Formulario

Cinematica

moto rettilineo uniforme

$$\begin{cases} x(t) = x_0 + v_0 t \\ v_0 \text{ costante} \end{cases}$$

moto uniformemente accelerato

$$\begin{cases} x(t) = x_0 + v_0 t + \frac{1}{2} a_0 t^2 \\ v(t) = v_0 + a_0 t \\ a_0 \text{ costante} \end{cases}$$

moto armonico

$x(t) = A \sin(\phi + \omega t)$

$v(t) = A\omega \cos(\phi + \omega t)$

$a(t) = -A\omega^2 \sin(\phi + \omega t) = -\omega^2 x(t)$

periodo $= T = \frac{2\pi}{\omega}$

Frequenza $: \nu = \frac{1}{T} = \frac{\omega}{2\pi}$

pulsazione $: \omega = 2\pi\nu$

moto circolare ($R ::$ raggio)

$\omega(t) =$ velocità angolare

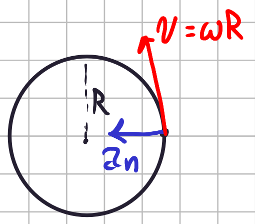
$v = \omega R$ velocità tangenziale

$a_t = \frac{dv}{dt}$ accelerazione tangenziale

$a_n = \omega^2 R$ accelerazione normale

$a = \sqrt{a_t^2 + a_n^2}$ acc. totale

$\bar{v} = \bar{\omega} \times \bar{R}$



moto circ. unifor.

$$\begin{cases} x(t) = R\cos(\theta(t)) \\ y(t) = R\sin(\theta(t)) \\ \theta = \omega t \end{cases}$$

Dinamica

$\bar{F} = m \cdot \bar{a}$

quantità di moto $\bar{p} = \frac{d}{dt}(m\bar{a}) = m\bar{v}$

impulso $I = \int_{t_0}^{t} \bar{F} dt$ e $I = \Delta \bar{p}$

Forza media $= \frac{I}{\Delta t} = \frac{\Delta \bar{p}}{\Delta t} = \frac{|\bar{p}(t_1) - \bar{p}(t_2)|}{t_2 - t_1}$

Attrito

Statico $\bar{F}_s \leq \mu_s R_n$ $R_n ::=$ reazione normale

Dinamico $\bar{F}_d = -\mu_d \cdot R_n \cdot \hat{\tau}$

versore velocità

$\hat{\tau} = \frac{\bar{v}}{|\bar{v}|}$

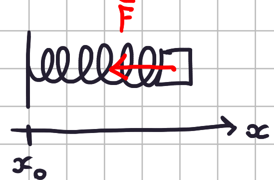
attrito dell'aria : $\bar{F} = -b\bar{v}$
coefficiente

Forza Elastica

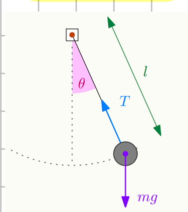
coeff centro

$\bar{F} = -K(x - x_0)$

pos



Pendolo



$-mg\sin\theta = -m\frac{d^2 S}{dt^2}$

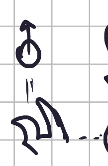
$-mg\sin\left(\frac{S}{l}\right) = -m\frac{d^2 S}{dt^2}$

per $\theta \to 0 \Rightarrow -mg\frac{S}{l} = -m\frac{d^2 S}{dt}$

$\Rightarrow S = A\cos(\omega t + \phi)$

$\omega = \sqrt{\frac{g}{l}}$

Gravi

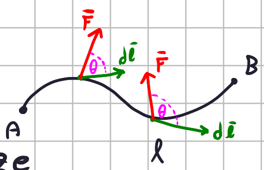


$$\begin{cases} h: \text{quota lancio} \\ v_0: \text{vel iniziale} \end{cases}$$

si fermerà in $\Rightarrow t^* = \frac{1}{g} v_0$

quota max raggiunta: $h + \frac{1}{2g} v_0^2$

Lavoro



$\bar{F} : \mathbb{R}^3 \to \mathbb{R}^3$ campo di Forze

$$L = \int_l \bar{F}\, d\bar{l} = \int_A^B F\, dl \cos\theta = \Delta T$$

Impulso

$I = \Delta\bar{p} = \Delta(m\bar{v})$ variazione della quantita' di moto

Teorema dell'impulso

$$\frac{I}{\Delta t} = \frac{\Delta \bar{p}}{\Delta t} = \frac{1}{\Delta t}\int_{t_1}^{t_2} \bar{F}\, dt$$ Forza media

