# Física III

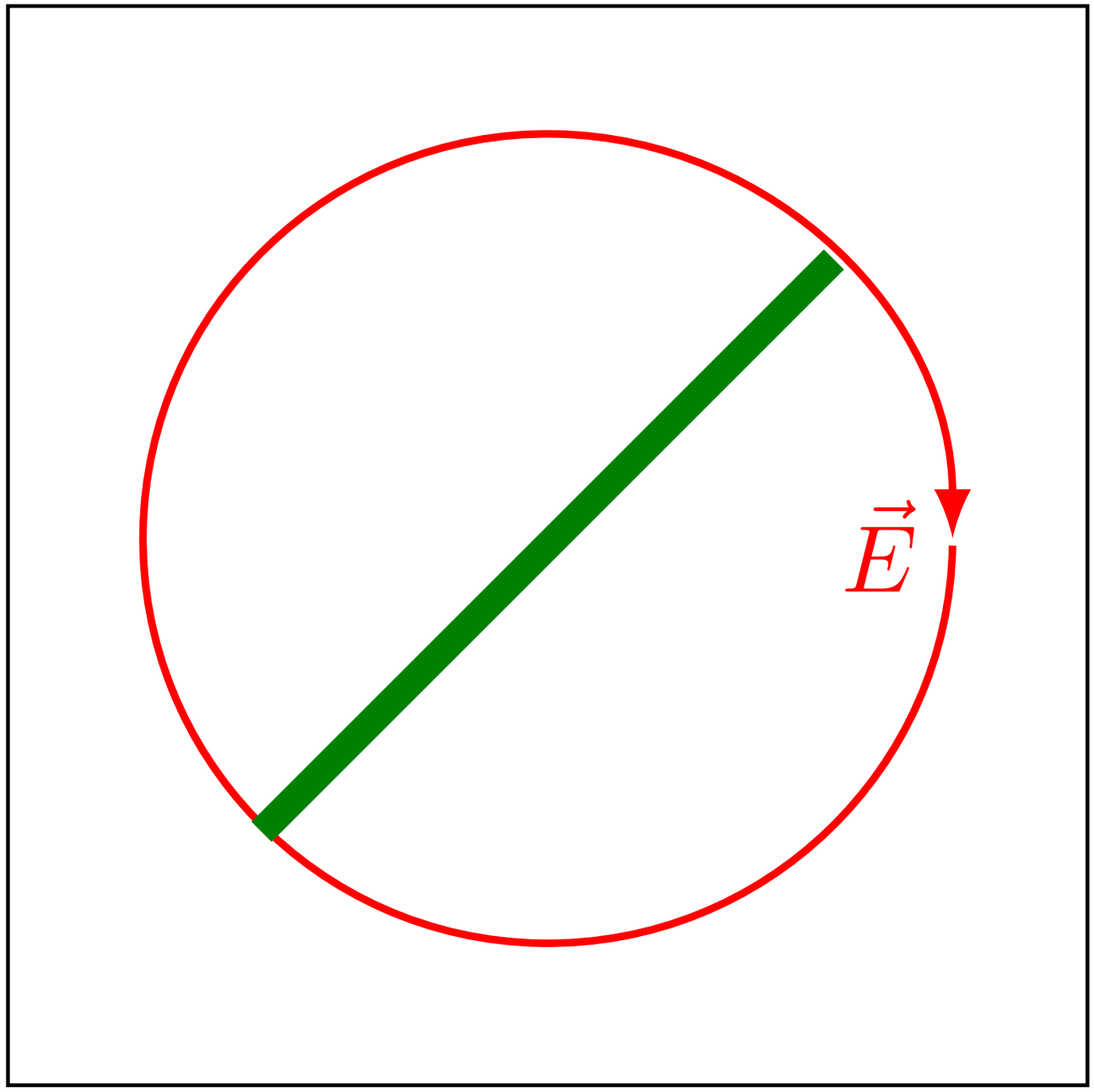
Aula *14/4/2020*

*Potencial eletrostático*

# Rotacional do campo elétrico

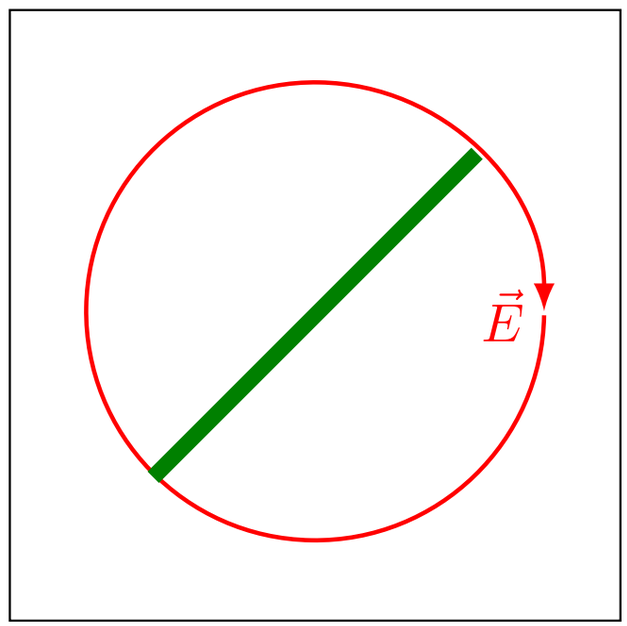
$$\int_{ABCD} \vec{E} \cdot \mathrm{d}\vec{r} = 0$$

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

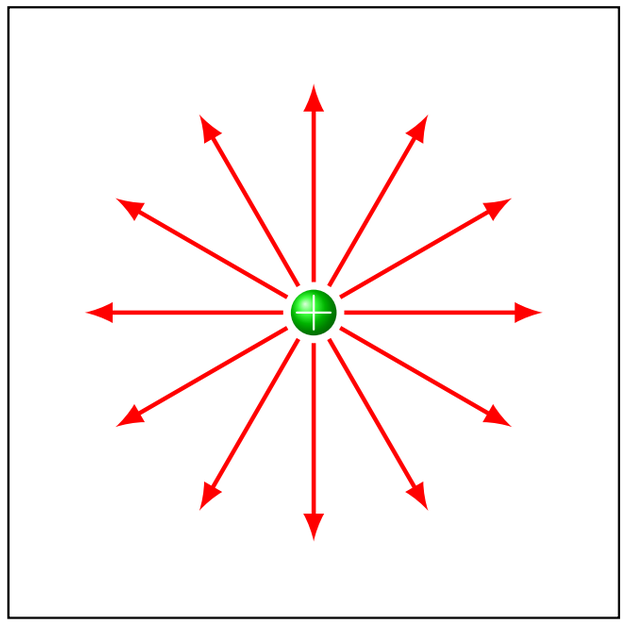


# Leis de Maxwell (provisoriamente)

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




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



# Um pouco mais sobre rotacional

$$W_z = \frac{\partial E_y}{\partial x} - \frac{\partial E_x}{\partial y}$$

$$\vec{\nabla} \times \vec{E} \equiv \vec{W}$$

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$$\vec{\nabla} \times \vec{E} = \begin{vmatrix} \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ E_x & E_y & E_z \\ \hat{x} & \hat{y} & \hat{z} \end{vmatrix}$$

# A pergunta do Marvin

$$\vec{\nabla} \times \vec{E} \equiv \vec{W}$$

$$\Rightarrow \quad \int_{ABCD} \vec{E} \cdot \mathrm{d}\vec{r} = \int \vec{W} \cdot \hat{n}\, \mathrm{d}S$$

$$\vec{W} = \begin{vmatrix} \dfrac{\partial}{\partial x} & \dfrac{\partial}{\partial y} & \dfrac{\partial}{\partial z} \\ E_x & E_y & E_z \\ \hat{x} & \hat{y} & \hat{z} \end{vmatrix}$$

$$\vec{W} \cdot \vec{n} = \begin{vmatrix} \dfrac{\partial}{\partial x} & \dfrac{\partial}{\partial y} & \dfrac{\partial}{\partial z} \\ E_x & E_y & E_z \\ n_x & n_y & n_z \end{vmatrix}$$

