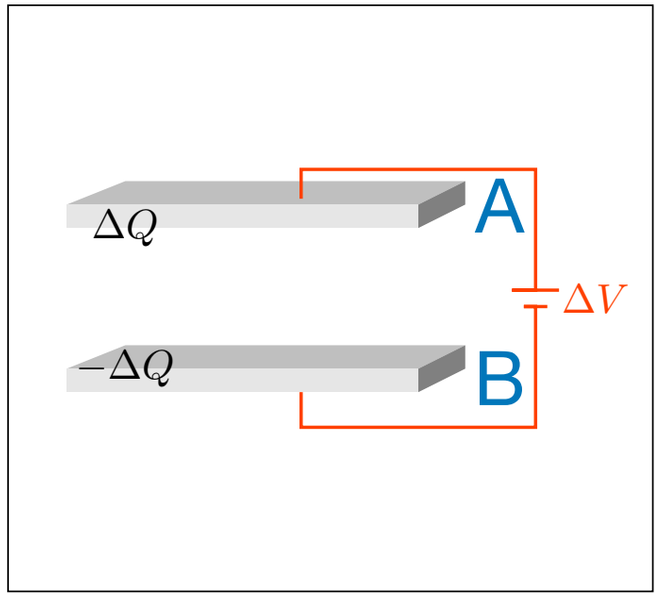


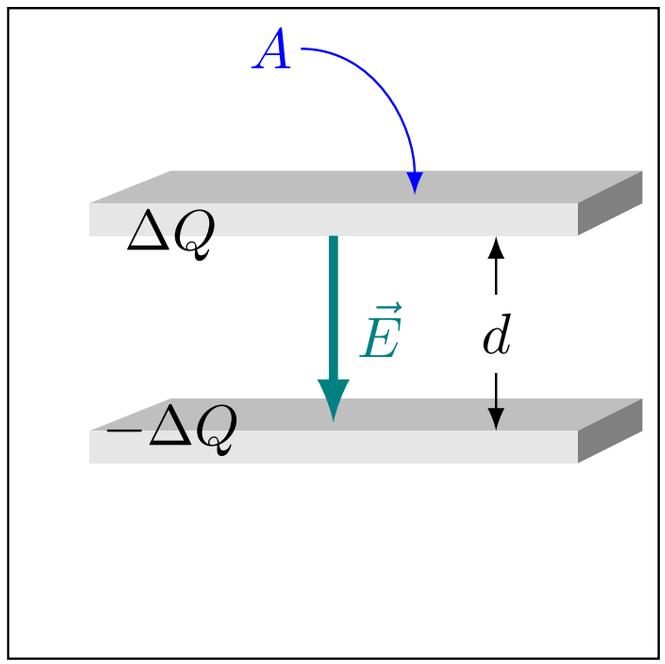
Capacitor

$$V_A - V_B = -\int_B^A \vec{E} \cdot \mathrm{d}\vec{r}$$

$$\Delta V = \int_A^B \vec{E} \cdot \mathrm{d}\vec{r}$$

$$\Delta V = Ed$$





Capacitor

$$V_A - V_B = -\int_B^A \vec{E} \cdot \mathrm{d}\vec{r}$$

$$\Delta V = \int_A^B \vec{E} \cdot \mathrm{d}\vec{r}$$

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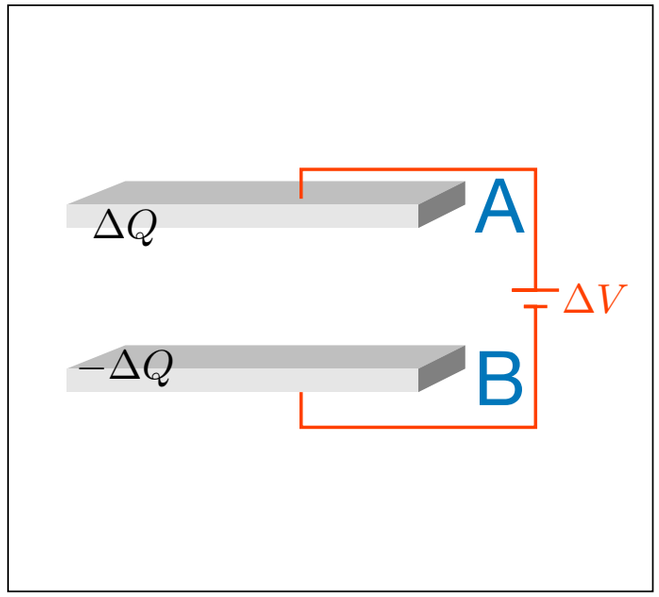
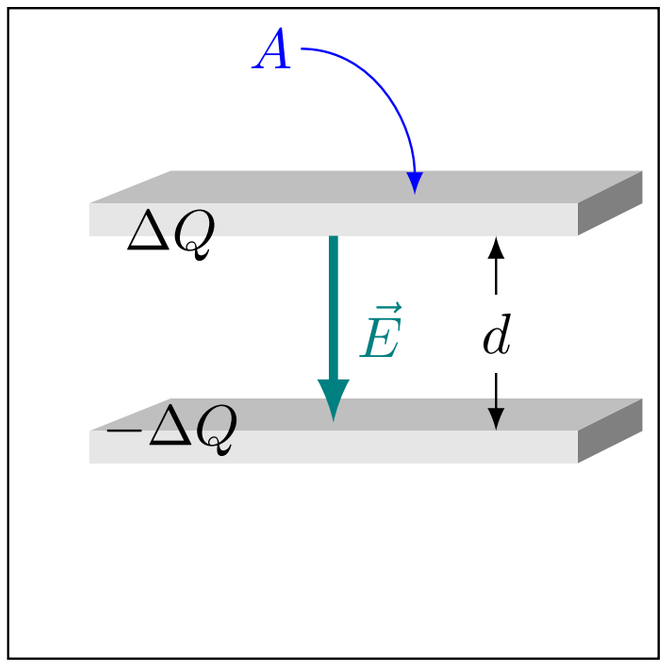
$$E = \frac{\sigma}{\epsilon_0}$$





Capacitor

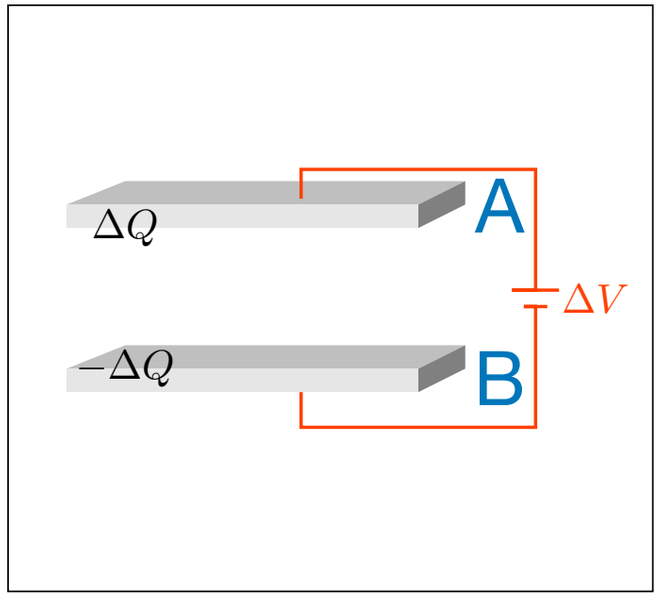
$$V_A - V_B = -\int_B^A \vec{E} \cdot \mathrm{d}\vec{r}$$

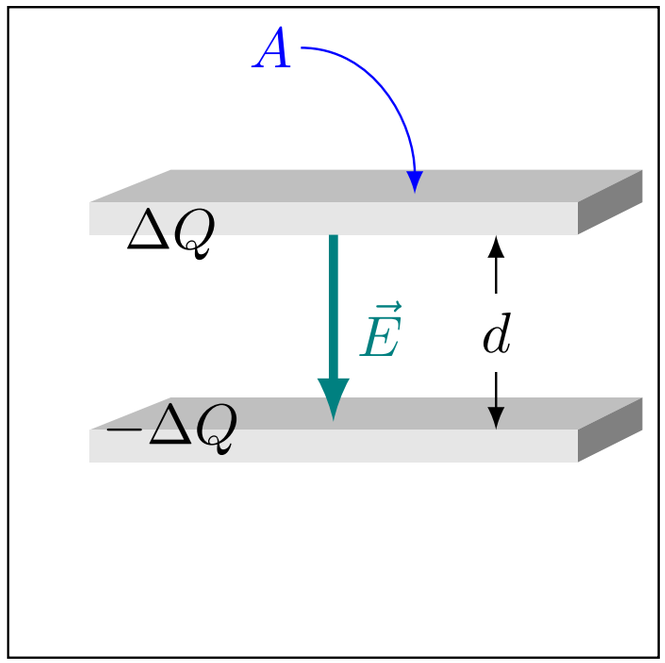
$$\Delta V = \int_A^B \vec{E} \cdot \mathrm{d}\vec{r}$$

