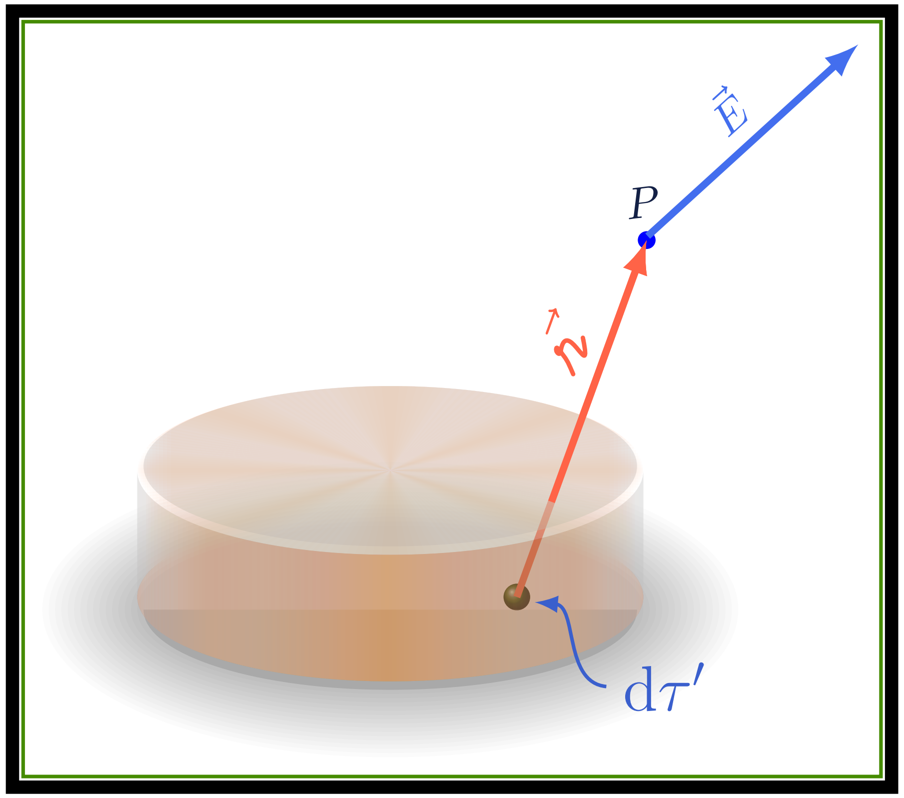
Eletromagnetismo

2 de abril
Eletrostática

Campo de distribuição de cargas

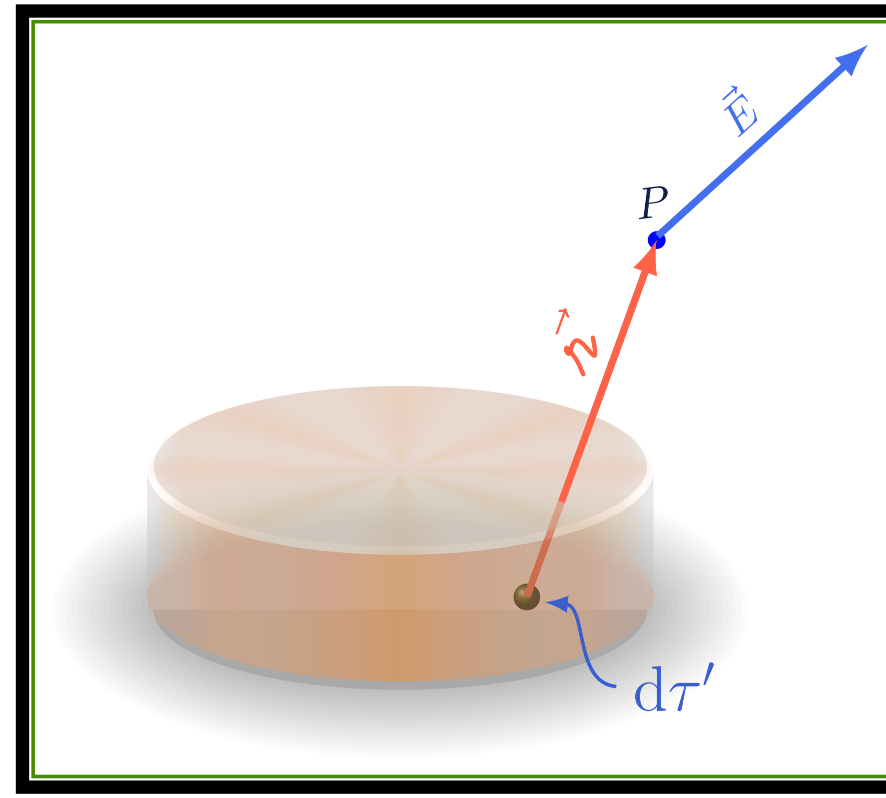
$$\vec{\mathbf{E}}(\vec{\mathbf{r}}) = \frac{1}{4\pi\epsilon_0}\int_{\mathcal{V}} \frac{\rho(\vec{\mathbf{r}}')}{\mathscr{r}^3}\vec{\mathscr{r}}\,\mathrm{d}\tau'$$



Rotacional do campo elétrico

$$\vec{\mathbf{E}}(\vec{\mathbf{r}}) = \frac{1}{4\pi\epsilon_0}\int_{\mathcal{V}} \frac{\rho(\vec{\mathbf{r}}')}{\mathscr{r}^3}\vec{\mathscr{r}}\,\mathrm{d}\tau'$$

$$\vec{\boldsymbol{\nabla}} \times \vec{\mathbf{E}}(\vec{\mathbf{r}}) = \frac{1}{4\pi\epsilon_0}\vec{\boldsymbol{\nabla}} \times \int_{\mathcal{V}} \frac{\rho(\vec{\mathbf{r}}')}{\mathscr{r}^3}\vec{\mathscr{r}}\,\mathrm{d}\tau'$$