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$$\vec{W} \cdot \hat{n} = \vec{\nabla} \times \vec{E} \cdot \hat{n}$$

$$\vec{A} \times \vec{B} \cdot \vec{C} = \vec{B} \times \vec{C} \cdot \vec{A}$$

$$\vec{A} \times \vec{B} \cdot \vec{C} = \vec{A} \cdot \vec{B} \times \vec{C}$$

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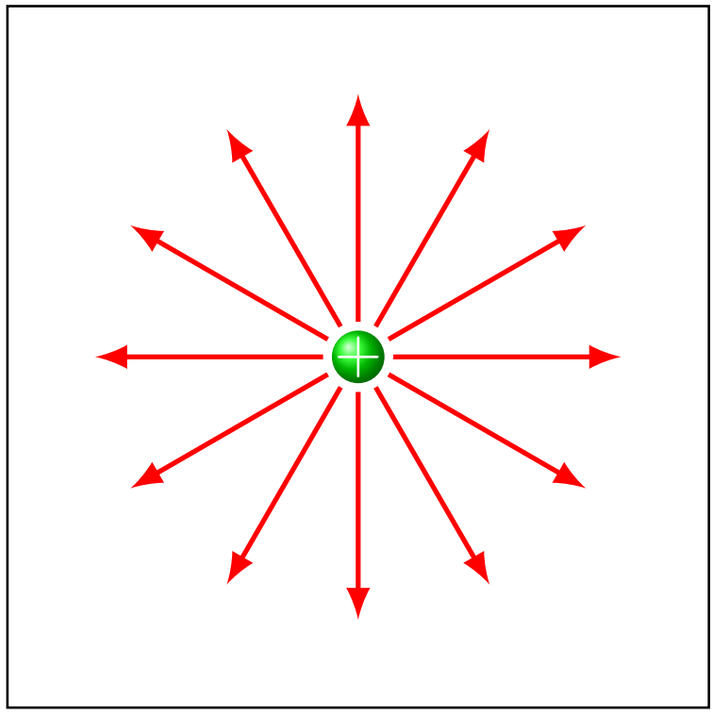
$$\vec{W} \cdot \hat{n} = \vec{\nabla} \times \vec{E} \cdot \hat{n}$$

$$\vec{A} \times \vec{B} \cdot \vec{C} = \vec{A} \cdot \vec{B} \times \vec{C} \quad \Rightarrow \vec{\nabla} \times \vec{E} \cdot \hat{n} = \vec{\nabla} \cdot \vec{E} \times \hat{n}$$

# Rotacional do campo elétrico

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

$$\vec{E} = \frac{q}{4\pi\epsilon_0} \frac{\vec{r}}{r^3}$$



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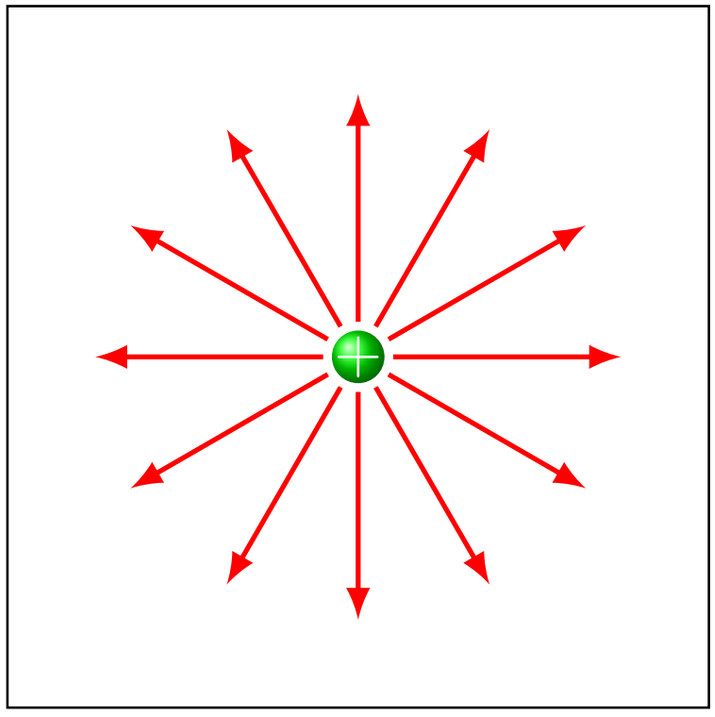
$$\vec{\nabla} \times \vec{E} = 0$$