energia cinetica $T = \frac{1}{2} m v^2$

$$L = \frac{1}{2} m v^2(B) - \frac{1}{2} m v^2(A)$$

$\bar{F}$ e' conservativa se

$L = -\Delta U$ dove U energia potenziale

$$\oint_l \bar{F}\, d\bar{l} = 0$$

altezza

Potenziale gravita' $U(y) = m g y$

Potenziale gravitazionale $U(r) = -\frac{G M m}{r}$

distanza

Potenziale elastica $U(x) = \frac{1}{2} K (x - x_0)^2$

Energia meccanica $E_m = U + T$

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

Se $\bar{F}$ e' conservativa $\Delta E_m = 0$

$$\Rightarrow \begin{cases} L = \Delta T \\ L = -\Delta U \end{cases} \Rightarrow \Delta T + \Delta U = 0 \Rightarrow \Delta(T + U) = 0$$

$\Delta E_m =$ LAVORO FORZE NON CONSERVATIVE

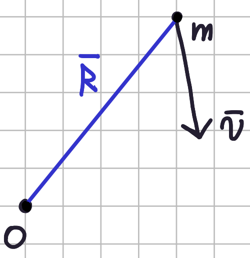
Potenza

$$P = \frac{dL}{dt}$$

Momento Angolare

$$\bar{M} = \bar{R} \times \bar{p} = \bar{R} \times \frac{d}{dt} m\bar{v}$$

quantita' di moto



momento della quantita' di moto

$$\bar{b} = \bar{R} \times m\bar{v}$$

$$\bar{M} = \frac{d\bar{b}}{dt} - \frac{d\bar{R}}{dt} \times m\bar{v}$$

essendo $\bar{v} = \bar{\omega} \times \bar{R}$

$$\bar{b} = \bar{R} \times m(\bar{\omega} \times \bar{R}) = m R^2 \bar{\omega}$$

momento di inerzia $I = m R^2$ $\qquad \bar{b} = I\bar{\omega}$

il momento si puo' scrivere $\bar{M} = \frac{d}{dt} I\bar{\omega} = I\dot{\bar{\omega}}$

se I cost.

Sistema di Punti

le Forze interne si annullano. n punti

$$\bar{F}_{(est)} = \sum_{i=1}^{n} m_i a_i$$

pos. di ogni punto

centro di massa $\bar{r}_c = \sum_i m_i \bar{r}_i \cdot \frac{1}{\sum_i m_i}$

vel. del sistema (centro di massa)

$\frac{d\bar{r}_c}{dt} = \bar{v}_c$ $\qquad$ somma masse $M = \sum_i m_i$

$\Rightarrow$ quantita' di moto del sistema

$$\bar{p}_c = M\bar{v}_c = \sum_i m_i \bar{v}_i$$

$$\frac{d}{dt}\bar{p}_c = \sum_i \frac{d}{dt} m_i \bar{v}_i = \sum_i m_i \bar{a}_i = \bar{F}_{(est)}$$

Urti

•elastici : la quantità di moto si conserva.

2 corpi

Masse : m_1 , m_2
vel. post urto V_1 V_2
vel. pre urto v_1 v_2

Cons. quantità di moto

$$m_1 v_1 + m_2 v_2 = m_1 V_1 + m_2 V_2$$

cons. energia cinetica

$$\frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 = \frac{1}{2} m_1 V_1^2 + \frac{1}{2} m_2 V_2^2$$

