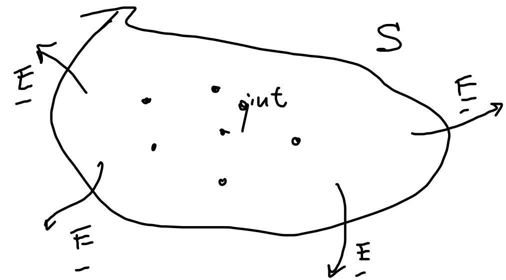
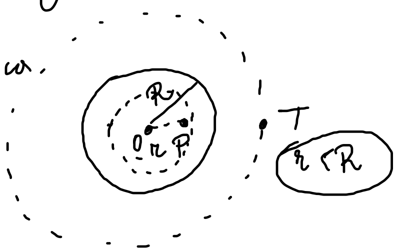
$$\oint_S \underline{E}\cdot d\underline{S} = \frac{q^{int}}{\varepsilon_0}$$



Sfera uniformemente carica q

Si sup. sferica



Nel punto T $\quad r < R$

" " T $\quad r > R$

$$\Phi(\underline{E}) = 4\pi r^2 E \qquad q^{int} = ?$$

$q^{int} \propto$ Volume della sfera ~~dove~~ sup. di Gauss

$$E = \frac{q}{4\pi\varepsilon_0}\frac{1}{r^2}$$

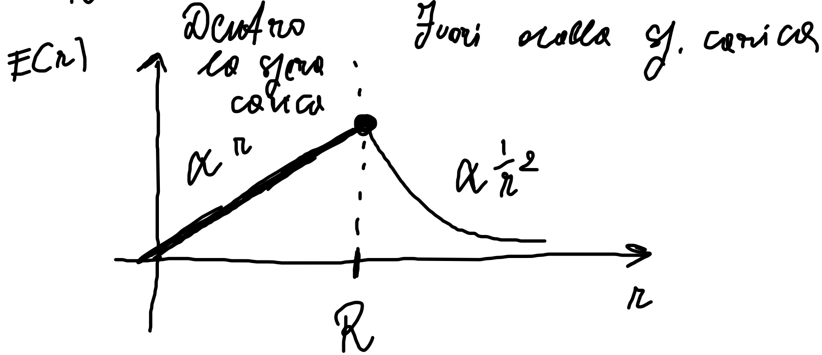
vol. della sfera di Gauss

$$\frac{q^{int}}{q} = \frac{\cancel{\tfrac{4}{3}}\pi r^3}{\cancel{\tfrac{4}{3}}\pi R^3}$$

volume totale che contiene q

$$q^{int} = \frac{q}{R^3}\, r^3 \qquad \text{Se } r = R \Rightarrow q^{int} = q$$

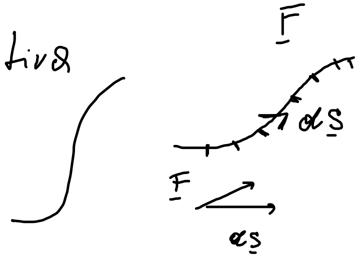
$$\underbrace{4\pi \cancel{r^2} E}_{\Phi(E)} = \frac{q\, r^{\cancel{3}}}{R^3 \varepsilon_0} \Rightarrow E(r) = \frac{q}{4\pi\varepsilon_0}\,\frac{r}{R^3}$$