$$\vec{E} = \frac{q}{4\pi\epsilon_0} \frac{\vec{r}}{r^3}$$

$$E_x = \frac{q}{4\pi\epsilon_0} \frac{x}{r^3}$$



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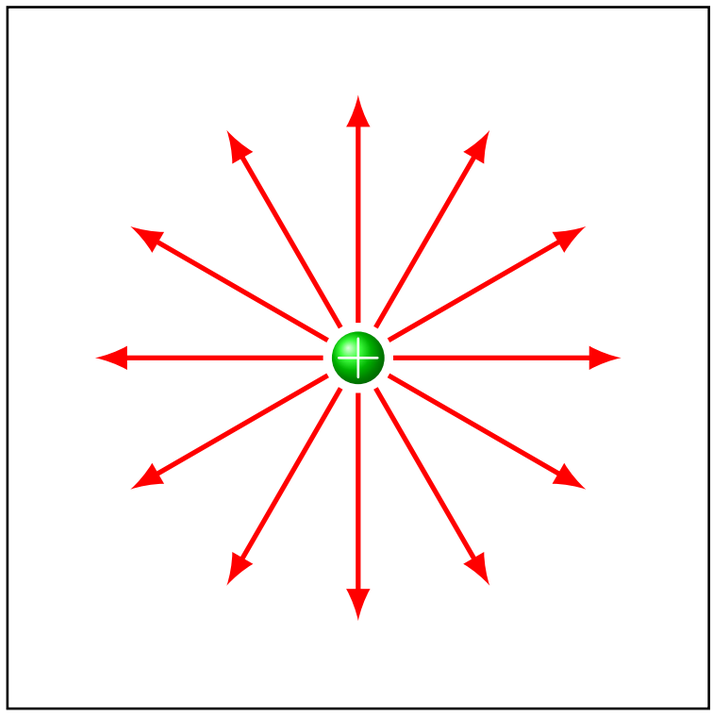

$$E_x = \frac{q}{4\pi\epsilon_0}\frac{x}{r^3}$$

$$E_y = \frac{q}{4\pi\epsilon_0}\frac{y}{r^3}$$

$$E_z = \frac{q}{4\pi\epsilon_0}\frac{z}{r^3}$$

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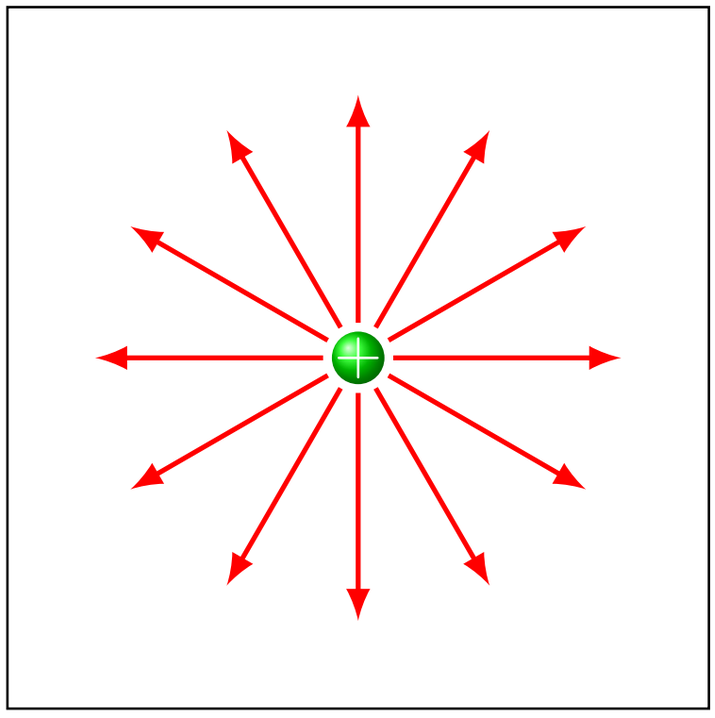