Momento sistema di punti

$$\begin{cases} \bar{M}_1 = \frac{d\bar{b}_1}{dt} + \bar{v}_0 \times \bar{r}_1 \\ \vdots \\ \bar{M}_n = \frac{d\bar{b}_n}{dt} + \bar{v}_0 \times \bar{r}_n \end{cases}$$

i momenti interni del sistema si annullano

$$\left(\frac{d}{dt} \sum \bar{b}_i\right) + \bar{v}_0 \times \left(\sum \bar{r}_i\right)$$

si può riscrivere

$$\frac{d}{dt}\left(\sum \bar{r}_i \times m_i \bar{v}_i\right) + \bar{v}_0 \times \left(\sum \bar{r}_i\right)$$

Il momento del sistema non è uguale alla somma dei momenti

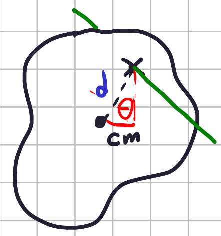
Sistema Continuo

per un oggetto puntiforme $I = Rm^2$

$dI = R^2 dm = R^2 \lambda dR \Rightarrow \lambda$ densità: $\frac{dm}{dR} = \lambda$

$I = \int_S dI$ ← sup. oggetto

Pendolo Composto



d = dist. centro di massa - punto inF.

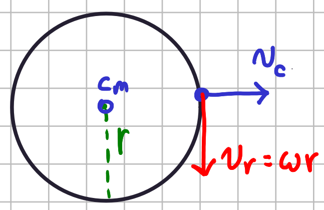
$$-mg \cdot d \cdot \theta = -I_0 \frac{d^2\theta}{dt^2}$$ per $\theta \to 0$

I_0 = momento di inerzia con polo in cm

$I_0 = I_{cm} + m \cdot d^2$

I_{cm} ← momento in. centro massa

Rotolamento



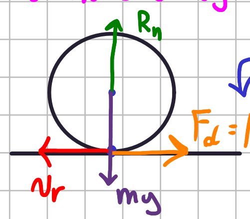
velocità centro di massa

velocità di rotazione

$v_a = v_c + v_r$

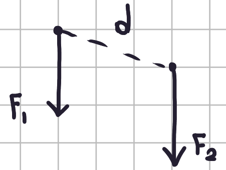
↑ vel. assoluta di ogni punto

$|v_c| = |v_r| \Rightarrow$ rotolamento puro

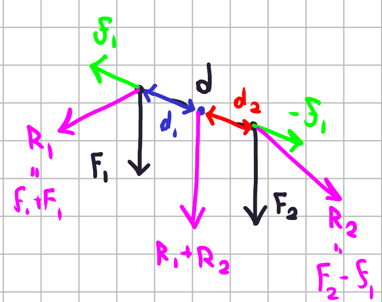


nel punto di contatto

Sistemi eq. di Forze



$$\frac{d_1}{d_2} = \frac{F_2}{F_1}$$

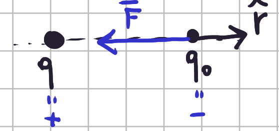


Campo Elettrico

Coloumb

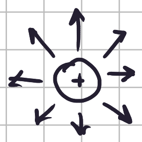
q esercita su q_0 $\quad \vec{F} = \frac{1}{4\pi\varepsilon_0} \frac{q \cdot q_0}{r^2} \hat{r}$

$r := dist(q, q_0)$



Campo Elettrico

$$\vec{E} = \lim_{q_0 \to 0} \frac{\vec{F}}{q_0} = \frac{1}{4\pi\varepsilon_0} \frac{q}{r^2} \hat{r}$$

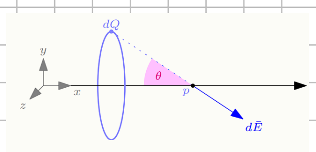


q_0 immersa in $\vec{E}$ sente $\vec{F} = q_0 \vec{E}$

Sistema di cariche : $\vec{E} = \frac{1}{4\pi\varepsilon_0} \sum_{i=1}^{n} \frac{q_i}{r_i^2} \hat{r}_i$

Sup. carica : $\vec{E} = \frac{1}{4\pi\varepsilon_0} \int_S \frac{dQ}{r^2} \hat{r}$

Anello Carico



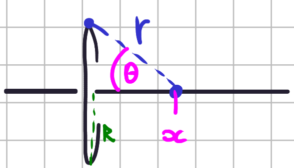
$dE_x = \frac{1}{4\pi\varepsilon_0} \frac{dQ}{r^2} \cos\alpha$

λ densità $\Rightarrow$ $dQ = \lambda dl$

dl = punto circonferenza

$$E_x = \frac{1}{4\pi\varepsilon_0} \int_A \frac{\lambda dl}{r^2} \cos\theta = \frac{1}{4\pi\varepsilon_0} \frac{1}{r^2} \cos\theta \, Q$$

↖ non dipende dal punto sulla circ.