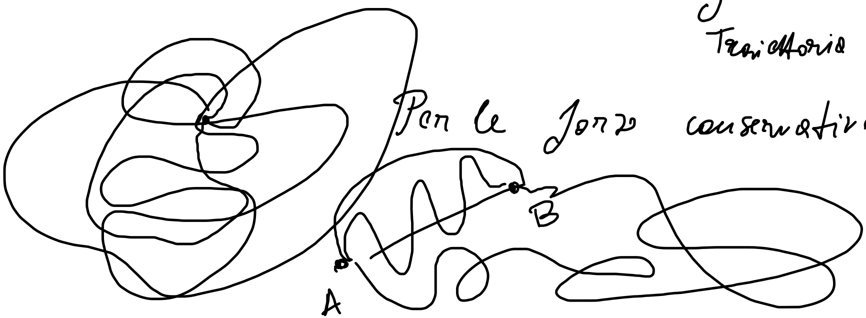
Potenziale elettrostatico

$$\underline{F}_{e.s.} = K_e \frac{q_1 q_2}{r_{12}^2} \hat{\underline{r}}_{12} \qquad \underbrace{\underline{F}_G = -G \frac{m_1 m_2}{r_{12}^2} \hat{\underline{r}}_{12}}_{\text{Forza conservativa}}$$

$$\mathcal{L} = \int_{\text{Traiettoria}} \underline{F} \cdot d\underline{s}$$



Per le forze conservative



$$\mathcal{L} = \text{lo stesso} = U(B) - U(A)$$

$$\mathcal{L}_{\text{percorso chiuso}} = 0 = U(A) - U(A)$$

Def

$$\Delta U_{es} = -\int_A^B \underline{F}_{es} \cdot d\underline{s}$$

Per qualunque forza

$$\mathcal{L} = \Delta K \qquad K = \frac{1}{2} m v^2$$

Se la forza è conservativa

$$-\Delta U = \Delta K = \mathcal{L} \Rightarrow \Delta(K+U) = 0$$

$$\Rightarrow E_{mecc} = K + U = cost$$

Per forze e.s. $K + U_{es} = cost$

U_{es} : energia potenziale elettrostatica

$$\underline{F} = q\underline{E} \qquad \Delta U_{es} = -\int_A^B q\,\underline{E} \cdot d\underline{s}$$

$$[U_{es}] = J$$

differenza di potenziale

$$\Delta V = \frac{\Delta U_{es}}{q} = -\int_A^B \underline{E} \cdot d\underline{s}$$

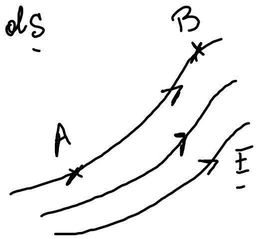
$$= -q \int_A^B \underline{E} \cdot d\underline{s}$$

$$[\Delta V] = \frac{J}{C} \overset{def}{=} volt$$

$$[\Delta V] = [E] \cdot m \rightarrow [E] = \frac{V}{m}$$

volt

$\Delta V_{AB} = -\int \underline{E} \cdot d\underline{s}$



Ci muoviamo lungo $\underline{E}$: $d\underline{s} \parallel \underline{E}$

$\underline{E} \cdot d\underline{s} > 0$

$\Rightarrow \Delta V_{AB} < 0$

Le linee di campo sono orientate verso potenziali decrescenti

Dato $\underline{E}$: $\underline{F} = q\underline{E}$

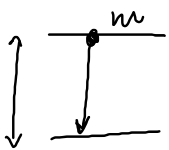
$\underline{F} \parallel \underline{E}$ se $q > 0$ $\Rightarrow$ $q > 0$ si muovono spontaneamente verso pot. decrescenti

$\underline{F}$ anti$\parallel$ $\underline{E}$ se $q < 0$

$\Downarrow$

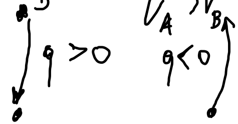
$q < 0$ si muovono spont. verso pot. crescenti