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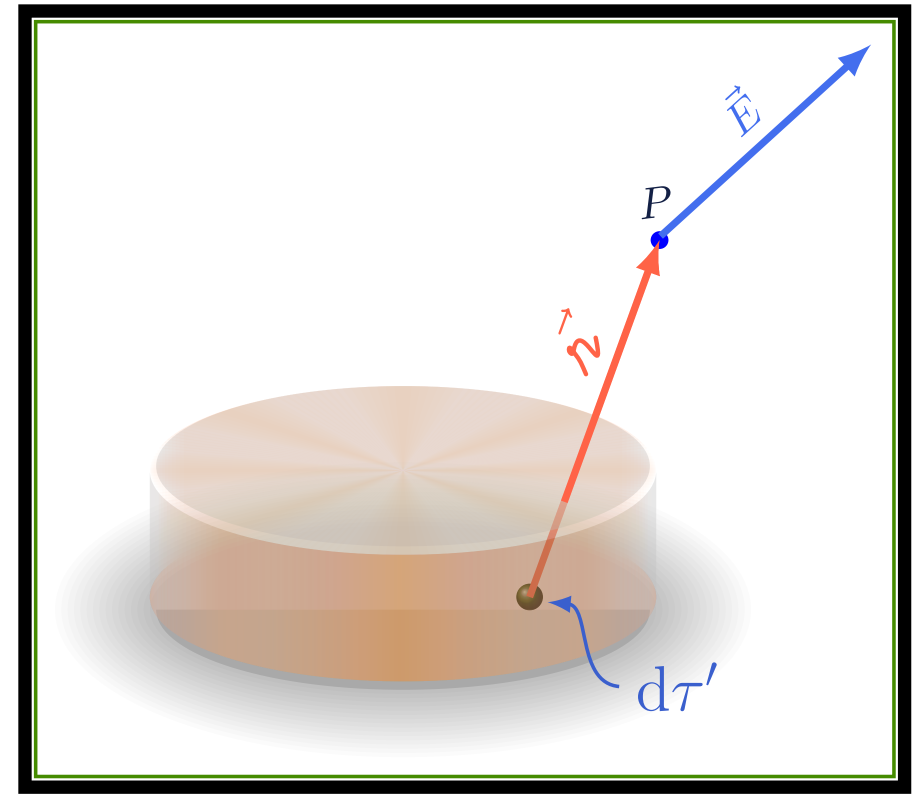

$$\vec{\boldsymbol{\nabla}} \times \vec{\mathbf{E}}(\vec{\mathbf{r}}) = \frac{1}{4\pi\epsilon_0}\vec{\boldsymbol{\nabla}} \times \int_{\mathcal{V}} \frac{\rho(\vec{\mathbf{r}}')}{\mathscr{r}^3}\vec{\mathscr{r}}\,\mathrm{d}\tau'$$

$$\vec{\mathscr{r}} = \vec{\mathbf{r}} - \vec{\mathbf{r}}\,'$$

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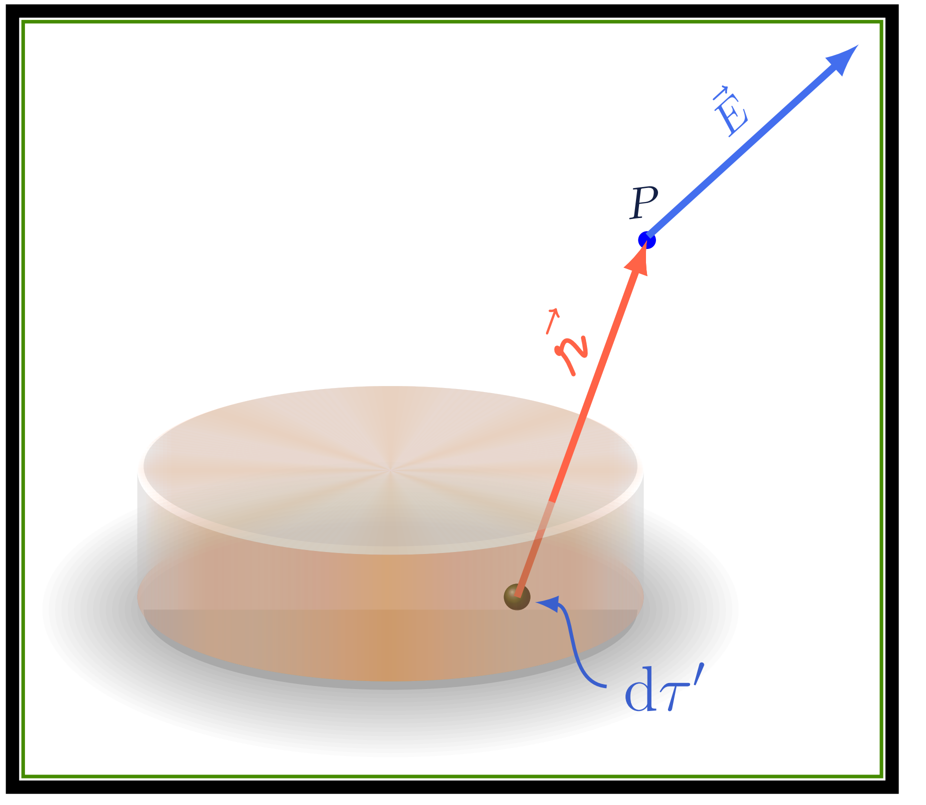

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$\vec{\mathbf{r}}\,'$ fixo $\quad\Rightarrow\quad \vec{\boldsymbol{\nabla}}_{\vec{\mathbf{r}}}\times = \vec{\boldsymbol{\nabla}}_{\vec{\mathscr{r}}}\times$

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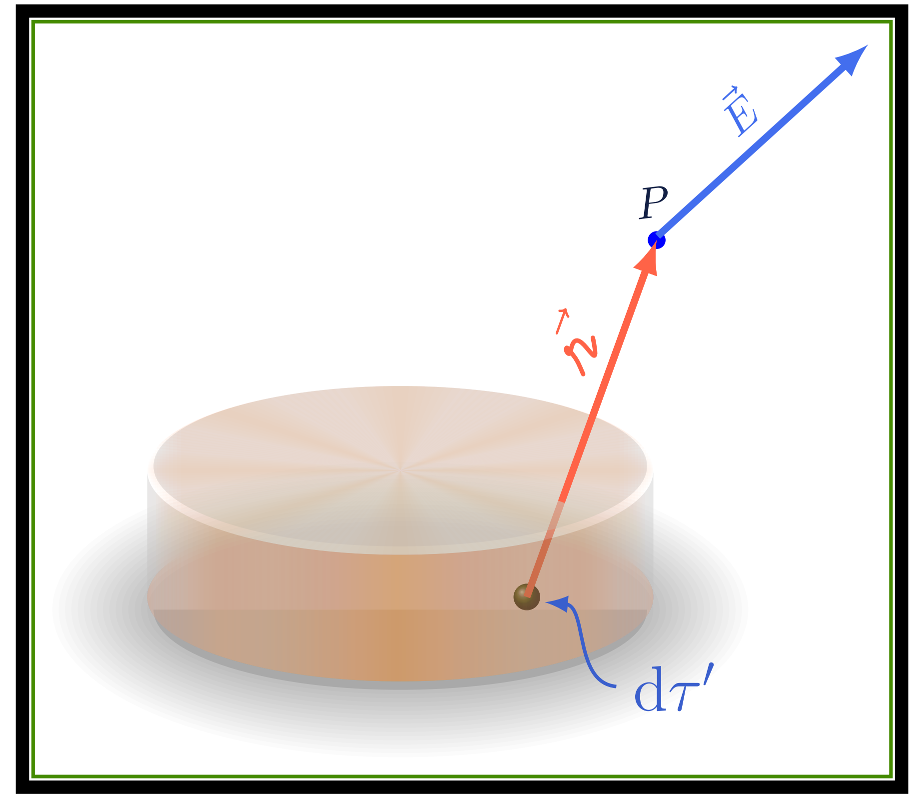

$$\vec{\boldsymbol{\nabla}}\times\vec{\mathbf{E}}(\vec{\mathbf{r}}) = \frac{1}{4\pi\epsilon_0}\vec{\boldsymbol{\nabla}}\times\int_{\mathcal{V}} \frac{\rho(\vec{\mathbf{r}}')}{\mathscr{r}^3}\vec{\mathscr{r}}\,\mathrm{d}\tau'$$