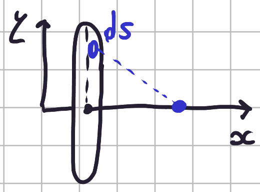
$\Rightarrow r\cos\theta = x \Rightarrow \cos\theta = \frac{x}{r}$

$E = \frac{1}{4\pi\varepsilon_0} \frac{x}{r^3} Q \qquad r = \sqrt{R^2 + x^2}$

↖ dipende da x $\qquad$ ↑ raggio

Disco Carico

$dQ = \lambda dS \qquad dS$ = sup. infinitesima



$E = \frac{1}{4\pi\varepsilon_0} \iint_S \frac{\lambda dS}{r^2}$

↗ superf.

Cambio :

dS = anello infinitesimo

↱ spessore anello

$dS = (2\pi r) \cdot dr$

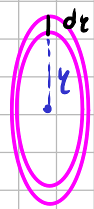
↑ raggio

$$dE = \frac{1}{4\pi\varepsilon_0} \cdot \frac{x}{\underbrace{(x^2 + z^2)^{3/2}}_{\text{dist}}} \cdot dQ$$

z = raggio r anello

dens.

$dQ = \sigma \cdot \underbrace{(2\pi z) dz}_{\text{sup. anello inf.}}$



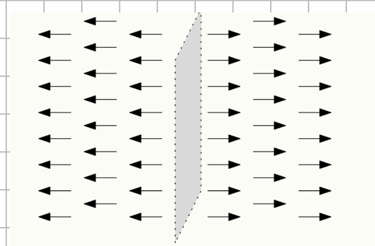
RAGGIO DISCO → R

$$E = \frac{1}{4\pi\varepsilon_0} \cdot \sigma 2\pi \cdot x \int_0^R \frac{z}{(x^2 + z^2)^{3/2}} dz$$

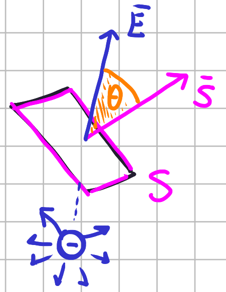
$$E(x) = \frac{\sigma x}{2\varepsilon_0} \cdot \left(\frac{1}{|x|} - \frac{1}{\sqrt{x^2 + R^2}} \right)$$

Piano Carico

$$\lim_{R \to \infty} \frac{\sigma x}{2\varepsilon_0} \cdot \left(\frac{1}{|x|} - \frac{1}{\sqrt{x^2 + R^2}} \right) = \pm \frac{\sigma}{2\varepsilon_0}$$



Flusso



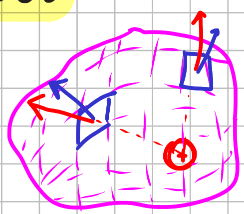
$\phi = \bar{E}\cdot\underbrace{\bar{S}}_{sup} = ES\cos\theta$

S = sup finita

$$\phi = \int_S d\phi = \int_S \bar{E}\cdot d\bar{s}$$

Legge di Gauss

S := sup. chiusa



$$\phi = \oint_S \bar{E}\cdot d\bar{s} = \frac{q}{\varepsilon_0}$$

$$d\phi = \bar{E}\cdot d\bar{s} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\hat{r}\,d\bar{s} = \frac{q}{4\pi\varepsilon_0}\cdot\frac{\hat{r}\,d\bar{s}}{r^2} = \frac{q}{4\pi\varepsilon_0}d\Omega$$