$$\Delta V = Ed$$

$$E = \frac{\sigma}{\epsilon_0}$$

$$\Delta V = \frac{\sigma}{\epsilon_0} d$$





Capacitor

$$V_A - V_B = -\int_B^A \vec{E} \cdot \mathrm{d}\vec{r}$$

$$\Delta V = \int_A^B \vec{E} \cdot \mathrm{d}\vec{r}$$

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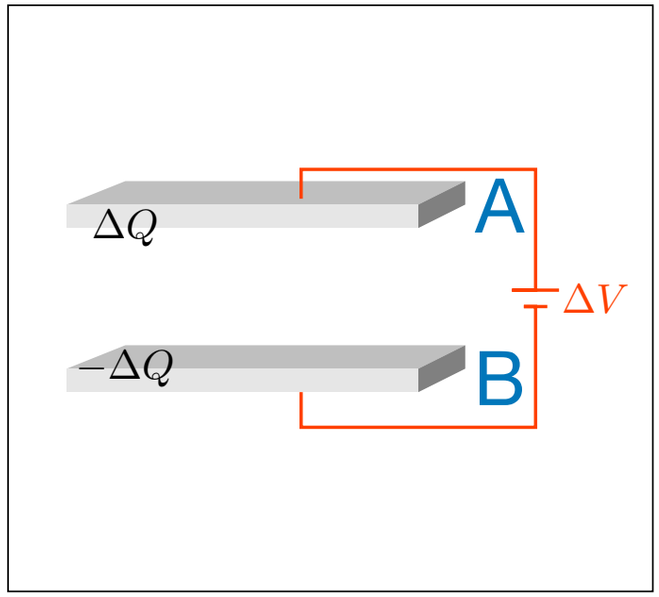
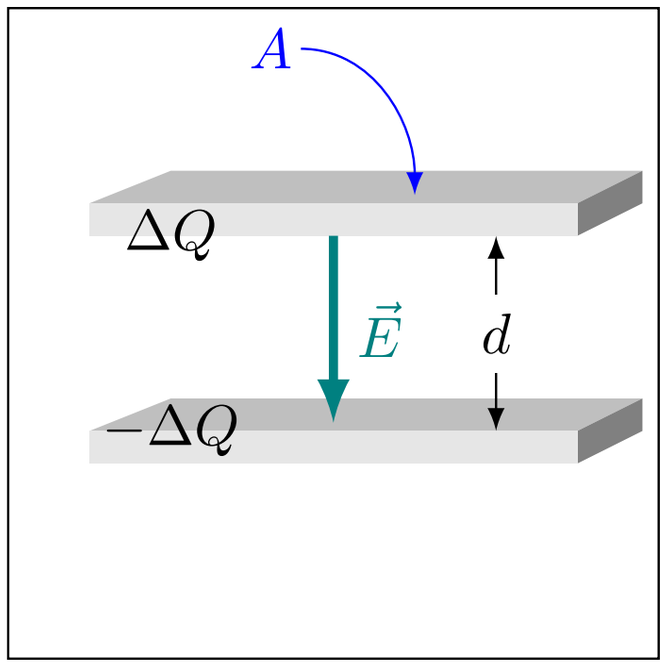
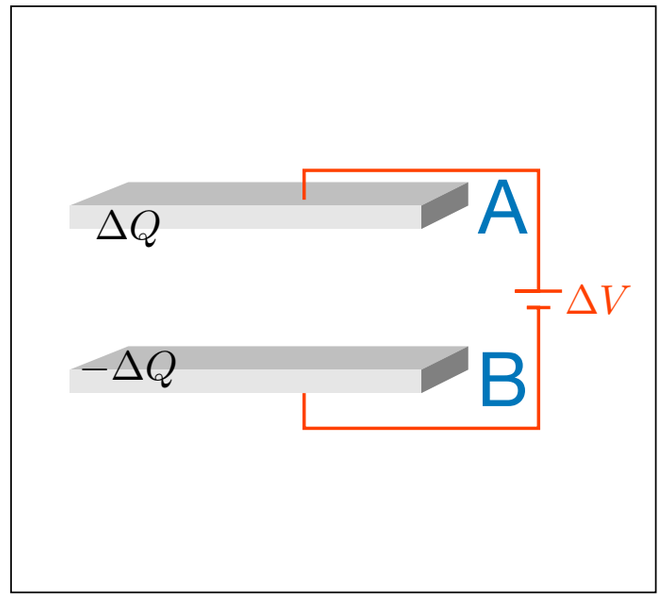
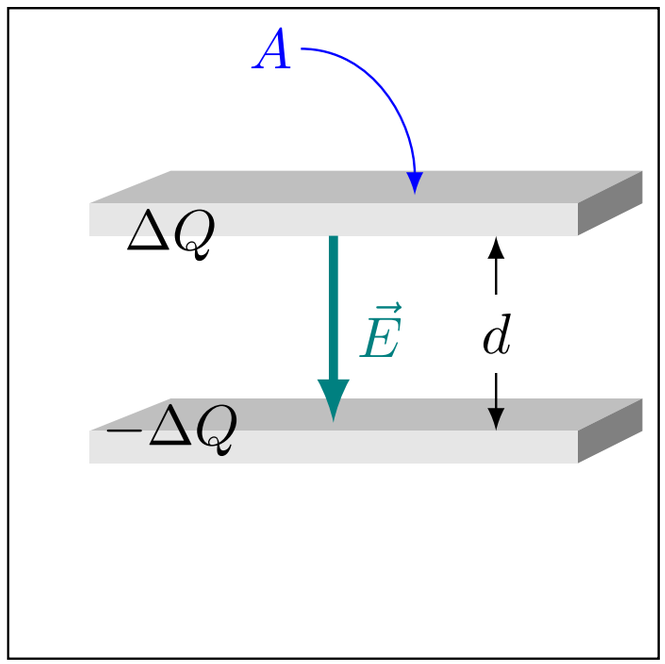




Capacitor

$$\Delta V = \frac{\sigma}{\epsilon_0} d$$

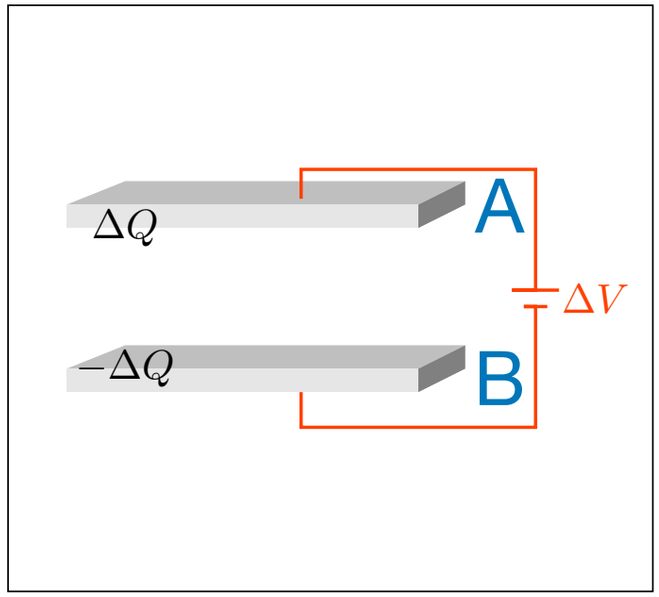


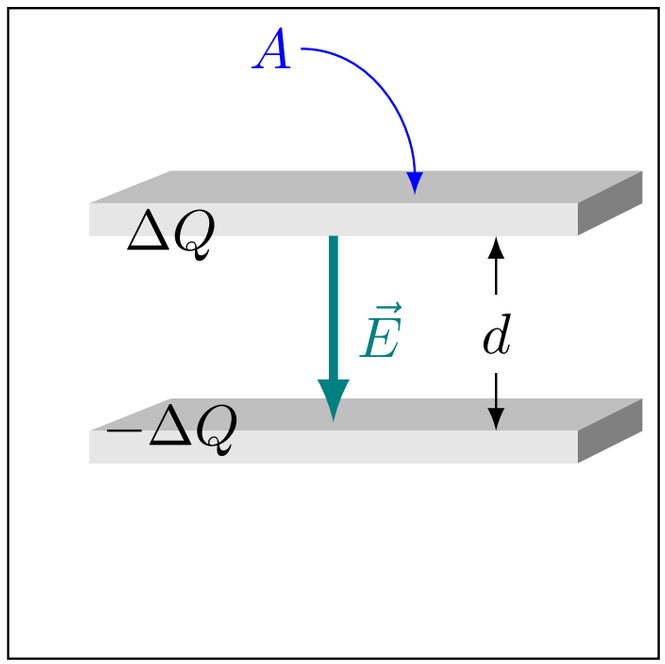


Capacitor

$$\Delta V = \frac{\sigma}{\epsilon_0} d$$

$$\Delta V = \frac{\Delta Q}{A\epsilon_0} d$$





Capacitor

$$\Delta V = \frac{\sigma}{\epsilon_0} d$$

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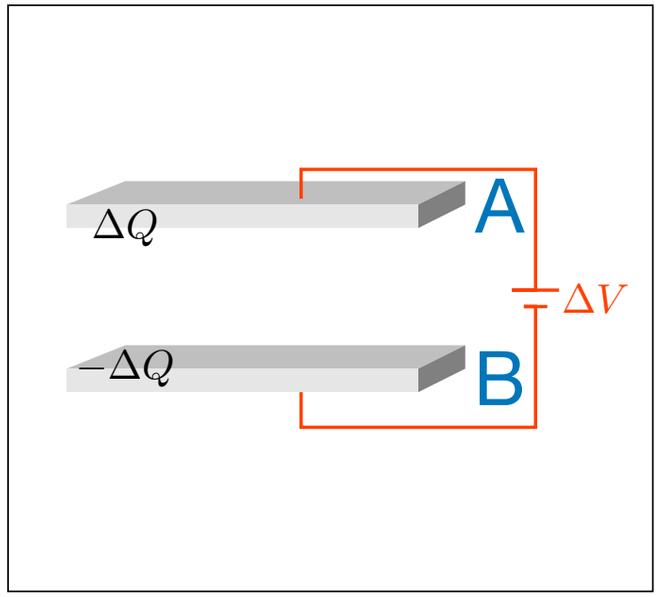
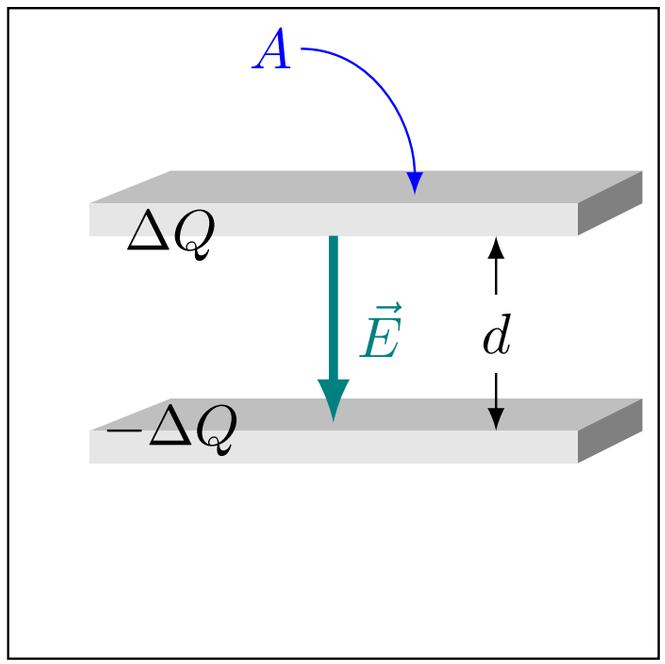
$$\Delta Q = \frac{A\epsilon_0}{d} \Delta V$$