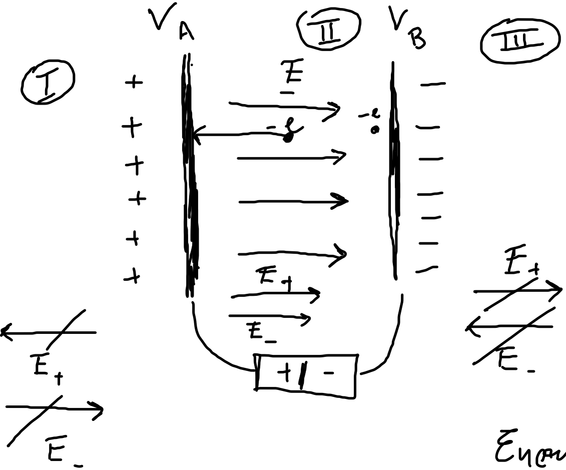
m h



masse vanno verso pot. decresenti

$V_A > V_B$ $q > 0$ $\quad$ $V_A > V_B$ $q < 0$





$V_0 = 12\,V$

$\underline{E} = \frac{\sigma}{2\varepsilon_0} \rightarrow C/m^2$

uscente dalla lastra se $\sigma > 0$

armatura: ciascuna lastra carica

$V_A > V_B$ $\quad \Delta V_{AB} = V_0 \rightarrow$ potenziale fornito dalla batteria

Energia iniziale: $E_i = \frac{1}{2} m_e v_e^2 - eV_B$

12

$E = \frac{1}{2} m v^2 + U \rightarrow qV$

0

Energia finale: $E_f = \frac{1}{2} m_e v_f^2 - eV_A$

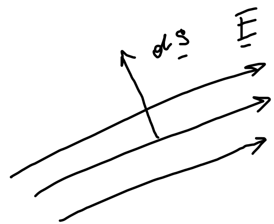
$v_f = \left(\frac{2eV_0}{m_e}\right)^{\frac{1}{2}} \simeq \left(\frac{2 \cdot 1.6 \cdot 10^{-19}\, 12}{10^{-30}}\right)^{\frac{1}{2}} \simeq 2 \cdot 10^6\, m/s$

$\frac{1}{2} m_e v_f^2 - eV_A = -eV_B$

$\Rightarrow \frac{1}{2} m_e v_f^2 = e\Delta V = eV_0$

Calcolo della differenza di potenziale (o del potenziale)

$\underline{E} = \vec{\text{const}}$



$$\Delta V = -\int \underline{E}\cdot d\underline{s}$$

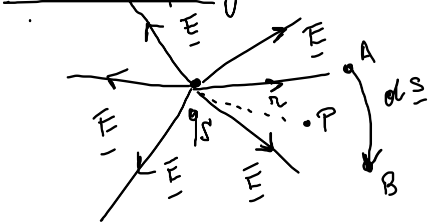
Se $d\underline{s} \perp \underline{E}$: $d\underline{s}\cdot\underline{E} = 0 \Rightarrow \Delta V = 0 \Rightarrow V = \text{const}$

Se $d\underline{s} \parallel \underline{E}$: $d\underline{s}\cdot \underline{E} = dS\,E$ E uniforme

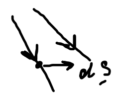
$$|\Delta V| = E\int dS = E\Delta S$$

Carica puntiforme

$q_S > 0$



$$\underline{E} = k_e \frac{q_S}{r^2}\hat{r}$$



$$\Delta V = -\int_A^B \frac{k_e q_S}{r^2}\underbrace{\hat{r}\cdot d\underline{s}}_{dr} = -k_e q_S \int_A^B \frac{dr}{r^2}$$

$$= k_e q_S \frac{1}{r}\Big|_{r_A}^{r_B} = k_e q_S\left[\frac{1}{r_B}-\frac{1}{r_A}\right]$$

Per carica puntiforme

$$V_B - V_A = \Delta V = \frac{k_e q_s}{r_B} - \frac{k_e q_s}{r_A}$$

$$V(r) = \frac{k_e q_s}{r}$$

Tante cariche $\underline{E} = \underline{E}_1 + \underline{E}_2 + \dots$

$$V_{TOT}(r) = \sum_{i=1}^{N} \frac{k_e q_{s_i}}{r_i}$$