$$\frac{\hat{r}\,d\bar{s}}{r^2} = d\Omega \Rightarrow \oint d\Omega = 4\pi$$

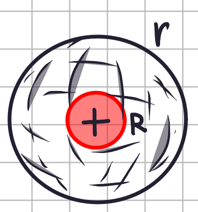
si scrive anche

$$\boxed{\oint_S \bar{E}\cdot d\bar{s} = \frac{1}{\varepsilon_0}\int_{\tau_S}\rho\,d\tau}$$

carica int. alla sup S

$\tau_S \Rightarrow$ volume di S

Campo sfera carica

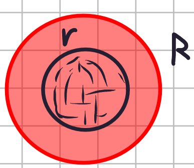


$r \geq R$

$$\phi = \frac{1}{\varepsilon_0}\int_{\tau_S}\rho\,d\tau = \frac{Q}{\varepsilon_0}$$

$$\frac{Q}{\varepsilon_0} = \oint_S E\,d\bar{s} = E\int_S d\bar{s} = E4\pi r^2 \Rightarrow E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$$

$r < R$

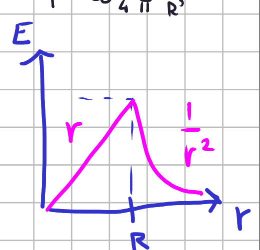


$$\phi = \frac{1}{\varepsilon_0}\int_{\tau_S}\rho\,d\tau = \frac{\rho}{\varepsilon_0}\int_0^r d\tau = \frac{\rho}{\varepsilon_0}\frac{4}{3}\pi r^3$$

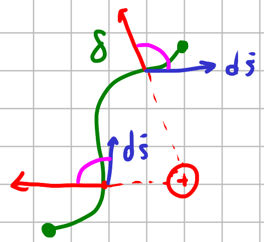
$$\rho\frac{4}{3}\pi R^3 = Q \;\Downarrow\; \rho = Q\frac{3}{4}\frac{1}{\pi}\frac{1}{R^3}$$

$$E4\pi r^2 = \frac{\rho}{\varepsilon_0}\frac{4}{3}\pi r^3$$

$$E = \frac{\rho}{\varepsilon_0}\frac{1}{3}r = \frac{Q}{4\pi\varepsilon_0}\cdot\frac{r}{R^3}$$



Circuitazione



$$L = \int_\delta q_0\bar{E} = q_0\int_\delta \bar{E}\,d\bar{s}$$

L lavoro

Sia C una curva chiusa

$$\mathcal{E} = \oint_C \bar{E}\,d\bar{s} \qquad \int_A^B \bar{E}\,d\bar{s} = V(A) - V(B) = \Delta V$$

CIRCUITAZIONE

potenziale

$$L = -q_0\Delta V = -\Delta U$$

CAMPO ELETTROSTATICO $\Rightarrow$ CONSERVATIVO $\Rightarrow \mathcal{E} = 0$

Potenziale di una Carica

$$\bar{E} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\hat{r} \Rightarrow \bar{E}\,d\bar{s} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\hat{r}\,d\bar{s} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}dr$$

$$\mathcal{E} = \int_C \bar{E}\,d\bar{s} = \int_A^B \bar{E}\,d\bar{s} = \frac{Q}{4\pi\varepsilon_0}\int_{r_A}^{r_B}\frac{1}{r^2}dr$$

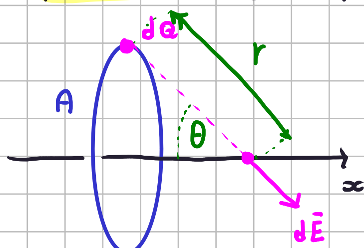
$$= \frac{Q}{4\pi\varepsilon_0}\left(\frac{1}{r_B} - \frac{1}{r_A}\right) \Rightarrow V(r) = \frac{Q}{4\pi\varepsilon_0}\cdot\frac{1}{r}$$

dist da Q

Gradiente

$$\bar{E} = -\nabla V = \left[-\frac{\partial V}{\partial x}, -\frac{\partial V}{\partial y}, -\frac{\partial V}{\partial z}\right]$$