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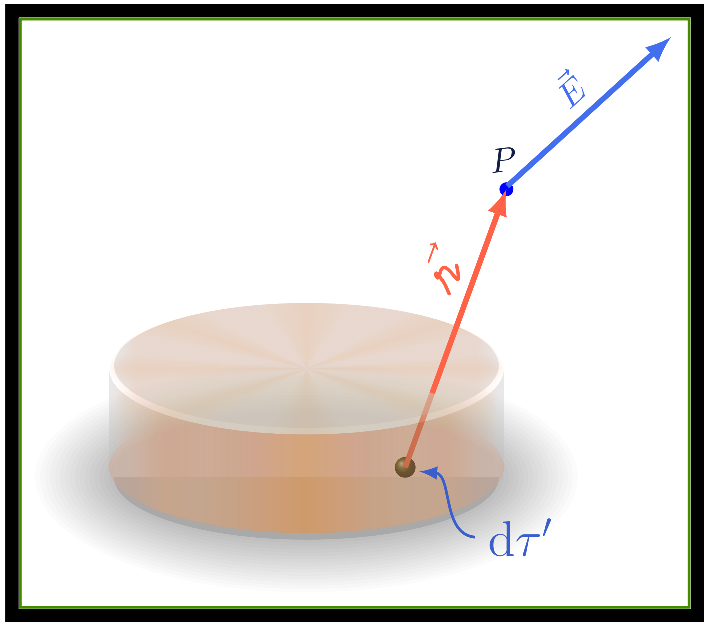
$$\vec{\boldsymbol{\nabla}}\times\vec{\mathbf{E}}(\vec{\mathbf{r}}) = \frac{1}{4\pi\epsilon_0}\int_{\mathcal{V}} \rho(\vec{\mathbf{r}}\,')\Big(\vec{\boldsymbol{\nabla}}\times\frac{\vec{\mathscr{r}}}{\mathscr{r}^3}\Big)\,\mathrm{d}\tau'$$

Rotacional do campo elétrico

$$\vec{\boldsymbol{\nabla}} \times \vec{\mathbf{E}}(\vec{\mathbf{r}}) = \frac{1}{4\pi\epsilon_0}\int_{\mathcal{V}} \rho(\vec{\mathbf{r}}\,')\left(\vec{\boldsymbol{\nabla}} \times \frac{\vec{\boldsymbol{\mathscr{r}}}}{\mathscr{r}^3}\right) \mathrm{d}\tau'$$



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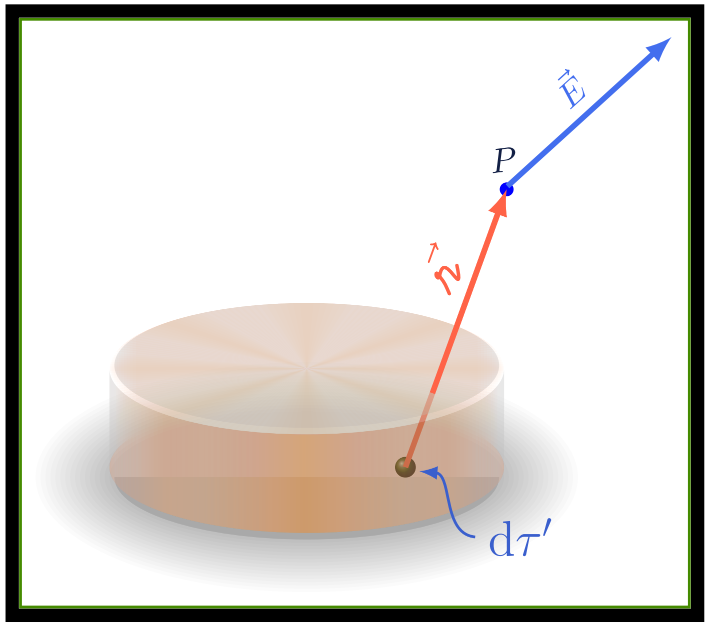
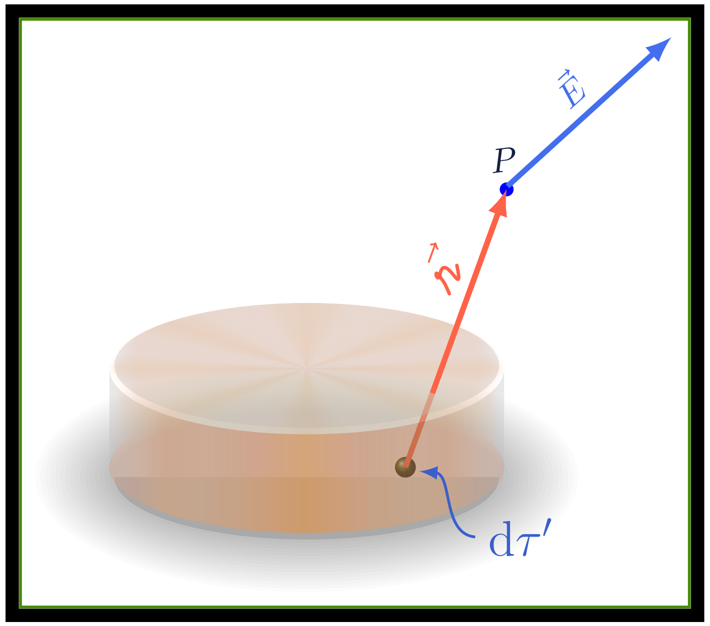


$$\vec{\boldsymbol{\nabla}} \times \frac{\vec{\mathscr{r}}}{\mathscr{r}^3} = \vec{\boldsymbol{\nabla}} \times \frac{\hat{\mathscr{r}}}{\mathscr{r}^2}$$

Rotacional do campo elétrico

$$\vec{\nabla} \times \vec{\mathbf{E}}(\vec{\mathbf{r}}) = \frac{1}{4\pi\epsilon_0} \int_{\mathcal{V}} \rho(\vec{\mathbf{r}}\,') \left(\vec{\nabla} \times \frac{\vec{\mathscr{r}}}{\mathscr{r}^3} \right) \mathrm{d}\tau'$$