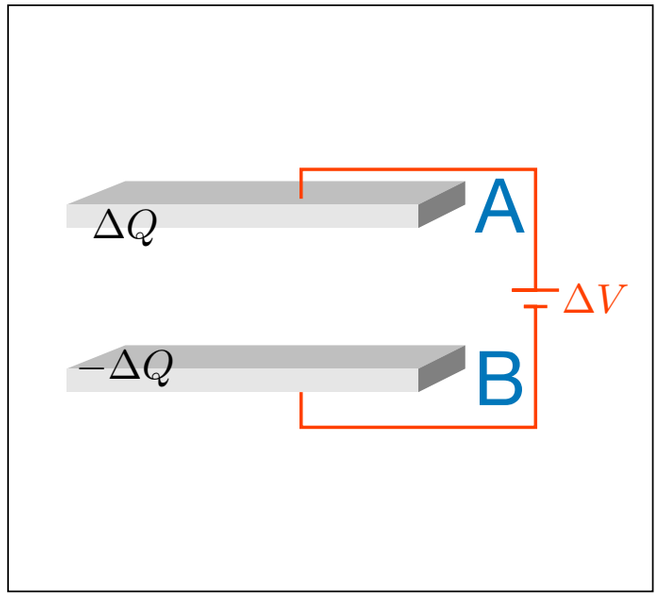
Capacitor

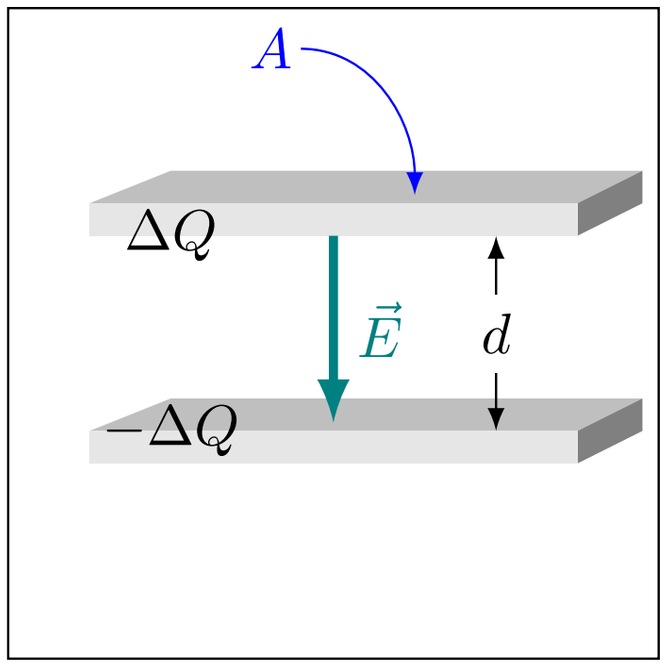
$$\Delta V = \frac{\sigma}{\epsilon_0} d$$

$$\Delta V = \frac{\Delta Q}{A\epsilon_0} d$$

$$\Delta Q = \frac{A\epsilon_0}{d} \Delta V$$

$$\Delta Q = C\Delta V$$





Capacitor

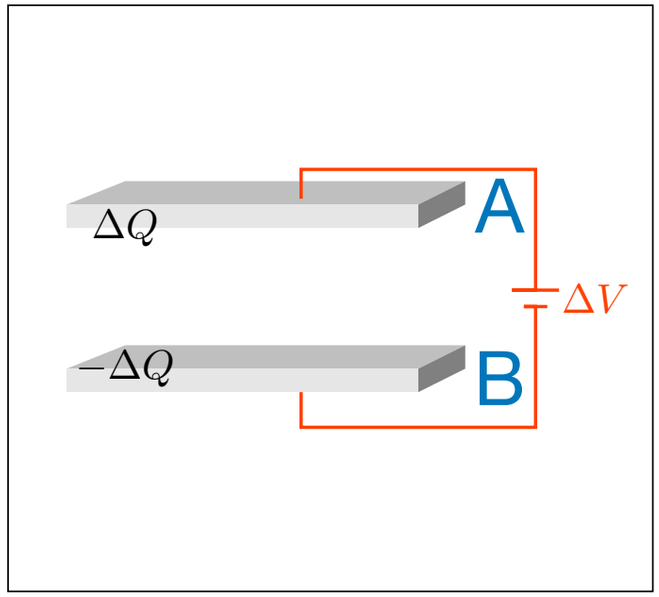
$$\Delta V = \frac{\sigma}{\epsilon_0} d$$

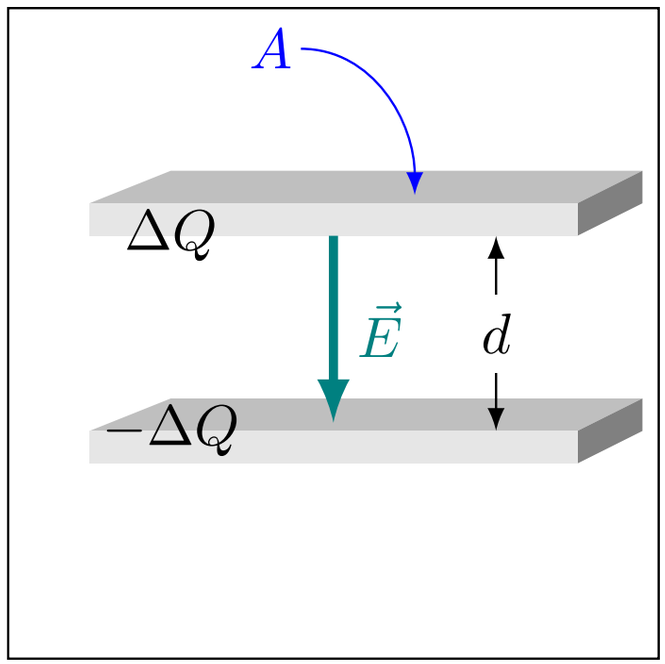
$$\Delta V = \frac{\Delta Q}{A\epsilon_0} d$$

$$\Delta Q = \frac{A\epsilon_0}{d} \Delta V$$

$$\Delta Q = C\Delta V$$

$$C = \frac{A\epsilon_0}{d}$$





Capacitor

$$\Delta V = \frac{\sigma}{\epsilon_0} d$$

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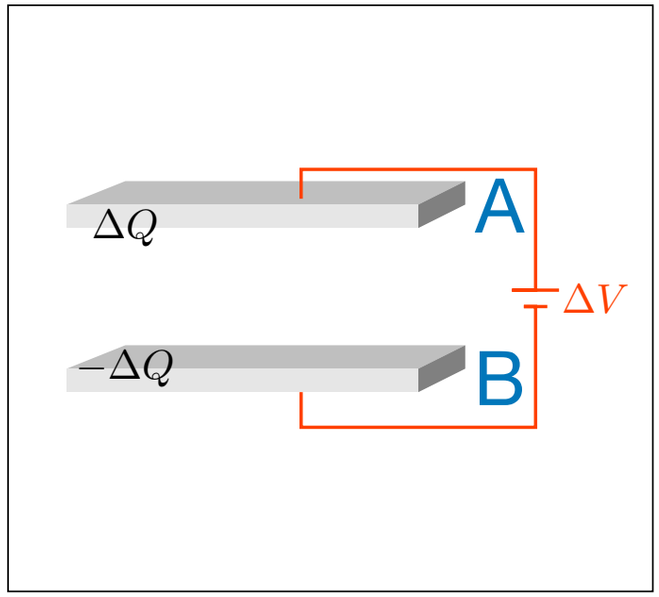
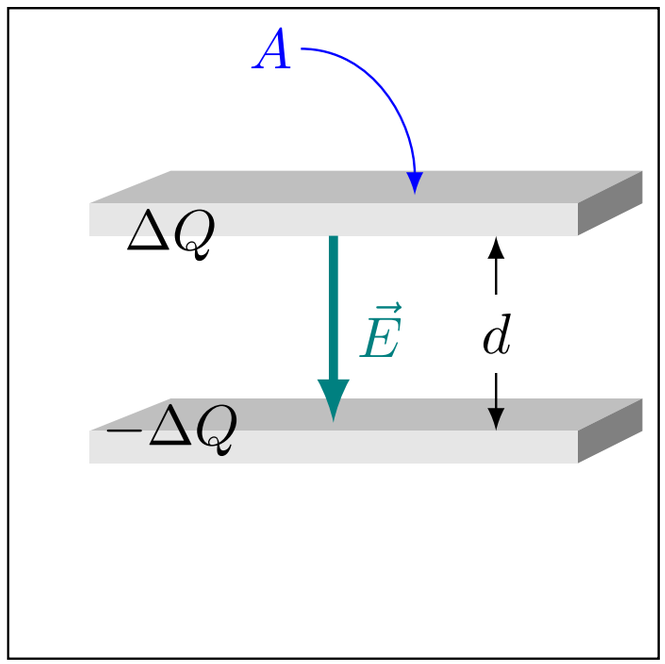
$$\Delta Q = \frac{A\epsilon_0}{d} \Delta V$$