Potenziale Anello Carico



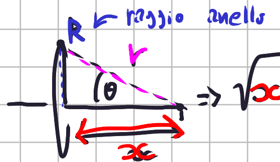
Potenziale di dQ é

$$\frac{1}{4\pi\varepsilon_0}\frac{dQ}{r}$$

$$\boxed{\int_A dQ = Q}$$

r non dipende dalla pos. di dQ

$$\text{Pot. totale } V(r) = \frac{1}{4\pi\varepsilon_0}\int_A\frac{dQ}{r} = \frac{1}{4\pi\varepsilon_0 r}\cdot Q$$



$$\Rightarrow \sqrt{x^2+R^2} = r \Rightarrow V(r) = \frac{Q}{4\pi\varepsilon_0}\cdot\frac{1}{\sqrt{x^2+R^2}}$$

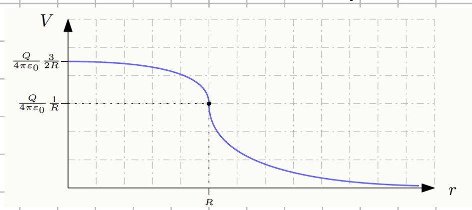
Potenziale Sfera Carica

raggio sfera: R

$$E(r) = \begin{cases} \frac{1}{r^2 4\pi\varepsilon_0} Q & \text{se } r \geq R \\ \frac{Q}{4\pi\varepsilon_0} \cdot \frac{r}{R^3} & \text{se } r \leq R \end{cases}$$

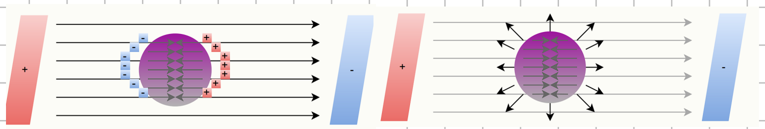
Interno: $V(r) = \int_r^\infty \frac{1}{r^2} \cdot \frac{Q}{4\pi\varepsilon_0} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{r}$ { come se fosse una carica punt.

esterno: $V(r) = \frac{Q}{4\pi\varepsilon_0} \frac{1}{R^3} \int_r^R r\,dr = \frac{1}{4\pi\varepsilon_0}\left(\frac{3}{2}R - \frac{r^2}{2R^3}\right)$

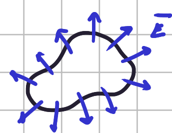


Conduttori

le cariche nei conduttori sono libere e perturbano il campo elettrico



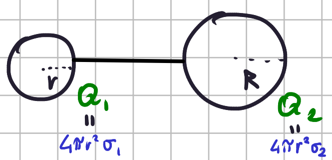
Un conduttore ha $\vec{E}$ nullo all'interno. Sulla sup. e' normale ad essa:



Equipotenziale

in un conduttore τ il campo $\vec{E}$ e' nullo $\Rightarrow \int_\ell \vec{E}\,d\vec{\ell} = 0 = \Delta V \Rightarrow$ in ogni punto il potenziale e' identico.

Effetto delle punte: il campo e' piu' intenso dove la curvatura e' maggiore.



$$\frac{\sigma_1}{\sigma_2} = \frac{R}{r} \Rightarrow \sigma_1 = \sigma_2 \frac{R}{r}$$

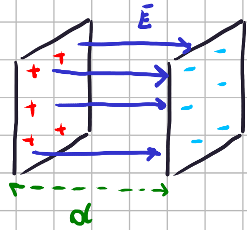
Questo perche' la superficie e' equipotenz.

Capacita'

conduttore di carica Q e pot. V $\Rightarrow C = \frac{Q}{V}$

nel caso della sfera $V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{R} \Rightarrow C = 4\pi\varepsilon_0 R$

Condensatore

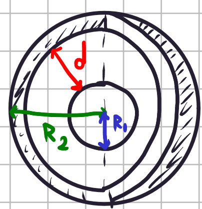


$E = \frac{\sigma}{\varepsilon_0} \Rightarrow V = \int_0^\infty E = \int_0^d \frac{\sigma}{\varepsilon_0} = d\frac{\sigma}{\varepsilon_0}$ (solo fra le lastre; sulla sup)