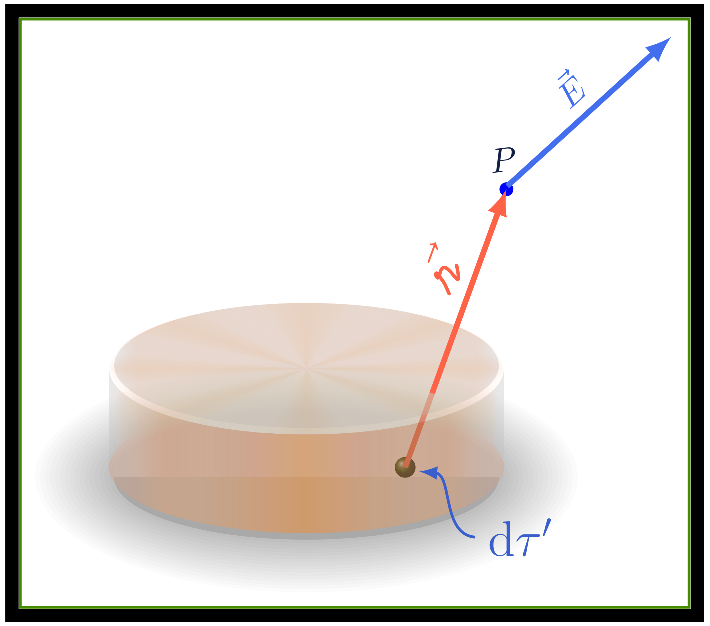


$$\vec{\nabla} \times \frac{\vec{\mathscr{r}}}{\mathscr{r}^3} = \vec{\nabla} \times \frac{\hat{\mathscr{r}}}{\mathscr{r}^2}$$

$$\vec{\nabla} \times \vec{\mathbf{v}} = \frac{1}{r\sin\theta}\left[\frac{\partial(\sin\theta v_\phi)}{\partial\theta} - \frac{\partial v_\theta}{\partial\phi}\right]\hat{\mathbf{r}} + \frac{1}{r}\left[\frac{1}{\sin\theta}\frac{\partial v_r}{\partial\phi} - \frac{\partial(r v_\phi)}{\partial r}\right]\hat{\theta} + \frac{1}{r}\left[\frac{\partial(r v_\theta)}{\partial r} - \frac{\partial v_r}{\partial\theta}\right]\hat{\phi}$$

Rotacional do campo elétrico

$$\vec{\nabla} \times \vec{\mathbf{E}}(\vec{\mathbf{r}}) = \frac{1}{4\pi\epsilon_0} \int_{\mathcal{V}} \rho(\vec{\mathbf{r}}\,') \left(\vec{\nabla} \times \frac{\vec{\mathscr{r}}}{\mathscr{r}^3} \right) \mathrm{d}\tau'$$



$$\vec{\nabla} \times \frac{\vec{\mathscr{r}}}{\mathscr{r}^3} = \vec{\nabla} \times \frac{\hat{\mathscr{r}}}{\mathscr{r}^2}$$

$$\vec{\nabla} \times \vec{\mathbf{v}} = \frac{1}{r\sin\theta}\left[\frac{\partial(\sin\theta v_\phi)}{\partial\theta} - \frac{\partial v_\theta}{\partial\phi}\right]\hat{\mathbf{r}} + \frac{1}{r}\left[\frac{1}{\sin\theta}\frac{\partial v_r}{\partial\phi} - \frac{\partial(r v_\phi)}{\partial r}\right]\hat{\theta} + \frac{1}{r}\left[\frac{\partial(r v_\theta)}{\partial r} - \frac{\partial v_r}{\partial\theta}\right]\hat{\phi}$$

$$\vec{\nabla} \times \vec{\mathbf{E}} = 0$$

Rotacional do campo elétrico

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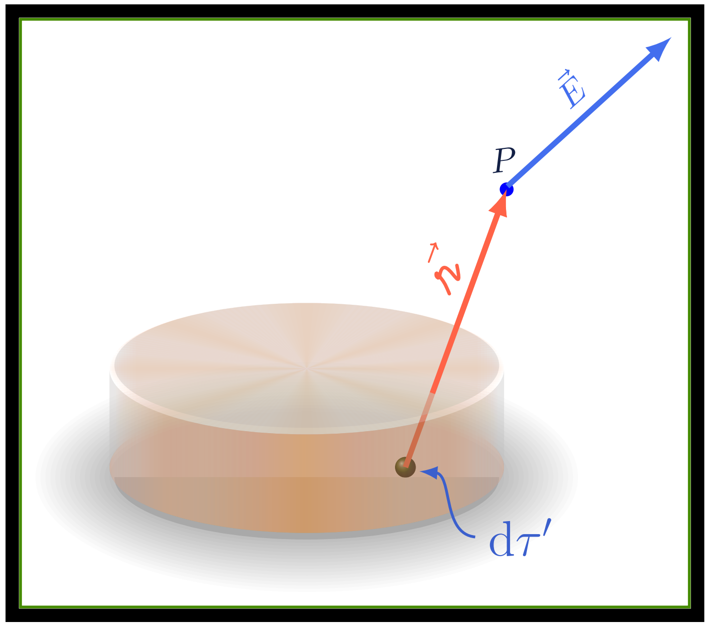
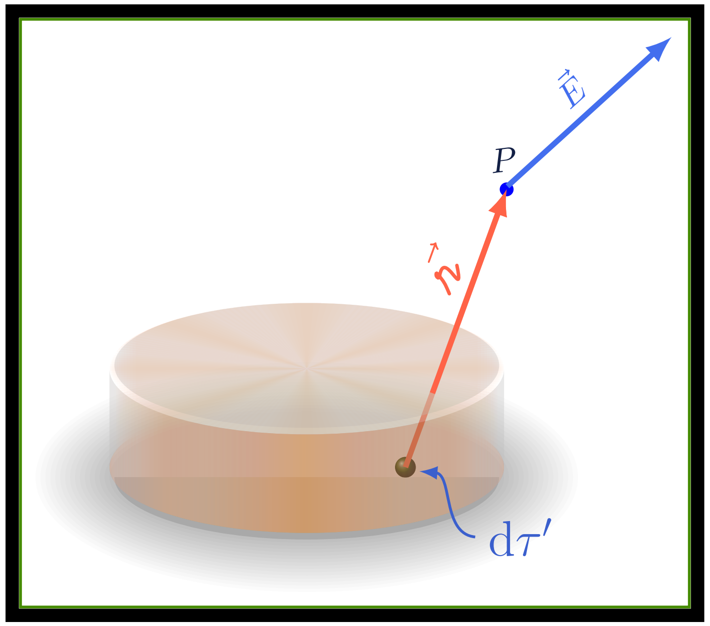


