Conteúdo

- Eqs. De Maxwell;
  - Eletrostática;
- Aplicação da Lei de Gauss:
  - Campo de uma carga puntiforme;
- A Lei de Coulomb;

A Eletrostática

- *As eqs. de Maxwell: estática ou quase-estática*

$$\begin{cases} \vec{\nabla} \times \vec{H} = \vec{J} + \dfrac{\partial \vec{D}(t)}{\partial t} & (1) \quad \rightarrow \vec{\nabla} \times \vec{H} = \sigma \cdot \vec{E} + \varepsilon \cdot \cancelto{0}{\dfrac{\partial \vec{E}(t)}{\partial t}} \quad \rightarrow \vec{\nabla} \times \vec{H} = \sigma \cdot \vec{E} \\ \vec{\nabla} \cdot \vec{B} = 0 & (2) \quad \rightarrow \vec{\nabla} \cdot \vec{H} = 0 \quad \rightarrow \vec{\nabla} \cdot \vec{H} = 0 \\ \vec{\nabla} \times \vec{E} = -\dfrac{\partial \vec{B}(t)}{\partial t} & (3) \quad \rightarrow \vec{\nabla} \times \vec{E} = -\mu \cdot \cancelto{0}{\dfrac{\partial \vec{H}(t)}{\partial t}} \quad \rightarrow \vec{\nabla} \times \vec{E} = 0\, \mu \cdot \dfrac{\partial \vec{H}(t)}{\partial t} \\ \vec{\nabla} \cdot \vec{D} = \rho_v & (4) \quad \rightarrow \vec{\nabla} \cdot \vec{E} = \dfrac{\rho_v}{\varepsilon} \end{cases}$$

$\rightarrow \vec{\nabla} \times \vec{H} = \sigma \cdot \vec{E}$ ⇨ **Magnetostática**

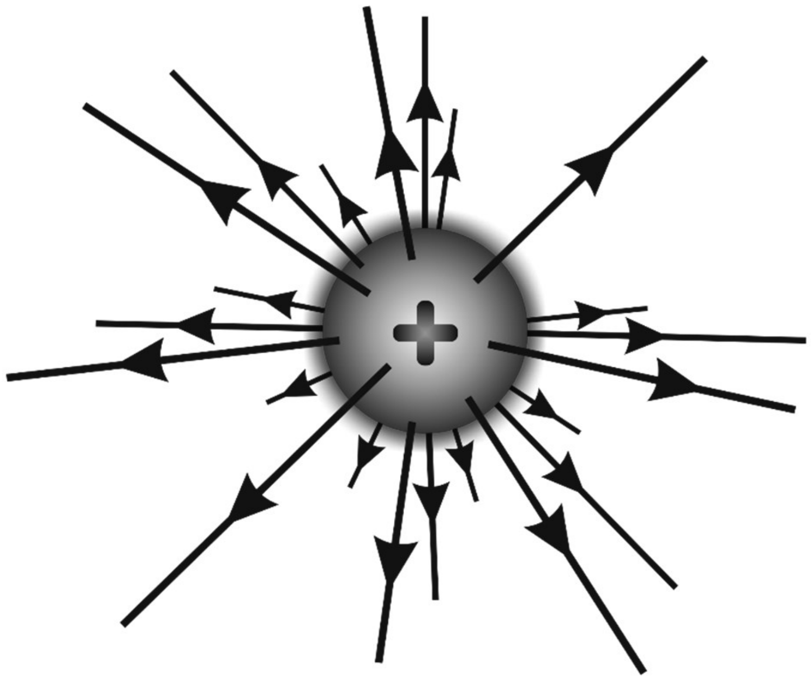
$\rightarrow \vec{\nabla} \cdot \vec{E} = \dfrac{\rho_v}{\varepsilon}$ ⇨ **Eletrostática**