$$\Delta Q = C\Delta V$$

$$C = \frac{A\epsilon_0}{d}$$





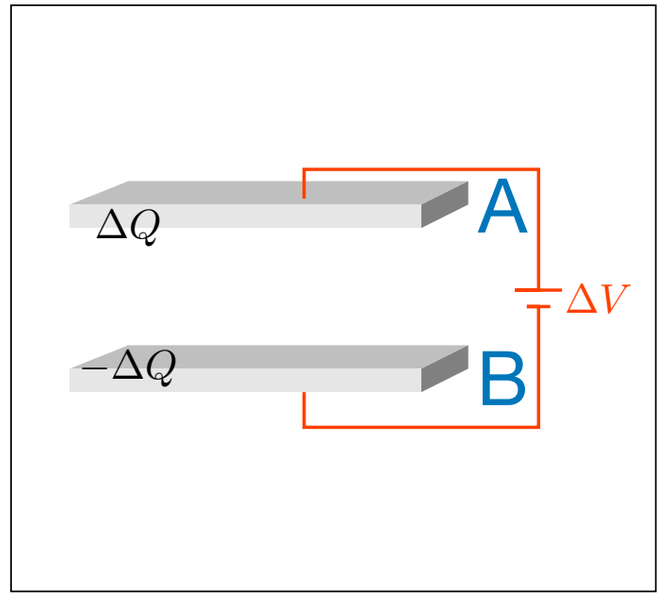
Capacitor

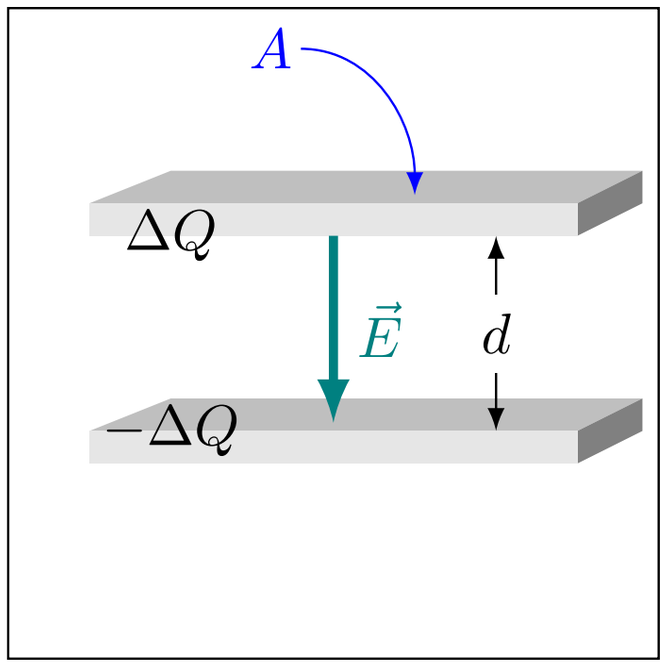
$$C = \frac{A\epsilon_0}{d}$$

$A = 1\text{cm}^2$

$d = 0.1\text{mm}$

$C = ?$





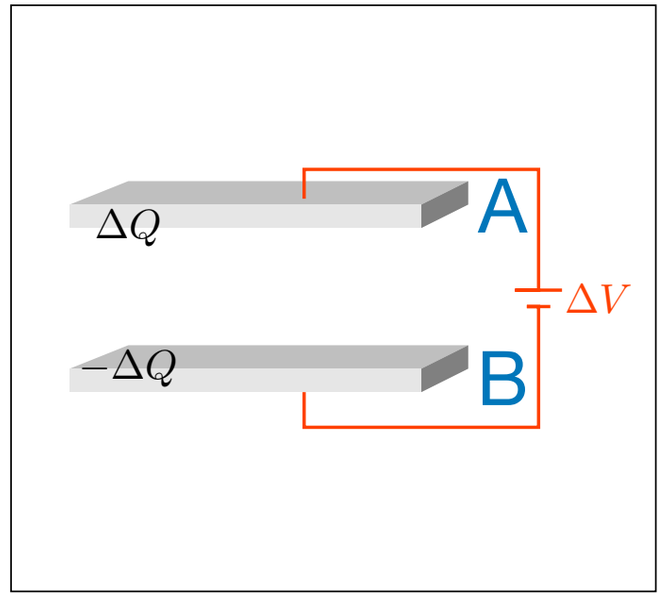
Capacitor

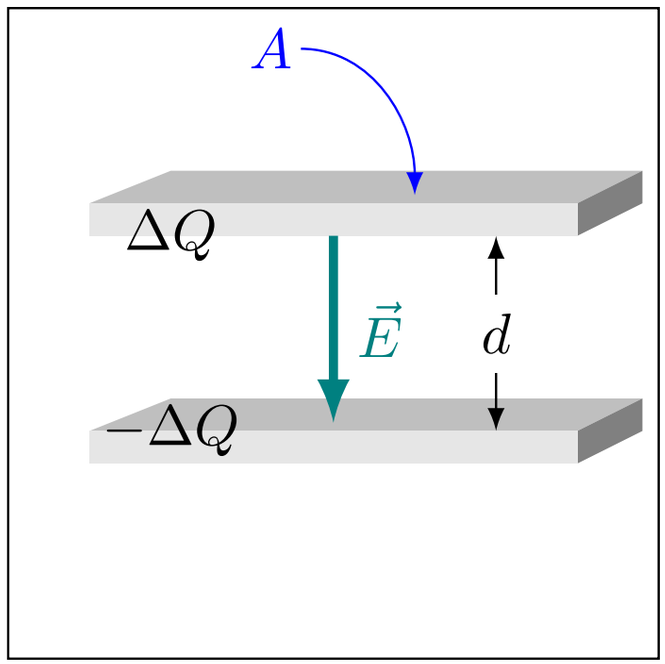
$$C = \frac{A\epsilon_0}{d}$$

$A = 1\text{cm}^2$

$d = 0.1\text{mm}$

$\epsilon_0 = 8.8 \times 10^{-12}$





Capacitor

$$C = \frac{A\epsilon_0}{d}$$

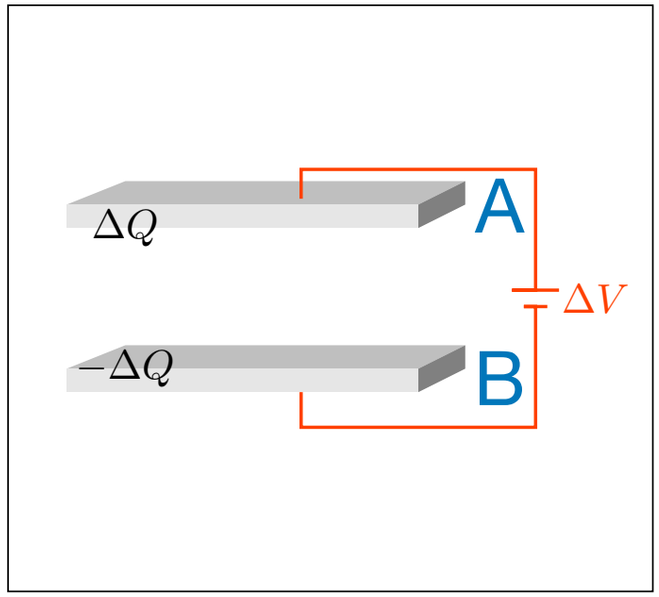
$A = 1\text{cm}^2$

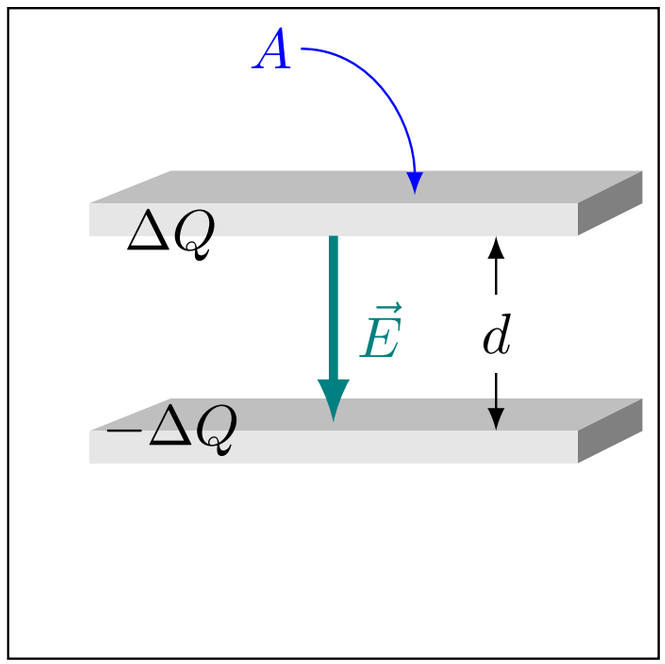
$d = 0.1\text{mm}$

$\epsilon_0 = 8.8 \times 10^{-12}$

$C = 8.8\,\text{pF}$

$1\text{F} = 1\text{C}/V$





Capacitor

$$C = \frac{A\epsilon_0}{d}$$

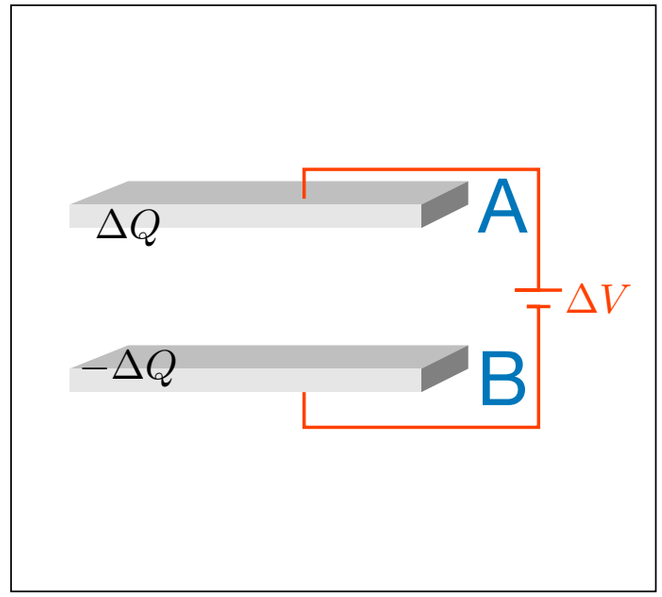
$A = 1\text{cm}^2$

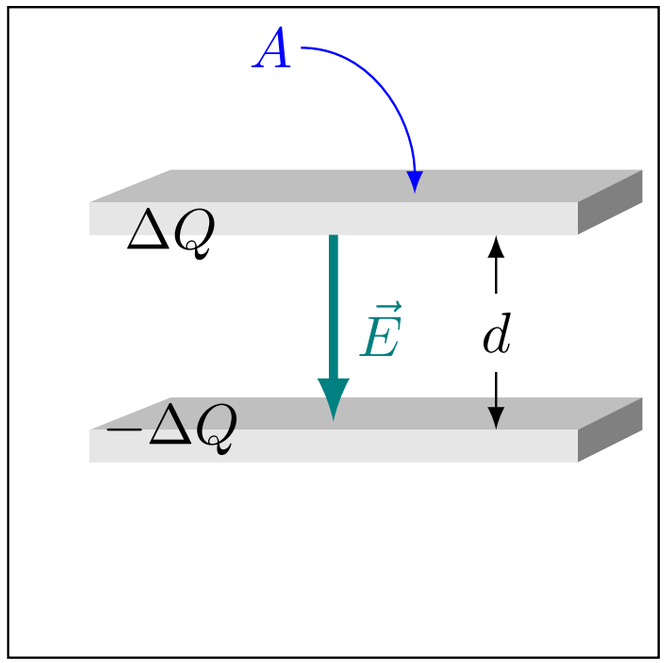
$d = 0.1\text{mm}$

$\epsilon_0 = 8.8 \times 10^{-12}\,\text{F/m}$

$C = 8.8\,\text{pF}$

$1\text{F} = 1\text{C}/V$





Capacitor

$$C = \frac{A\epsilon_0}{d}$$

$A = 1\text{cm}^2$

$d = 0.1\text{mm}$

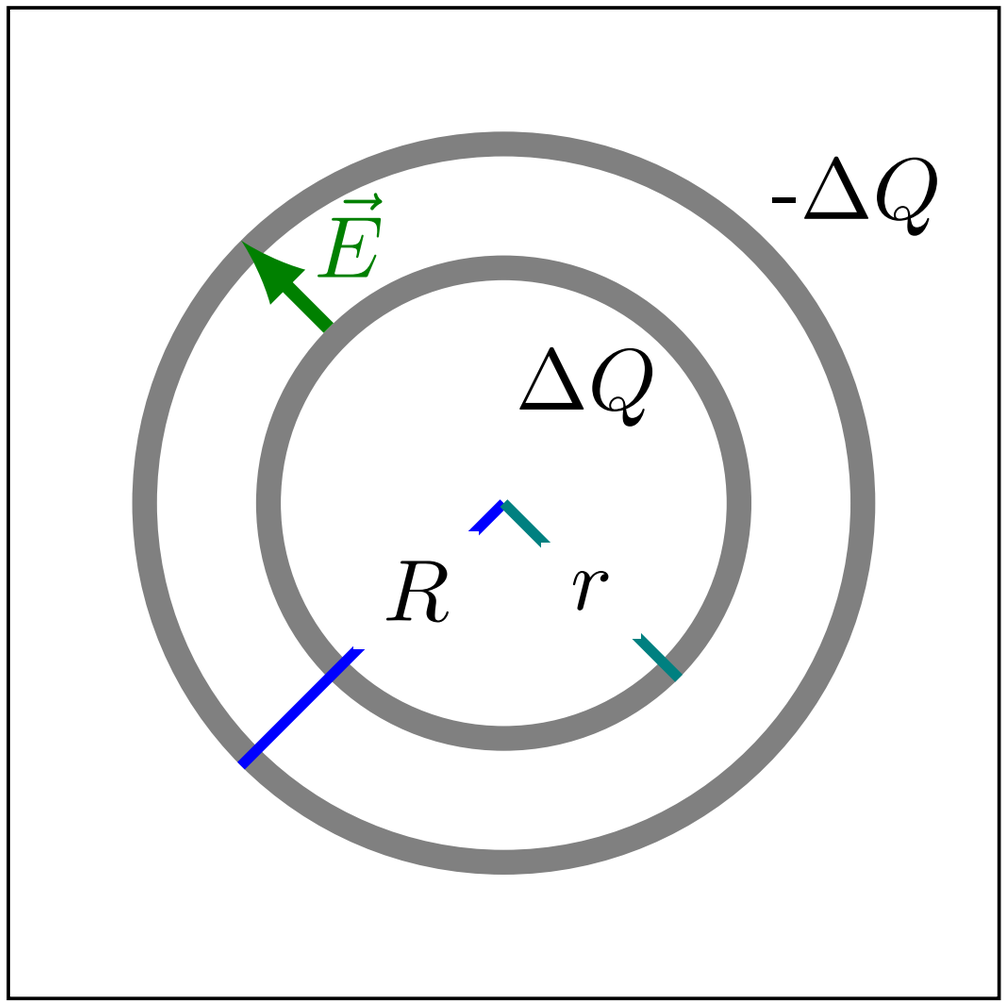
$\epsilon_0 = 8.8 \times 10^{-12}\,\text{F/m}$