Equações da eletrostática

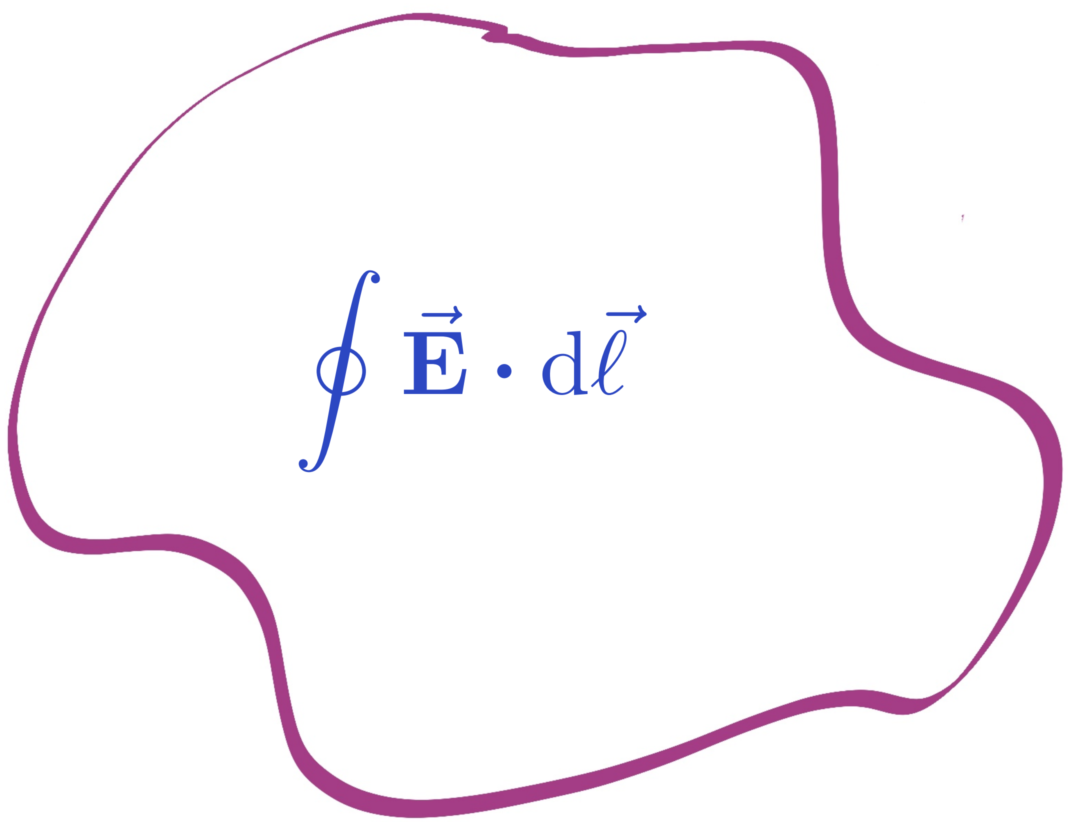
$$\vec{\boldsymbol{\nabla}} \cdot \vec{\mathbf{E}} = \frac{\rho}{\epsilon_0}$$