$$E_x = \frac{q}{4\pi\epsilon_0}\frac{x}{r^3}$$

$$\frac{\partial E_x}{\partial y} = \frac{q}{4\pi\epsilon_0}(-3x)\frac{\partial r/\partial x}{r^4}$$

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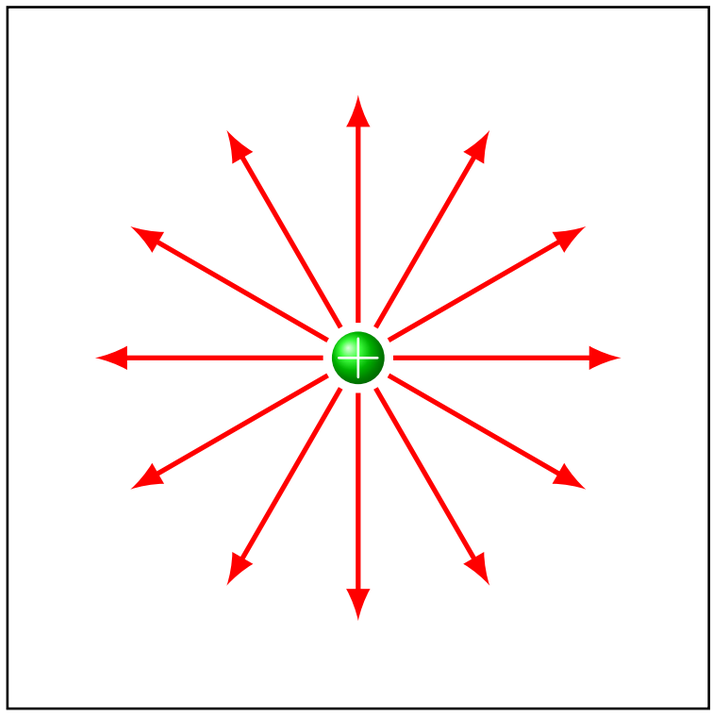

$$E_x = \frac{q}{4\pi\epsilon_0}\frac{x}{r^3}$$

$$\left.\begin{aligned} \frac{\partial E_x}{\partial y} &= \frac{q}{4\pi\epsilon_0}(-3x)\frac{\partial r/\partial x}{r^4} \\ \frac{\partial r}{\partial y} &= \frac{1}{2}\frac{2y}{r} \end{aligned}\right\} \quad \frac{\partial E_x}{\partial y} = \frac{-3q}{4\pi\epsilon_0}\frac{xy}{r^5}$$