A: sup. lastre $\Rightarrow Q = \sigma A$

$$\Rightarrow C = \frac{Q}{V} = \boxed{\varepsilon_0 \frac{A}{d}}$$

Condensatore Sferico



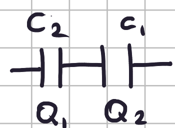
$V_1 = \frac{1}{4\pi\varepsilon_0}\frac{Q}{R_1}$

$V_2 = \frac{1}{4\pi\varepsilon_0}\frac{Q}{R_2}$

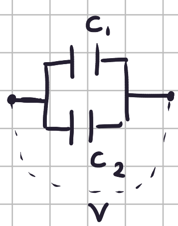
$\Rightarrow \Delta V = \frac{1}{4\pi\varepsilon_0} Q \frac{d}{R_1 R_2}$

Una C eq. $\Rightarrow C = \frac{Q}{V_1} - \frac{Q}{V_2} = \frac{Q}{\Delta V} = 4\pi\varepsilon_0 \frac{R_1 R_2}{d}$

Collegamento Condensatori



$Q_1 = Q_2 \Rightarrow C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$



$V_1 = V_2 = V$

$\Rightarrow C_1 = \frac{Q_1}{V}$

$C_2 = \frac{Q_2}{V}$

$\Rightarrow C_{eq} = \frac{(Q_1 + Q_2)}{V} \Rightarrow C_{eq} = C_1 + C_2$

Energia Condensatore

Lavoro per caricarlo: $\int_0^q \frac{1}{C} dq = \frac{q^2}{2C}$

e' l'energia ACCUMULATA: $U_e = q^2 \frac{1}{2C} = \frac{1}{2} qV$

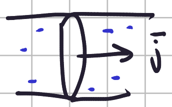
Condensatore piano:

$$C = \varepsilon_0 \frac{A}{d} \Rightarrow U_e = \sigma^2 A \frac{d}{2\varepsilon_0} = \underbrace{\frac{1}{2}\varepsilon_0 E^2}_{\text{DENSITA' DI ENERGIA}} \overbrace{Ad}^{\text{VOLUME CAMPO } E}$$

in generale $U_e = \int_\tau \frac{1}{2}\varepsilon_0 E^2 d\tau$ { τ: VOLUME DOVE E' CONTENUTO E

Corrente Elettrica

$\bar{j}$: vettore dens. di corrente



$|\bar{j}| = j = \frac{dQ}{ds\,dt}$ $\qquad I = \int_S \bar{j}\, d\bar{s}$

Intensita' di corrente

in un conduttore

$$\Delta V = \int_A^B \bar{E}\, d\bar{l} = V(A) - V(B) = R \cdot I$$

R: resistenza : $R = \rho \cdot l \cdot \frac{1}{A}$

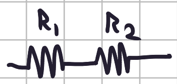
lunghezza (l)

area sezione (A)

dipende dal materiale (ρ)

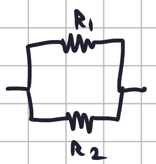
Collegamento Resistenze

serie:



$\Rightarrow R = R_1 + R_2$

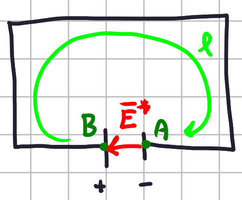
parallelo



$\Rightarrow R = \frac{R_1 \cdot R_2}{R_1 + R_2}$

Campo Elettromotore

$\Delta V = RI$ $\qquad \Delta V = \oint_l \bar{E}\, d\bar{l} \neq 0 \iff \bar{E}$ non elettrostatico



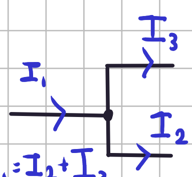
$\bar{E}^*$ = campo elettromotore

$$\oint_l \bar{E} = \oint_l \bar{E}^* = \int_A^B \bar{E}^* = \Delta V$$

Generatore di forza elettromotrice: un qualsiasi dispositivo capace di mantenere una d.d.p. costante fra due punti di un conduttore.