$$\vec{\boldsymbol{\nabla}} \times \vec{\mathbf{E}} = 0$$



Potencial eletrostático

$$\vec{\nabla} \times \vec{\mathbf{E}} = 0$$



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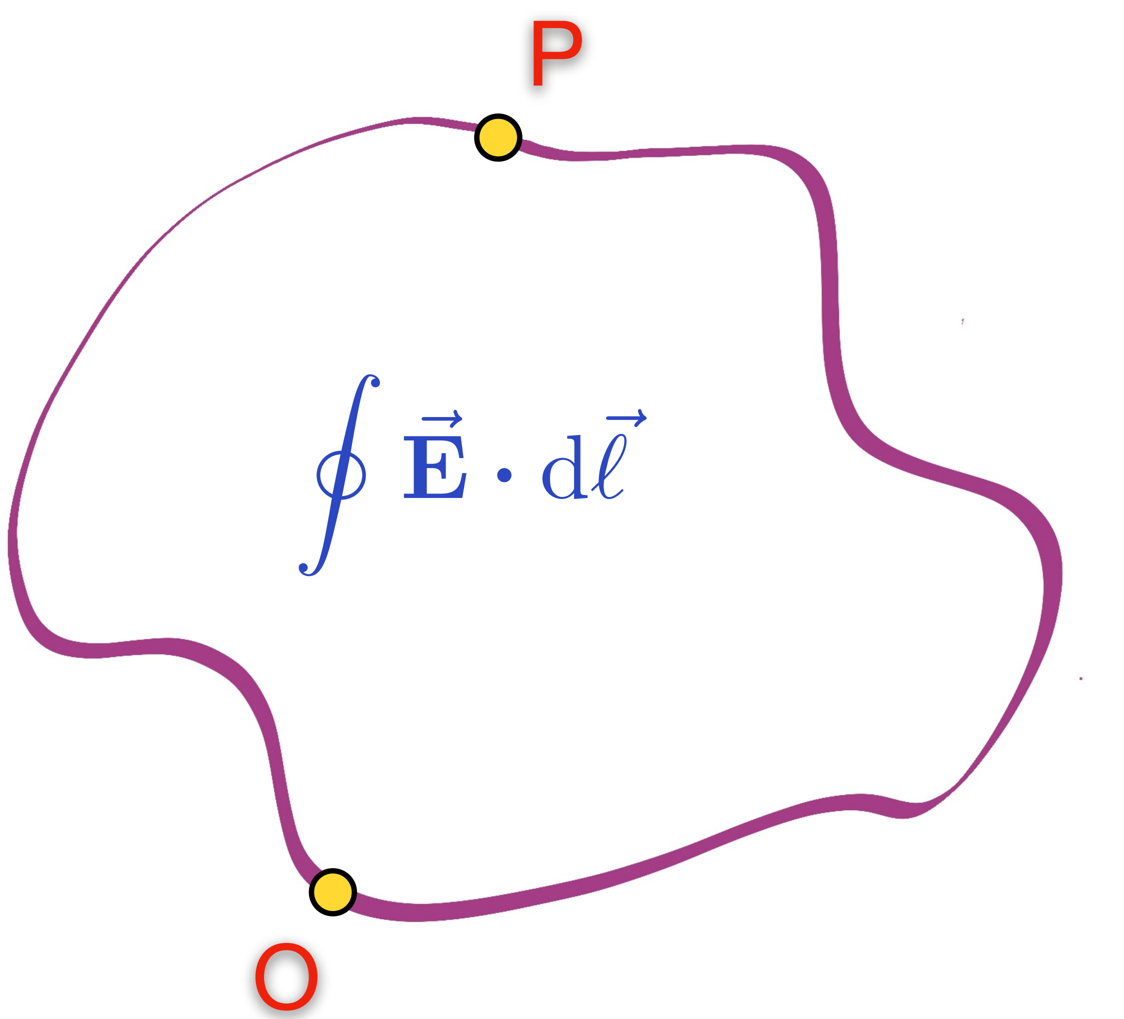
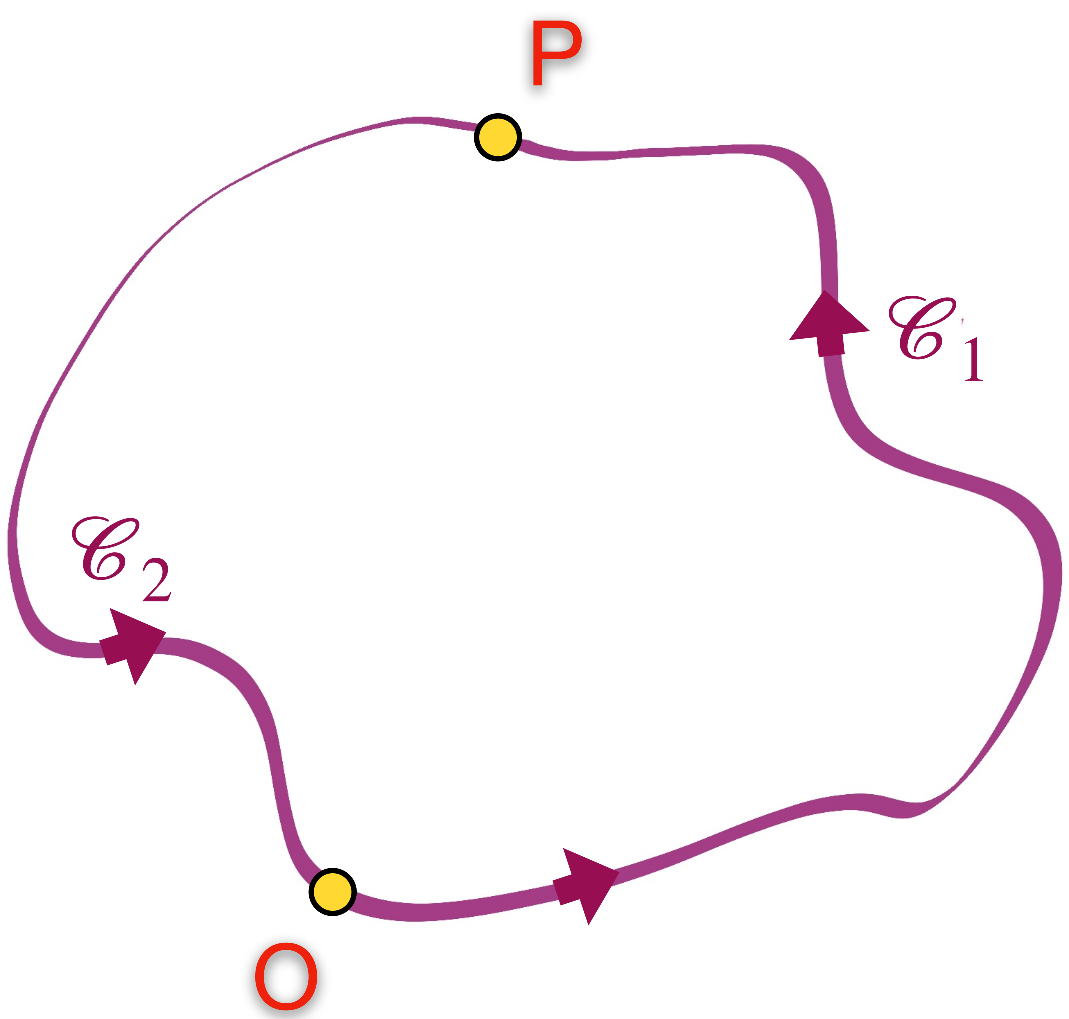


Potencial eletrostático

$$\vec{\nabla} \times \vec{\mathbf{E}} = 0$$

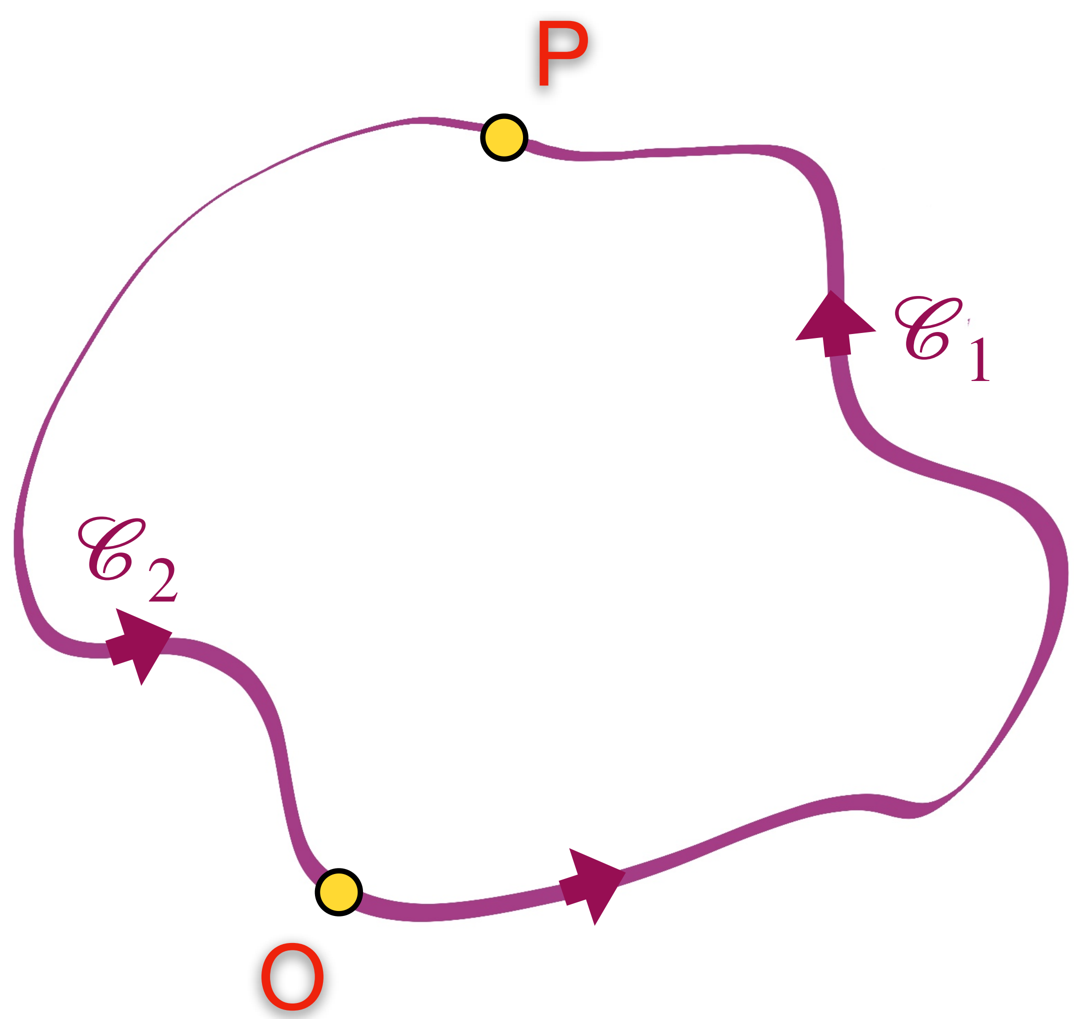
$$\int_{\mathcal{C}_1} \vec{\mathbf{E}} \cdot d\vec{\ell} + \int_{\mathcal{C}_2} \vec{\mathbf{E}} \cdot d\vec{\ell} = 0$$