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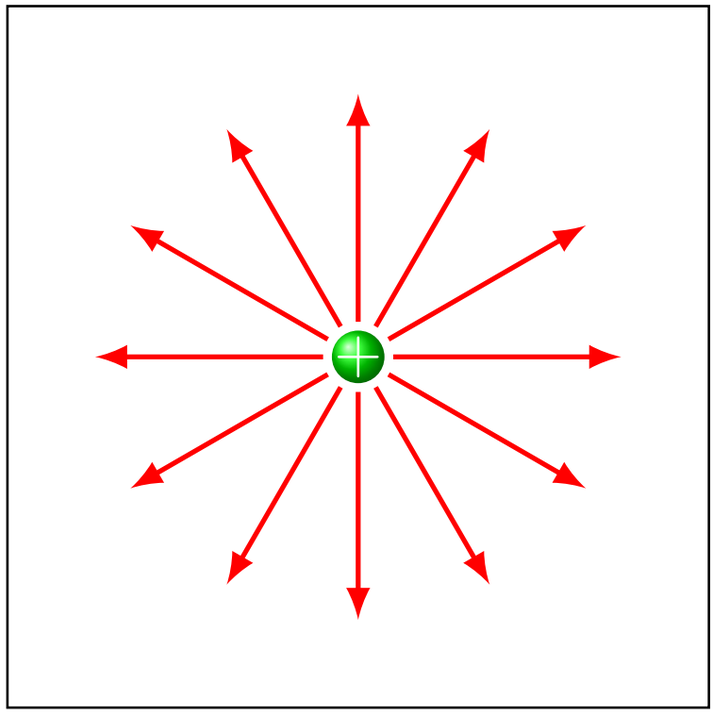


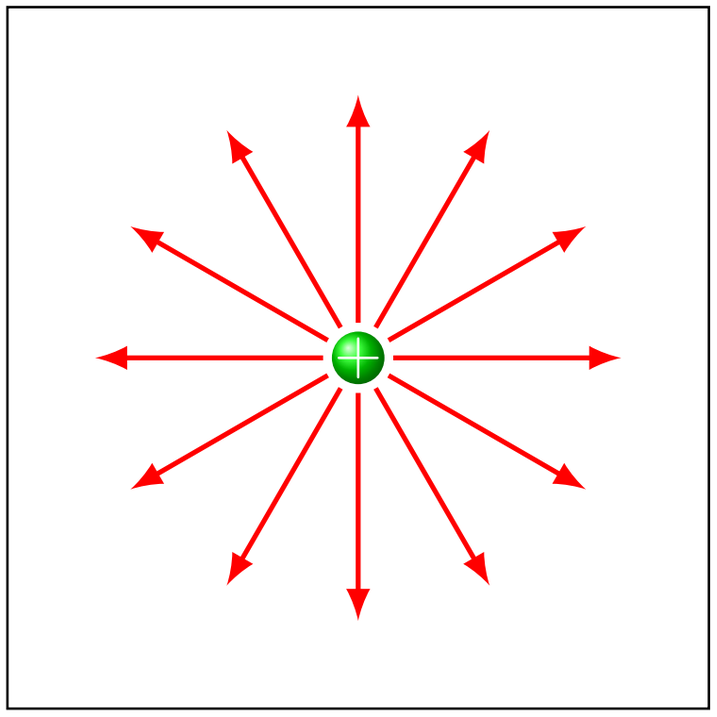
$$E_x = \frac{q}{4\pi\epsilon_0}\frac{x}{r^3}$$

$$\left.\begin{aligned} \frac{\partial E_x}{\partial y} &= \frac{-3q}{4\pi\epsilon_0}\frac{xy}{r^5} \\ \frac{\partial E_y}{\partial x} &= \frac{-3q}{4\pi\epsilon_0}\frac{yx}{r^5} \end{aligned}\right\} \quad \frac{\partial E_y}{\partial x} - \frac{\partial E_x}{\partial y} = 0$$

# Rotacional do campo elétrico

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

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



$$\vec{\nabla} \times \vec{E} = -\vec{\nabla} \times (\vec{\nabla} V)$$

$$\vec{\nabla} V = \frac{\partial V}{\partial x}\hat{x} + \frac{\partial V}{\partial y}\hat{y} + \frac{\partial V}{\partial z}\hat{z}$$

$$\left(\vec{\nabla} \times \vec{E}\right)_z = \frac{\partial}{\partial x}\frac{\partial V}{\partial y} - \frac{\partial}{\partial y}\frac{\partial V}{\partial x} = 0$$

# Corrente elétrica

$$I = \frac{dq}{dt}$$

$$\text{Ampere} = \frac{\text{Coulomb}}{\text{segundo}}$$

$$A = \frac{C}{s}$$