$C = 8.8\,\text{pF}$

$1\text{F} = 1\text{C}/V$

Capacitor esférico

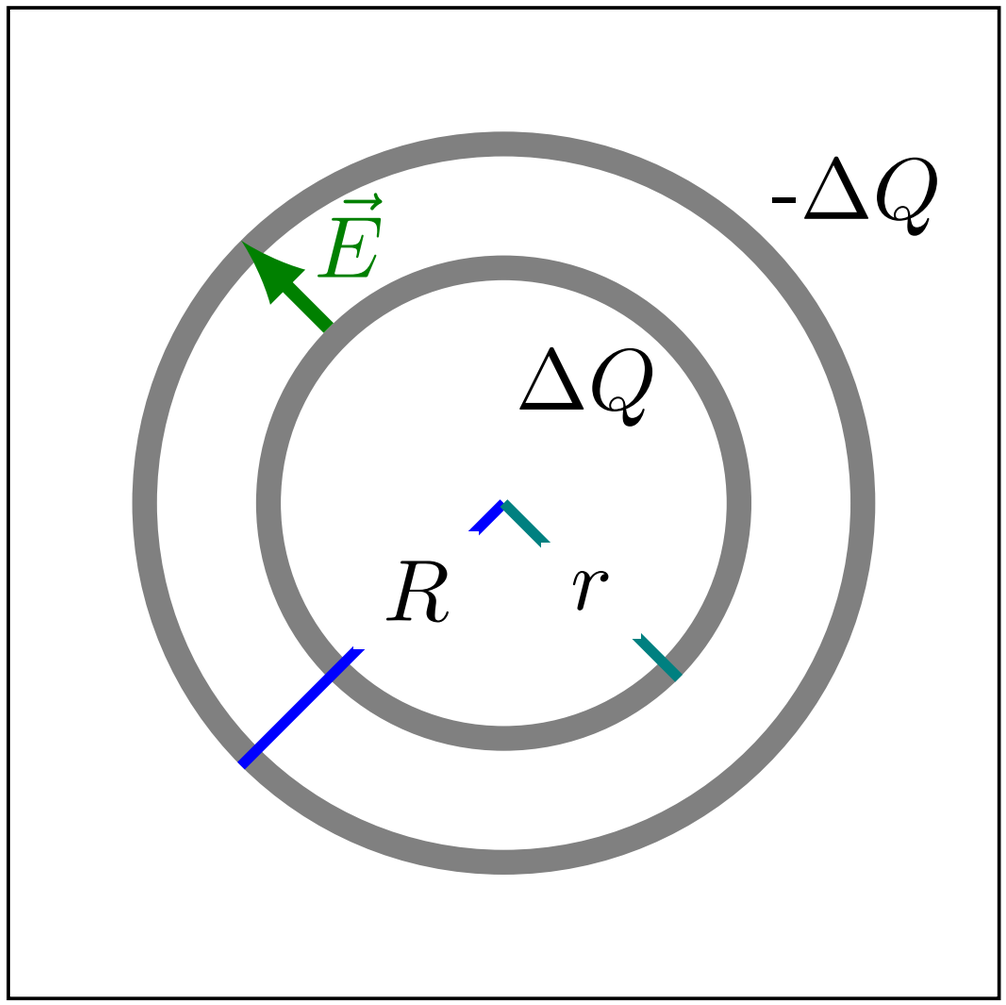
$$V_r - V_R = \int_r^R \vec{E} \cdot \mathrm{d}\vec{r}$$



Capacitor esférico

$$V_r - V_R = \int_r^R \vec{E} \cdot \mathrm{d}\vec{r}$$

$$\Delta V = \frac{1}{4\pi\epsilon_0}\left(\frac{\Delta Q}{r} - \frac{\Delta Q}{R}\right)$$



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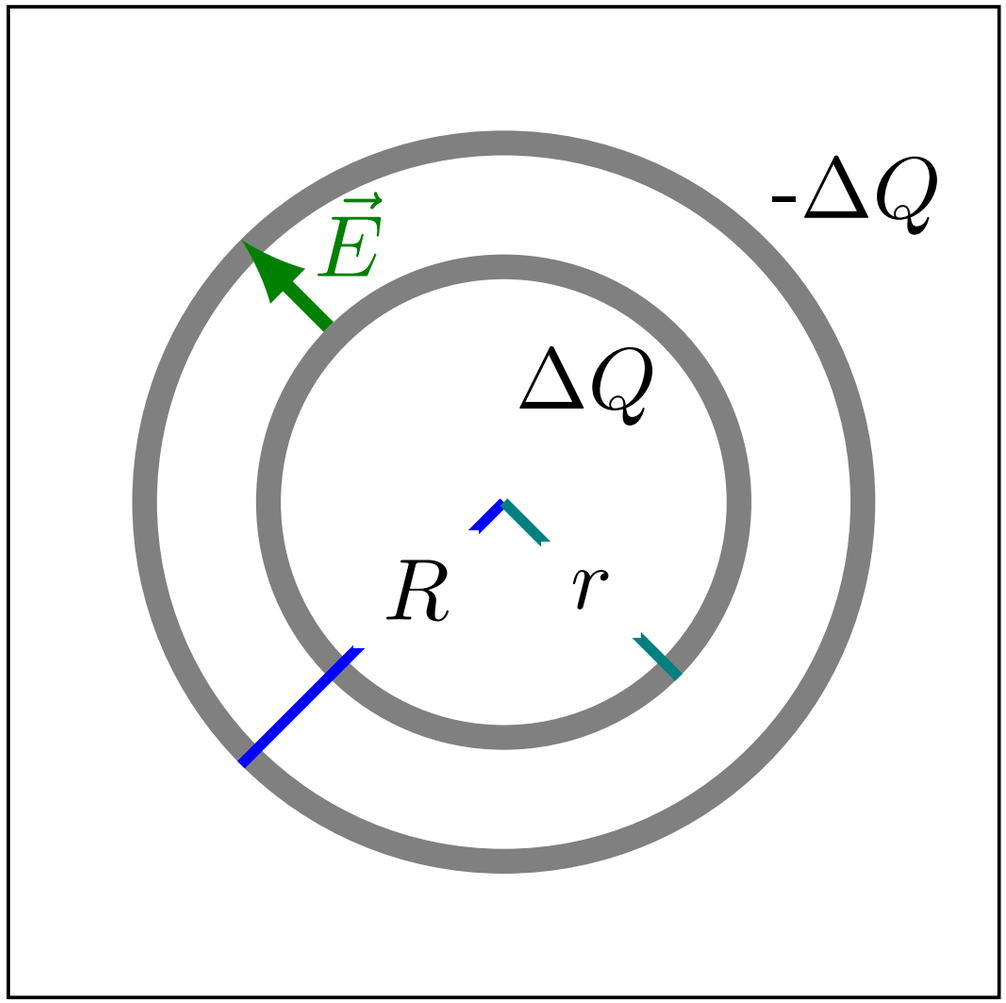
$$\Delta V = \frac{1}{4\pi\epsilon_0}\left(\frac{\Delta Q}{r} - \frac{\Delta Q}{R}\right)$$