Potencial eletrostático

$$\vec{\nabla} \times \vec{\mathbf{E}} = 0$$

$$\underset{\mathscr{C}_1}{\int_O^P} \vec{\mathbf{E}} \cdot d\vec{\ell} = - \underset{\mathscr{C}_2}{\int_P^O} \vec{\mathbf{E}} \cdot d\vec{\ell}$$

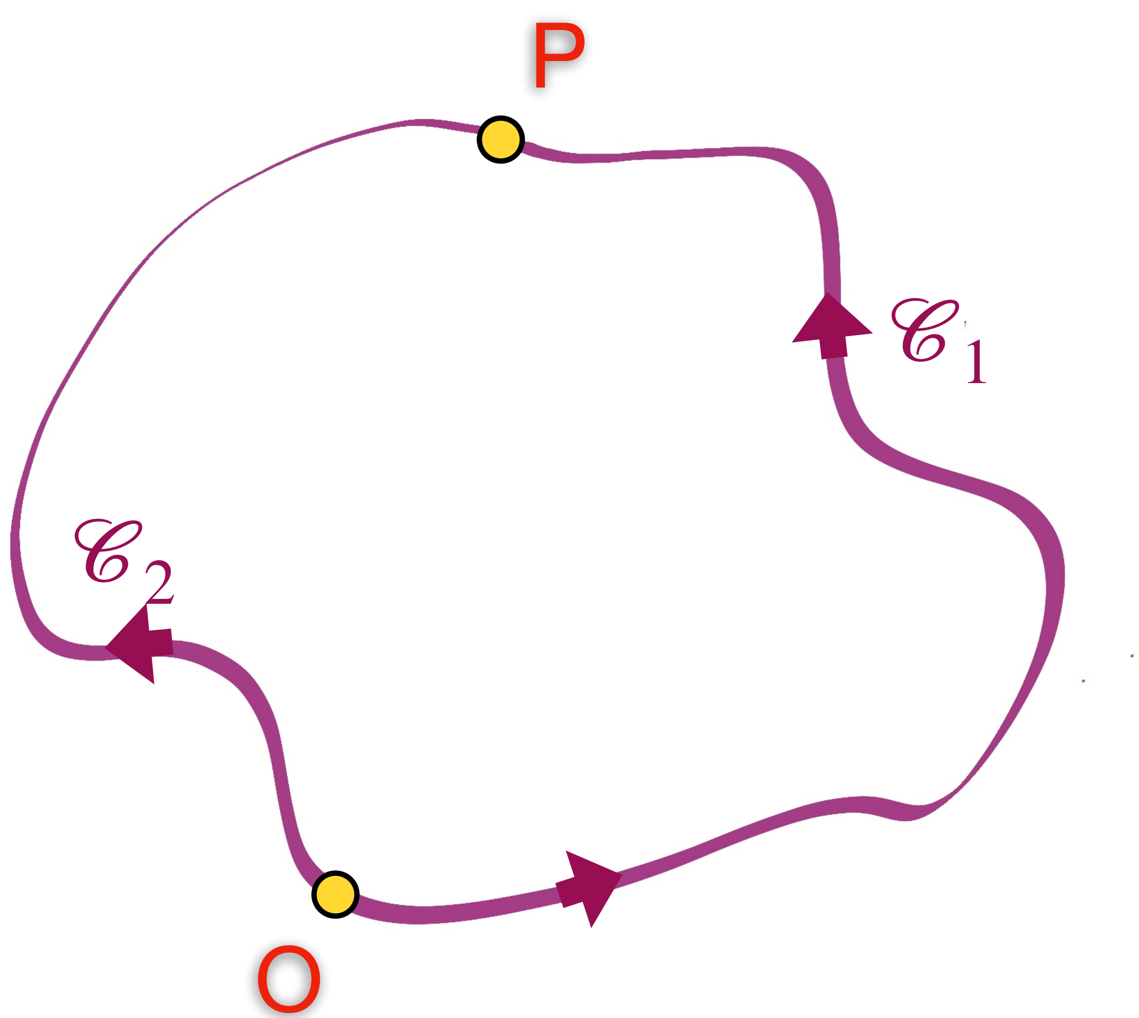


Potencial eletrostático

$$\vec{\nabla} \times \vec{\mathbf{E}} = 0$$

$$\underset{\mathscr{C}_1}{\int_O^P} \vec{\mathbf{E}} \cdot \mathrm{d}\vec{\ell} = \underset{\mathscr{C}_2}{\int_O^P} \vec{\mathbf{E}} \cdot \mathrm{d}\vec{\ell}$$