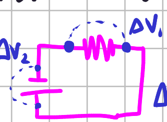
Leggi di Kirchhoff

1°) correnti entranti = uscenti



$I_1 = I_2 + I_3$

2°) su una maglia $\sum \Delta V_i = 0$

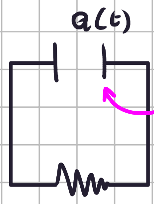


$\Delta V_1 + \Delta V_2 = 0$

Potenza

$$P = \frac{dL}{dt} = \frac{\Delta V\, dq}{dt} = \Delta V \cdot I = RI^2 \quad \frac{J}{s}$$

Andamento Circuito



condensatore

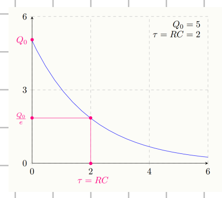
$$\begin{cases} \text{si scarica} & I = -\frac{dQ}{dt} \\ \text{si carica} & I = \frac{dQ}{dt} \end{cases}$$

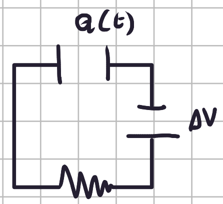
$\hookrightarrow \Delta V$ ai capi del cond. e' $\frac{Q}{C}$

$\Rightarrow RI - \frac{Q}{C} = 0 \Rightarrow \frac{1}{Q} dQ = -\frac{1}{RC} \Rightarrow$

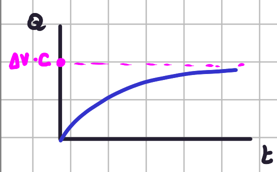
CARICA INIZIALE

$$Q(t) = Q_0 e^{-\frac{1}{RC}t}$$





$$\begin{cases} \Delta V - IR - \frac{Q}{C} = 0 \Rightarrow \Delta V - \frac{dQ}{dt} - \frac{1}{C} Q = 0 \\ \Rightarrow Q(t) = \Delta V \cdot C \cdot \left(1 - e^{-\frac{1}{RC}t}\right) \end{cases}$$

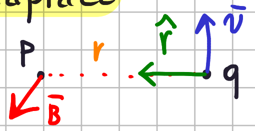


Campo Magnetico

Una carica q a velocità $\bar{v}$ in un campo $\bar{B}$ subisce una forza $\bar{F} = q(\bar{v} \times \bar{B})$

Un filo $\bar{\ell}$ in cui scorre corrente I subisce $\bar{F} = I(\bar{\ell} \times \bar{B})$

Prima Legge di Laplace



q = carica a vel. $\bar{v}$

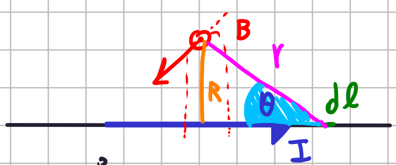
r = dist. da q a P

$\hat{r}$ = congiunge P a q

$$\boxed{\bar{B} = \frac{1}{r^2} \cdot \frac{\mu_0}{4\pi} q(\hat{r} \times \bar{v})}$$

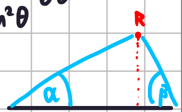
Campo Generato da un Filo

$$dB = \frac{\mu_0}{4\pi} \frac{1}{r^2} I(d\bar{\ell} \times \hat{r}) = \frac{\mu_0}{4\pi} \frac{1}{r^2} I \, d\ell \sin\theta$$



$r \sin\theta = R \Rightarrow \frac{R}{x} = \tan\theta$

$dx = -R \frac{1}{\sin^2\theta} d\theta$



$$B = \frac{\mu_0 I}{4\pi} \int_\alpha^\beta -\frac{1}{R} \sin\theta \, d\theta = \frac{\mu_0 I}{4\pi R}(\cos\beta - \cos\alpha)$$

$\Rightarrow$ Se il filo e' infinito $\begin{cases} \alpha = \pi \\ \beta = 0 \end{cases} \Rightarrow B = \frac{\mu_0 I}{2\pi R}$

$\cos\alpha = \frac{s}{\sqrt{s^2+R^2}}$

se $s \to -\infty$

$\cos\alpha \to \pi \Rightarrow \alpha = -1$