$$\Delta V = \frac{\Delta Q}{4\pi\epsilon_0}\frac{R-r}{Rr}$$



Capacitor esférico

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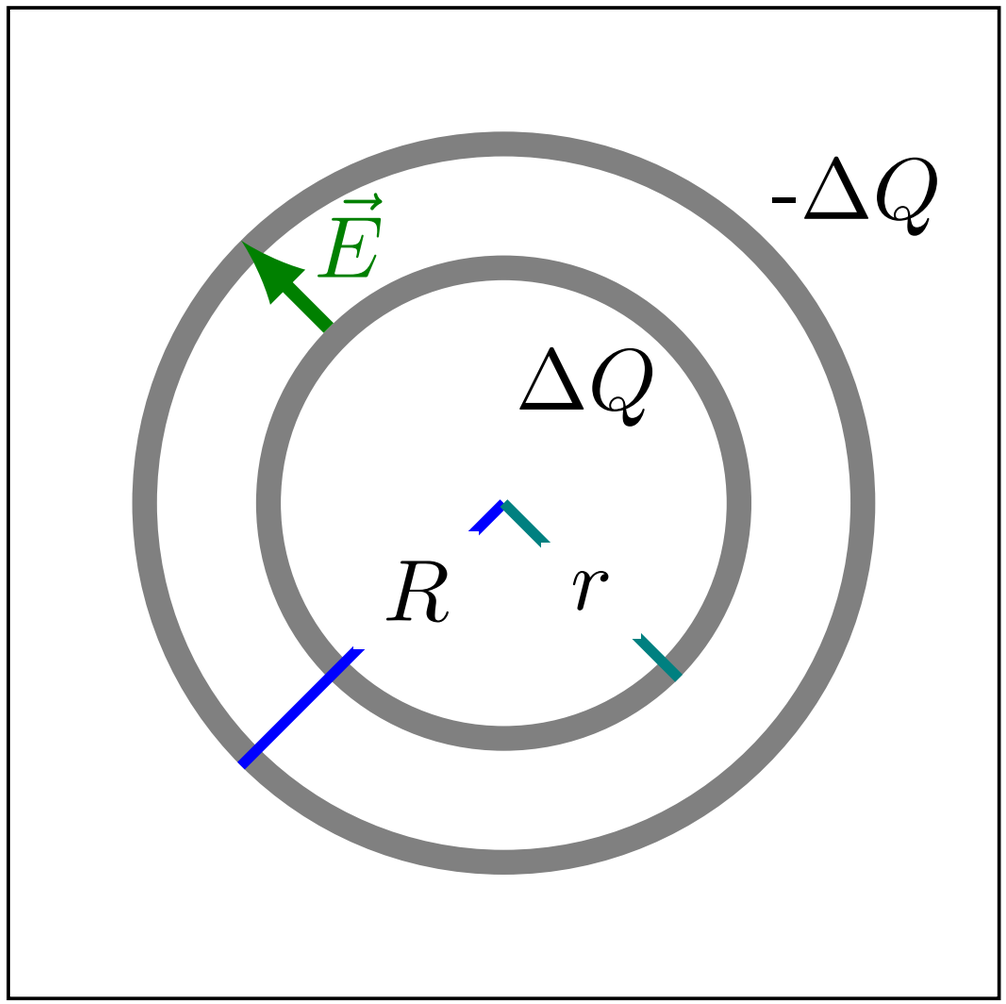
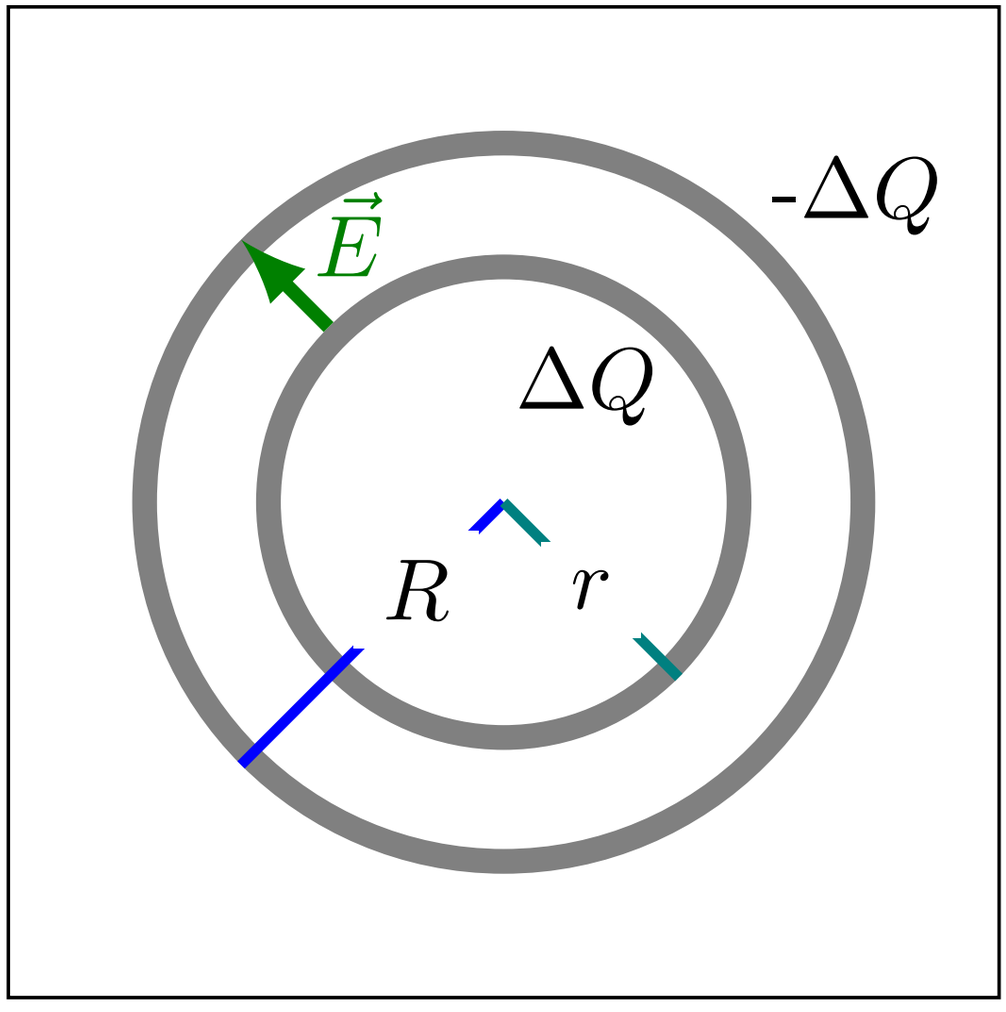
$$\Delta V = \frac{\Delta Q}{4\pi\epsilon_0}\frac{R-r}{Rr}$$