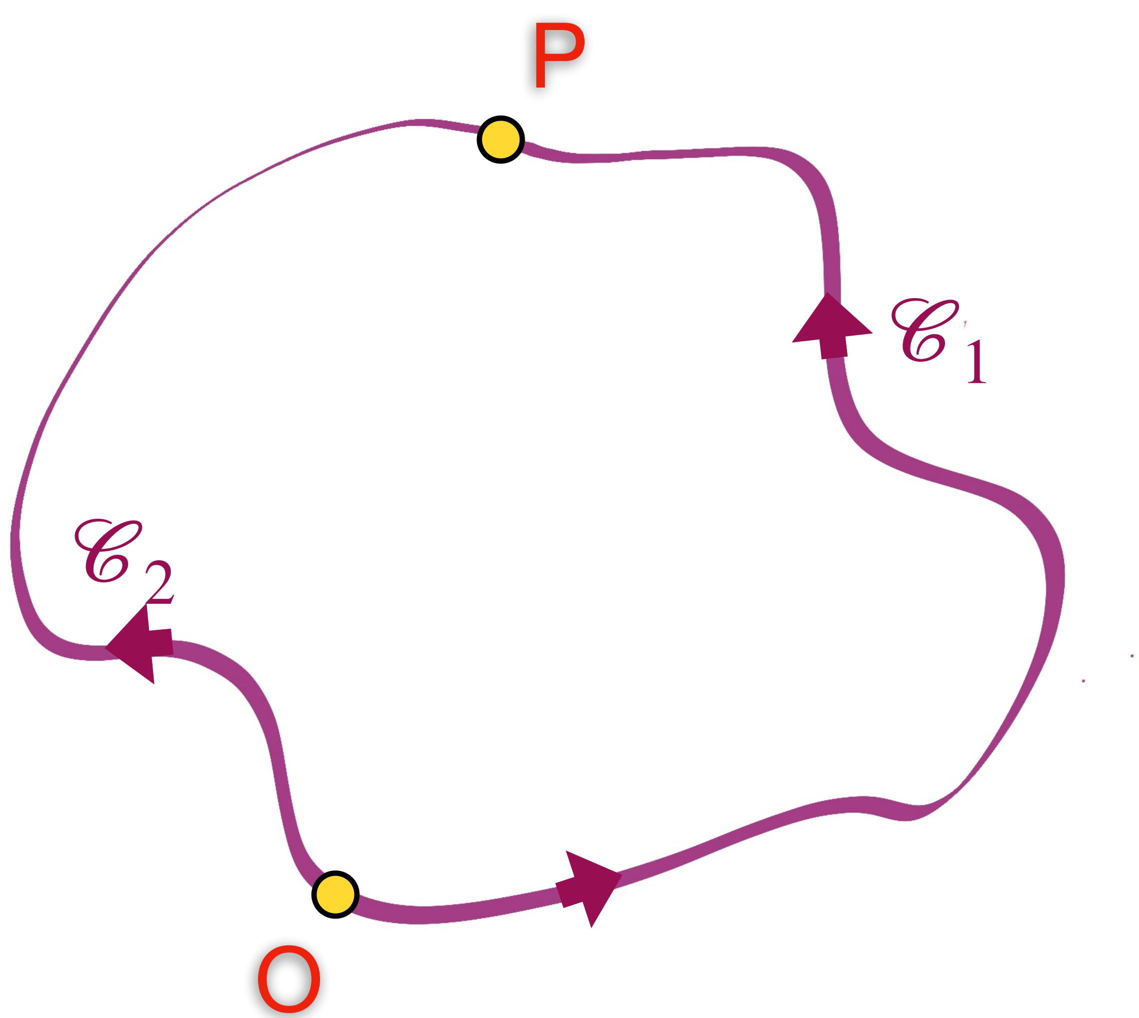
$$V(P) = -\int_O^P \vec{\mathbf{E}} \cdot \mathrm{d}\vec{\ell}$$



Potencial eletrostático

$$V(P) = -\int_O^P \vec{\mathbf{E}} \cdot \mathrm{d}\vec{\ell}$$

$$V(P) - V(O) = \int_O^P \vec{\boldsymbol{\nabla}} V \cdot \mathrm{d}\vec{\ell}$$

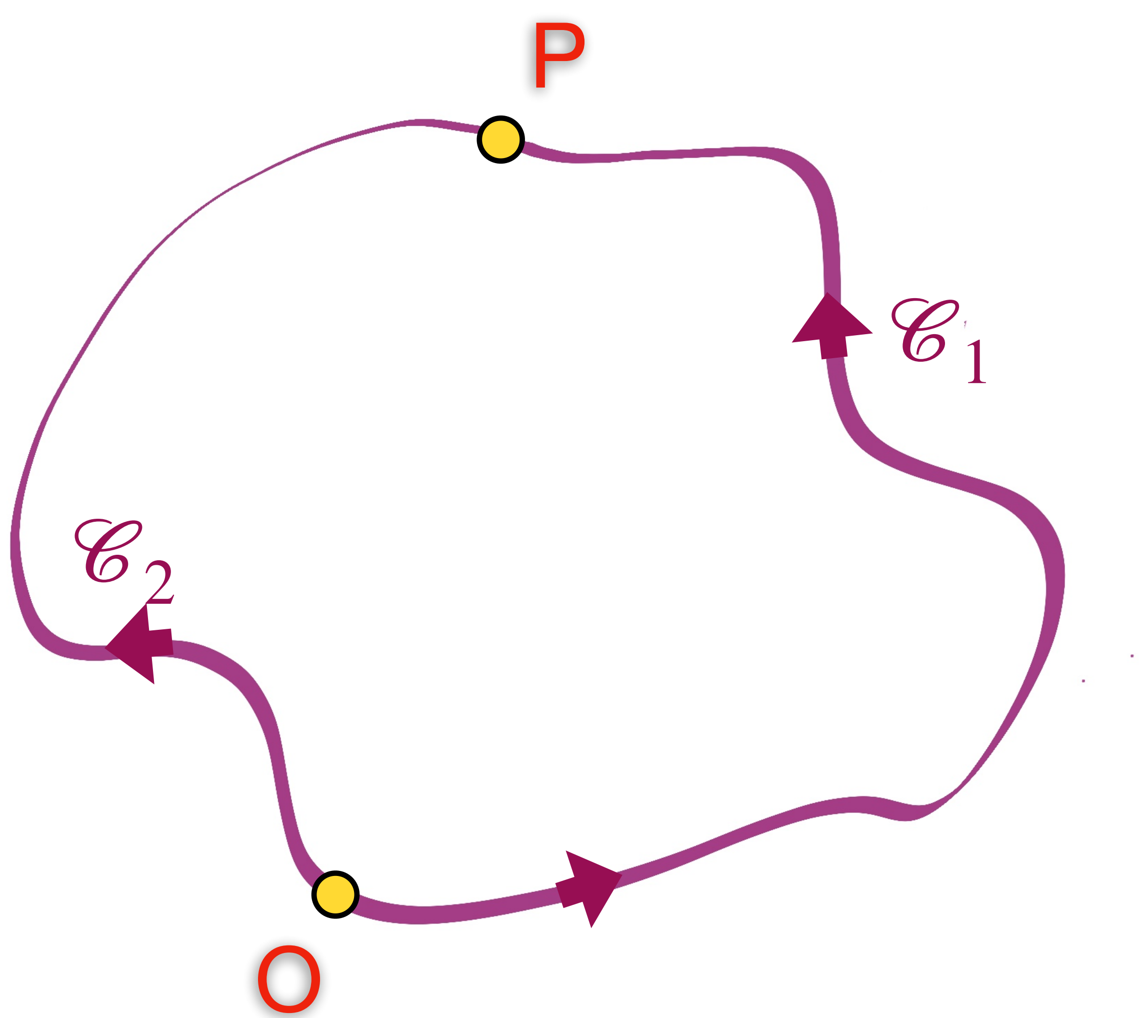


Potencial eletrostático

$$V(P) = -\int_O^P \vec{\mathbf{E}} \cdot d\vec{\ell}$$

$$V(P) - V(O) = \int_O^P \vec{\nabla} V \cdot d\vec{\ell}$$

$$\vec{\mathbf{E}} = -\vec{\nabla} V$$



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