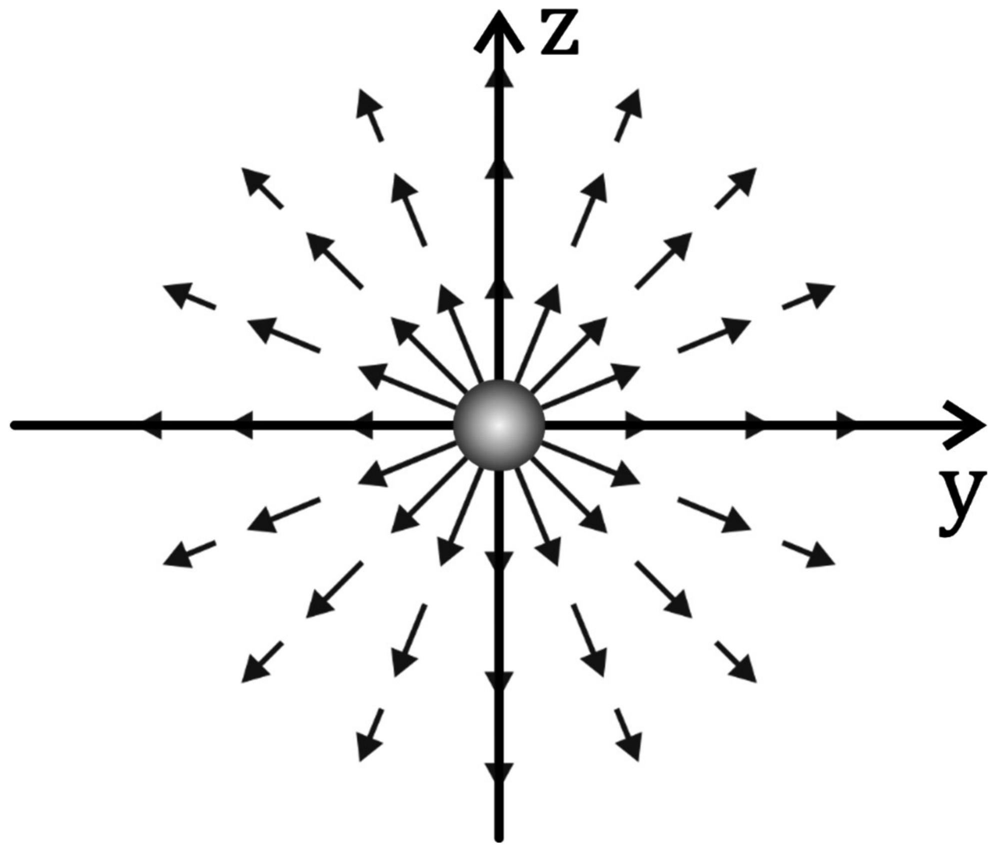
$\rightarrow \oint_s \vec{E} \cdot \overrightarrow{dS} = \dfrac{q_{env}}{\varepsilon}$ (Lei de Gauss)

- *Relações constitutivas:*

$$\begin{cases} \vec{D} = \varepsilon \cdot \vec{E} \\ \vec{B} = \mu \cdot \vec{H} \\ \vec{J} = \sigma \cdot \vec{E} \end{cases}$$

- *Campo Elétrico gerado por uma carga pontual de '**Q**' Coulombs:*





- Campo Elétrico gerado por uma carga pontual de 'Q' Coulombs:

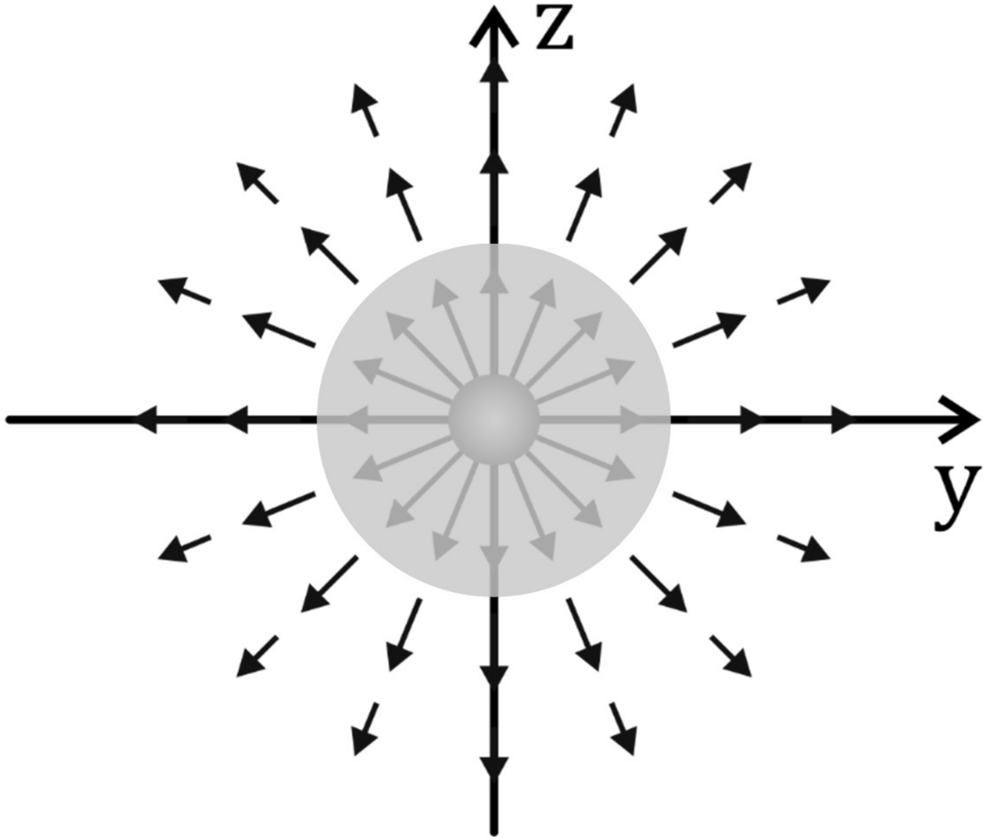
$$i)\ \oint_s \vec{E} \cdot \overrightarrow{dS} = \frac{q_{env}}{\varepsilon}$$

$$ii)\ \vec{E}(r) = E(r)\hat{a}_r$$

$$iii)\ \overrightarrow{dS} = r^2 \cdot sen(\theta) d\theta d\varphi \hat{a}_r$$

$$iv)\ q_{env} = Q$$

$$v)\ \oint_s \ E(r)\hat{a}_r \cdot r^2 \cdot sen(\theta) d\theta d\varphi \hat{a}_r = \frac{Q}{\varepsilon}$$



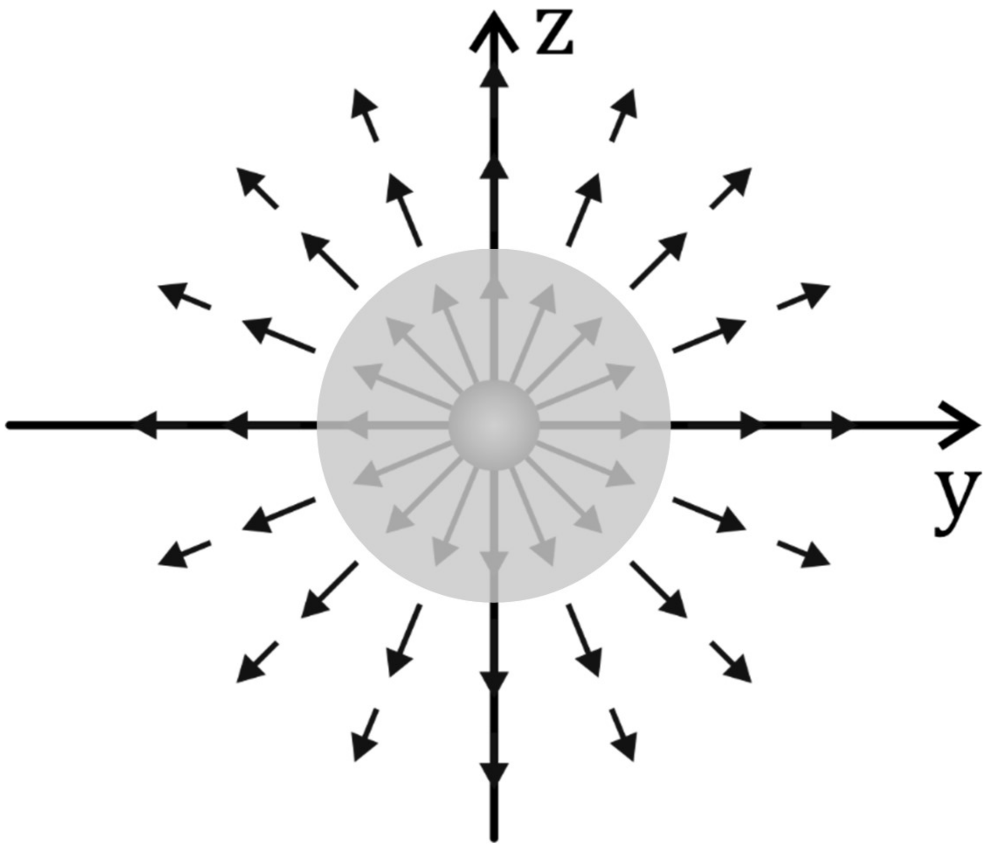
- Campo Elétrico gerado por uma carga pontual de '**Q**' Coulombs:

$$v)\oint_s E(r)\hat{a}_r \cdot r^2 \cdot sen(\theta)d\theta d\varphi \hat{a}_r = \frac{Q}{\varepsilon}$$

$$\rightarrow \oint_s E(r) \cdot r^2 \cdot sen(\theta)d\theta d\varphi = \frac{Q}{\varepsilon}$$

$$\rightarrow E(r) \cdot r^2 \cdot \int_0^{\pi} sen(\theta)d\theta \int_0^{2\pi} d\varphi = \frac{Q}{\varepsilon}$$

$$\rightarrow E(r) \cdot r^2 \cdot 2 \cdot 2\pi = \frac{Q}{\varepsilon}$$

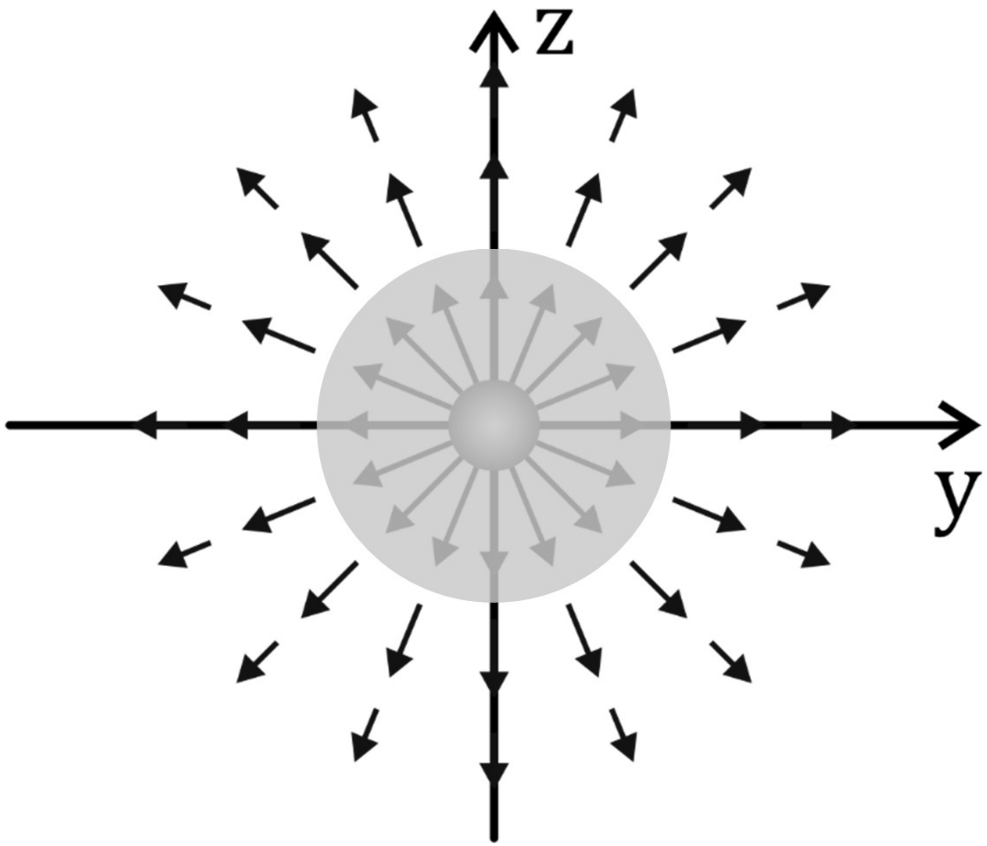


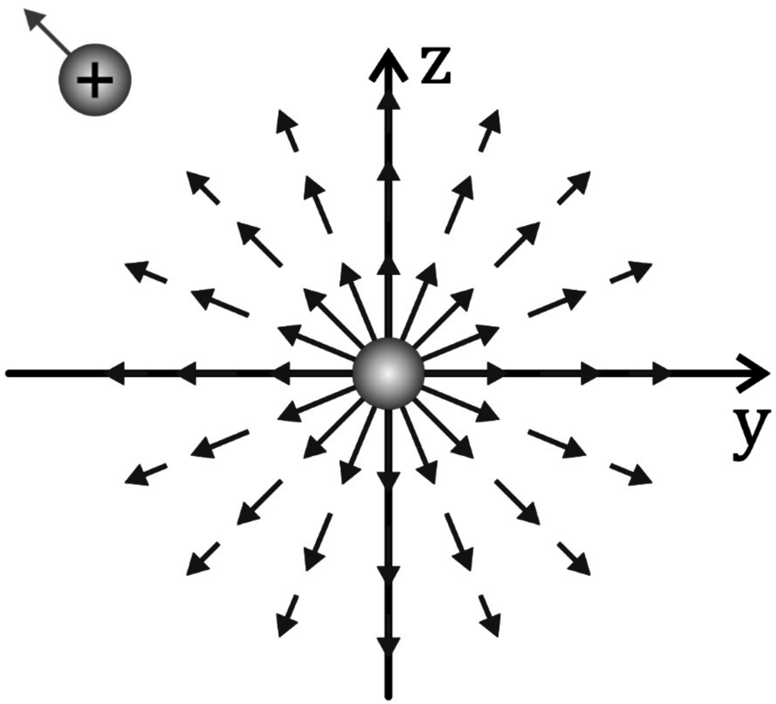
- Campo Elétrico gerado por uma carga pontual de '**Q**' Coulombs:

$$\rightarrow E(r) \cdot r^2 \cdot 2 \cdot 2\pi = \frac{Q}{\varepsilon}$$

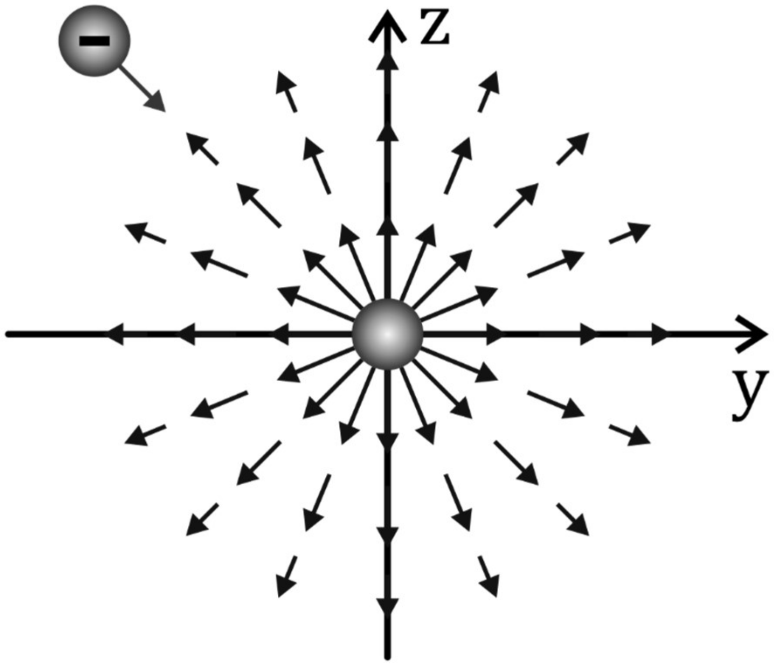
$$\rightarrow E(r) = \frac{1}{4\pi \cdot \varepsilon} \cdot \frac{Q}{r^2}$$

$$\rightarrow \vec{E}(r) = \frac{1}{4\pi \cdot \varepsilon} \cdot \frac{Q}{r^2} \hat{a}_r \; \left({}^{V}/_{m}\right)$$





$$\vec{F}_E = Q_p \cdot \vec{E} \rightarrow \left|\vec{F}_E\right| = \frac{1}{4\pi \cdot \varepsilon} \cdot \frac{\left|Q_p \cdot Q\right|}{r^2}$$



$$\vec{F}_E = Q_p \cdot \vec{E} \rightarrow \left|\vec{F}_E\right| = \frac{1}{4\pi \cdot \varepsilon} \cdot \frac{\left|Q_p \cdot Q\right|}{r^2}$$