$$C = 4\pi\epsilon_0\frac{Rr}{R-r}$$



Pratique o que aprendeu:
R-r pequeno

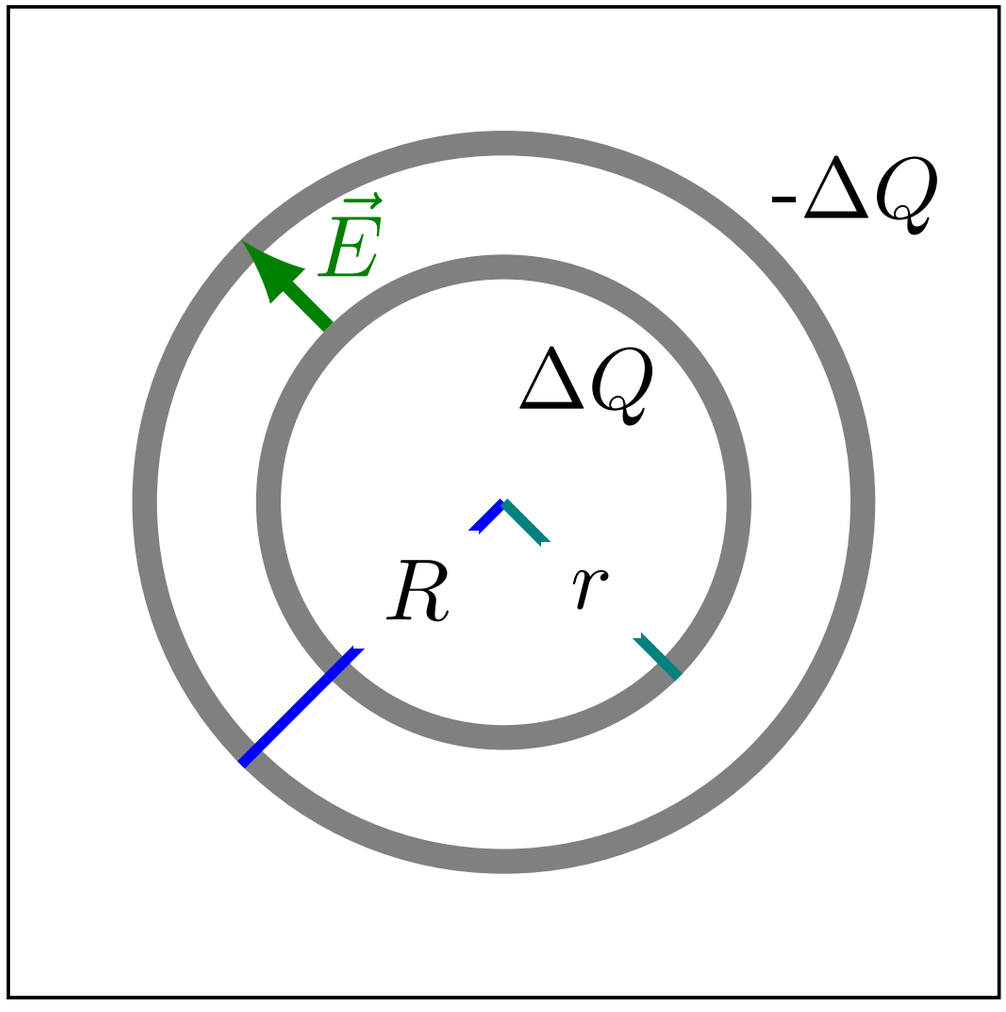
$$R - r = d \qquad (d \ll R)$$



Pratique o que aprendeu:
R-r pequeno

$$R - r = d \qquad (d \ll R)$$

$$C = 4\pi\epsilon_0 \frac{Rr}{R - r}$$

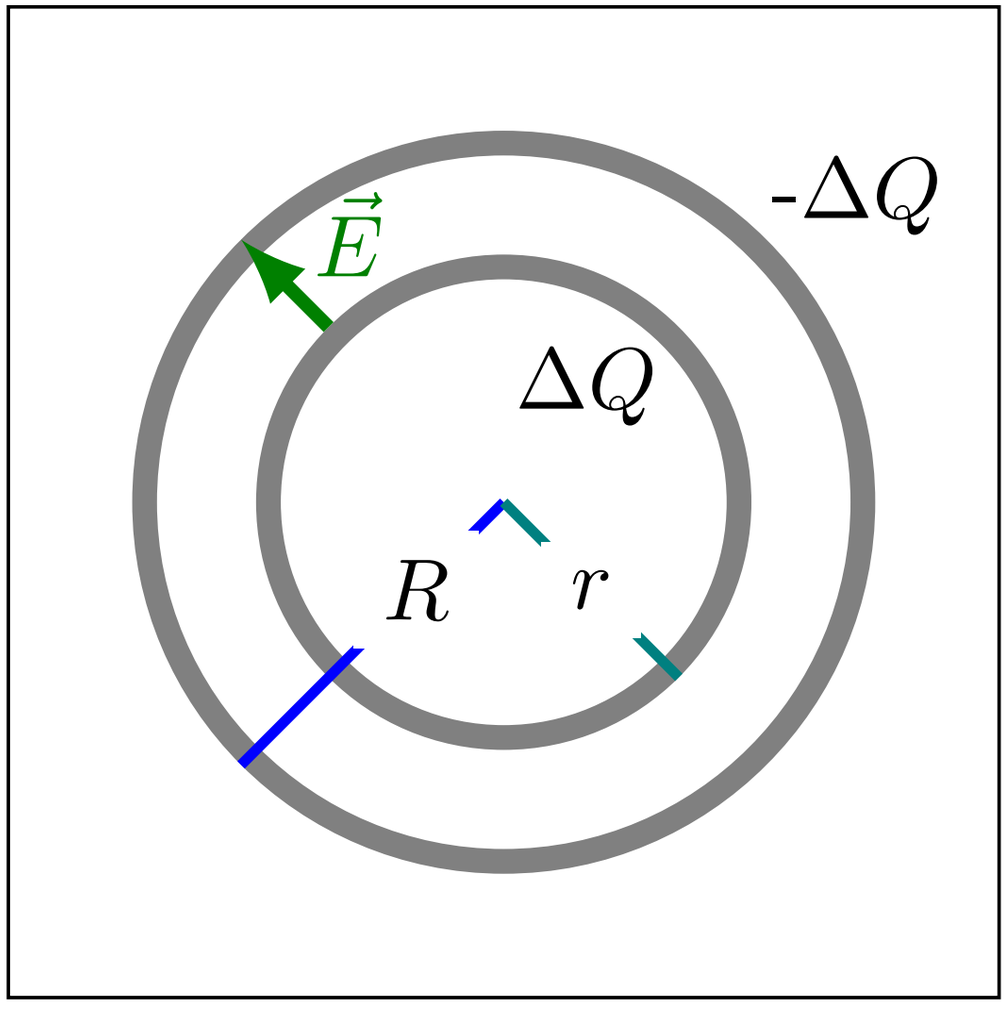


Pratique o que aprendeu:
R-r pequeno

$$R - r = d \qquad (d \ll R)$$

$$C = 4\pi\epsilon_0 \frac{Rr}{R - r}$$

$$C = 4\pi\epsilon_0 \frac{R(R - d)}{d}$$



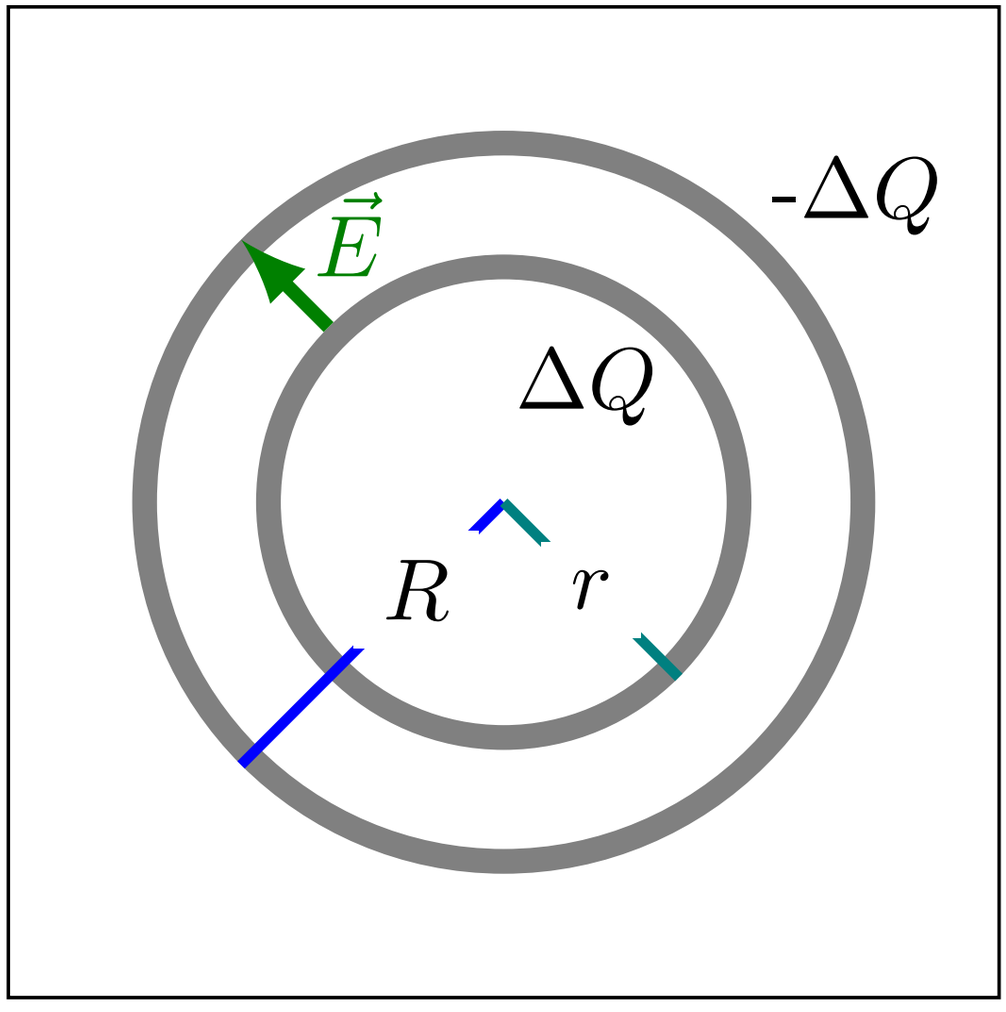
Pratique o que aprendeu:
R-r pequeno

$$R - r = d \qquad (d \ll R)$$

$$C = 4\pi\epsilon_0 \frac{Rr}{R - r}$$

$$C = 4\pi\epsilon_0 \frac{R(R - d)}{d}$$

$$C \approx 4\pi\epsilon_0 \frac{R^2}{d}$$



Pratique o que aprendeu:
R-r pequeno

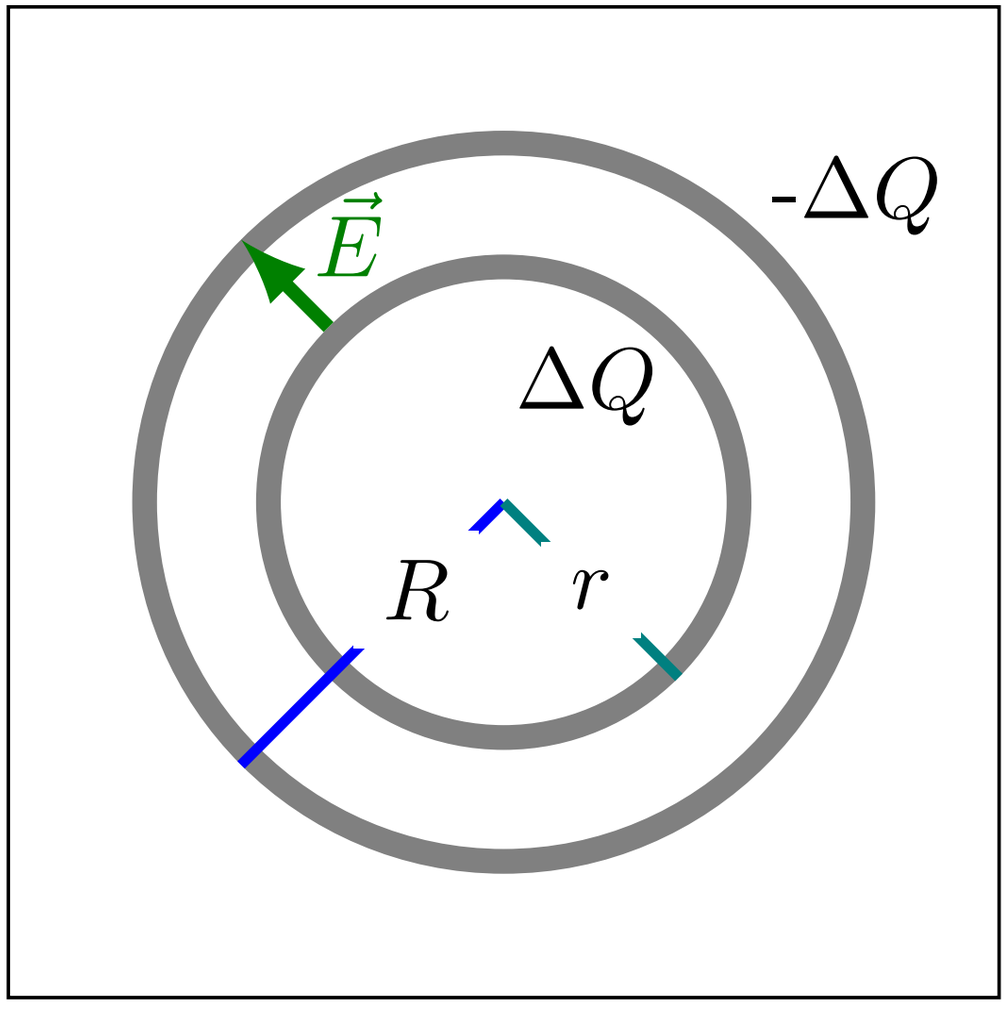
$$R - r = d \qquad (d \ll R)$$

$$C = 4\pi\epsilon_0 \frac{Rr}{R-r}$$

$$C = 4\pi\epsilon_0 \frac{R(R-d)}{d}$$

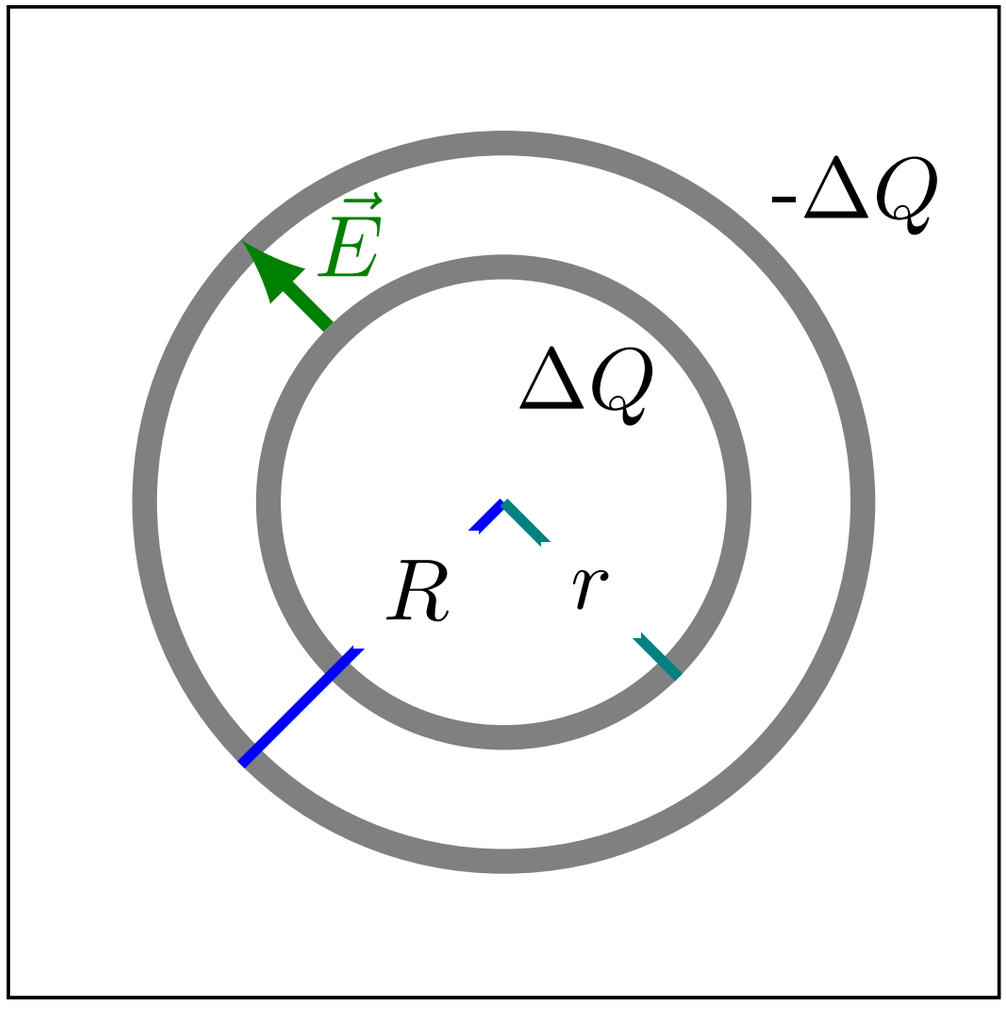
$$C \approx 4\pi\epsilon_0 \frac{R^2}{d}$$

$$C \approx \epsilon_0 \frac{A}{d}$$



Pratique o que aprendeu:
Capacitância da Terra

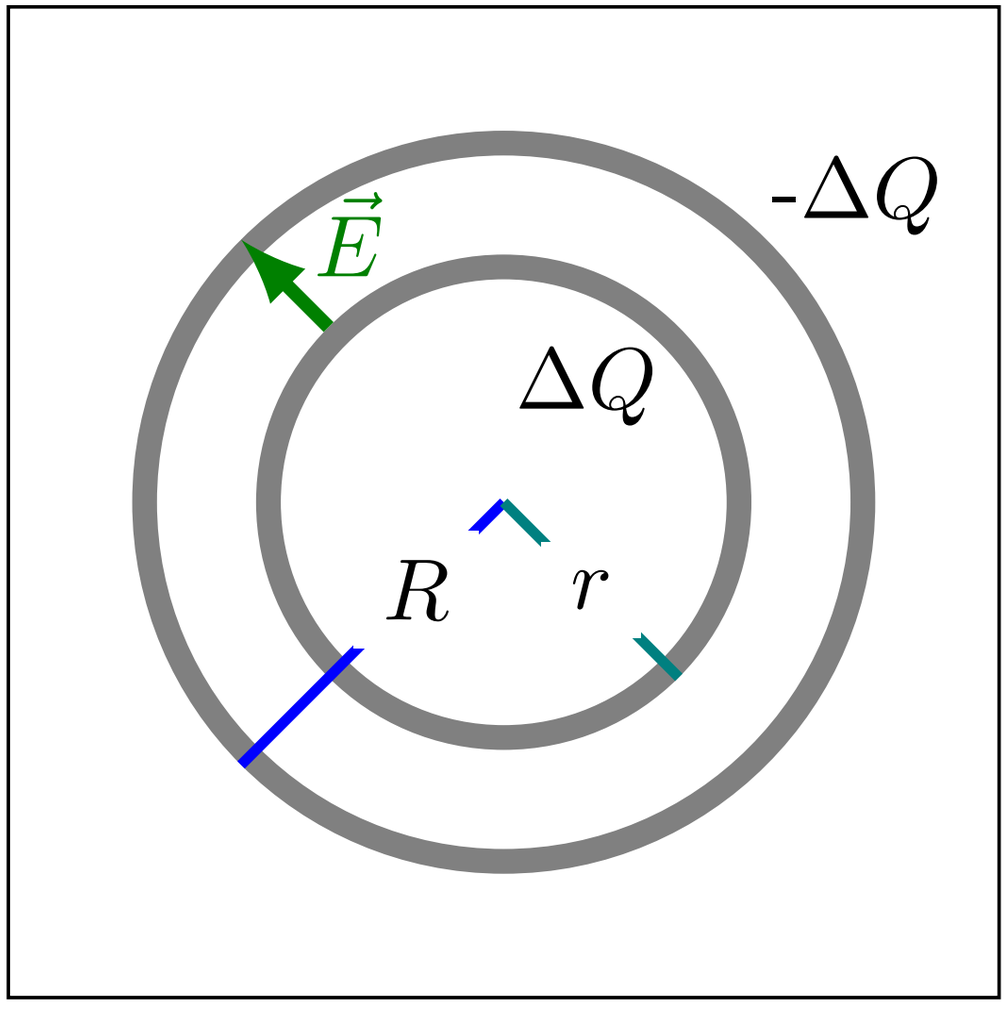
$R \to \infty$



Pratique o que aprendeu:
Capacitância da Terra

$$R \to \infty$$

$$C = 4\pi\epsilon_0 \frac{Rr}{R-r}$$

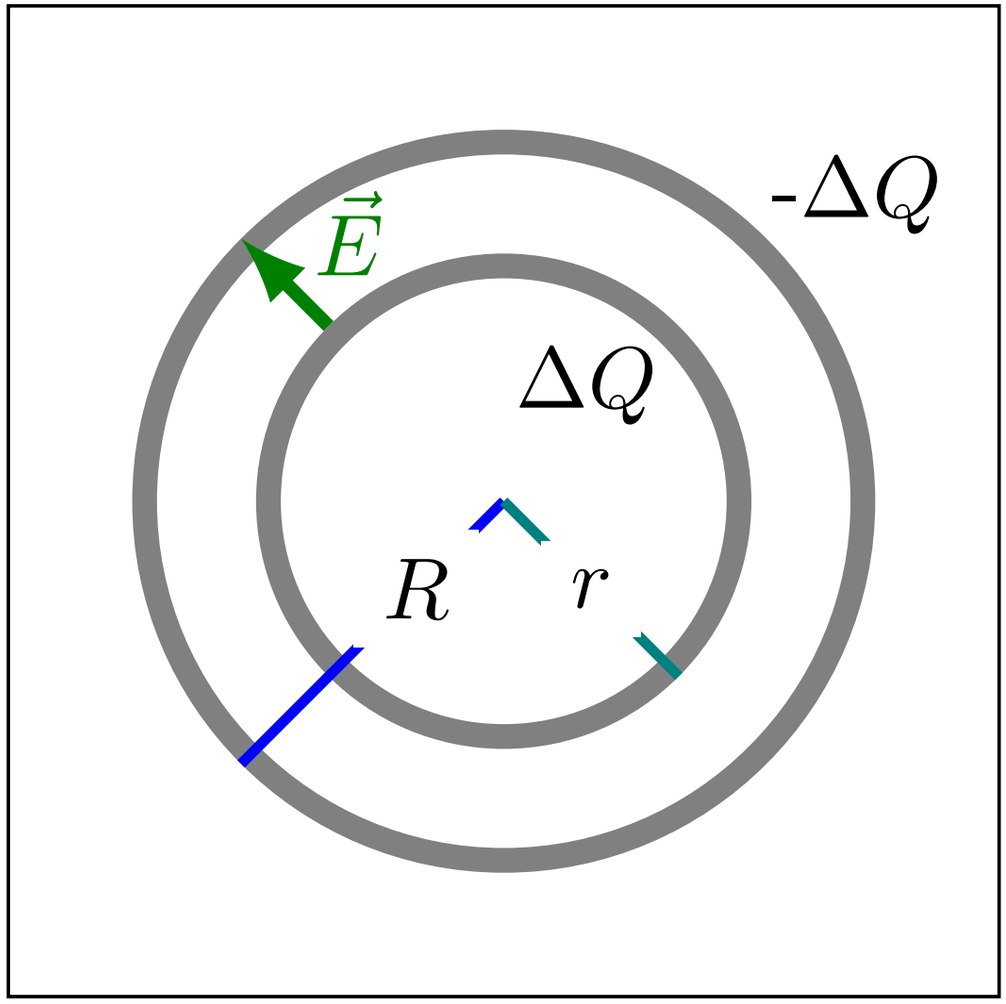


Pratique o que aprendeu:
Capacitância da Terra

$$R \to \infty$$

$$C = 4\pi\epsilon_0 \frac{Rr}{R - r}$$

$$C = 4\pi\epsilon_0 \frac{\cancel{R}r}{\cancel{R - r}}$$



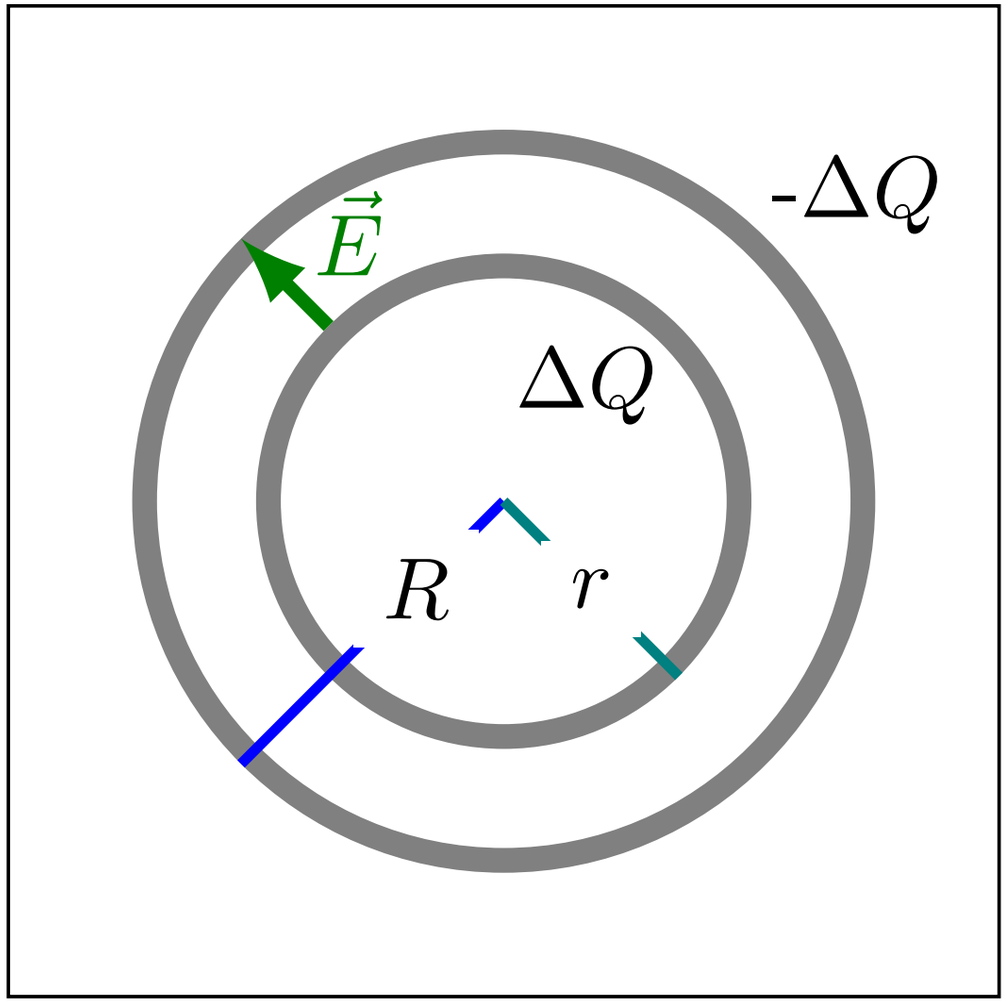
Pratique o que aprendeu:
Capacitância da Terra

$$R \to \infty$$

$$C = 4\pi\epsilon_0 \frac{Rr}{R - r}$$

$$C = 4\pi\epsilon_0 \frac{\cancel{R}r}{\cancel{R - r}}$$

$$C = 4\pi\epsilon_0 r$$



Pratique o que aprendeu:
Capacitância da Terra

$$R \to \infty$$

$$C = 4\pi\epsilon_0 \frac{Rr}{R-r}$$

$$C = 4\pi\epsilon_0 \frac{\cancel{R}r}{\cancel{R-r}}$$

$$C = 4\pi\epsilon_0 r$$

$$r = 6.4 \times 10^6 \text{m}$$

$$C = 7.1 \times 10^{-4} \text{F}$$