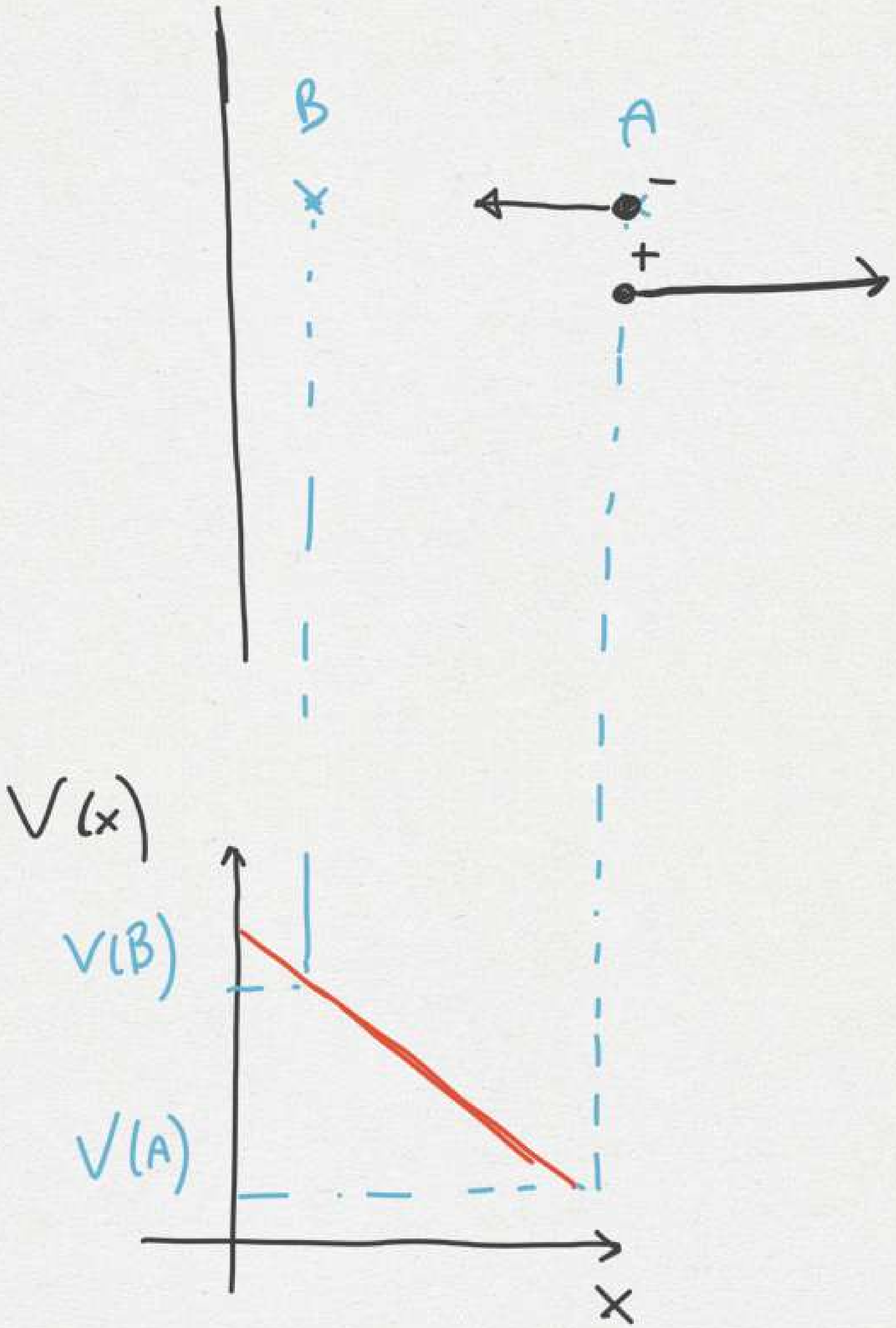
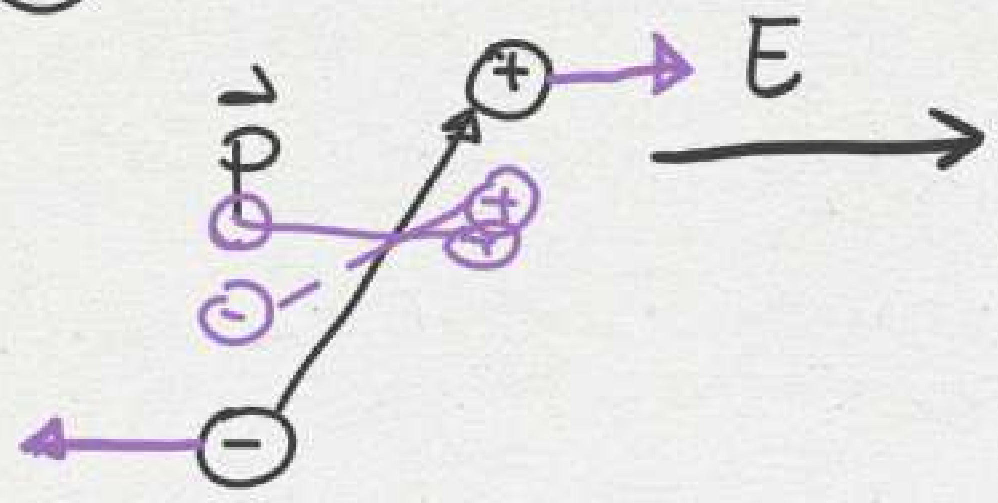
2

$\sigma > 0$



3



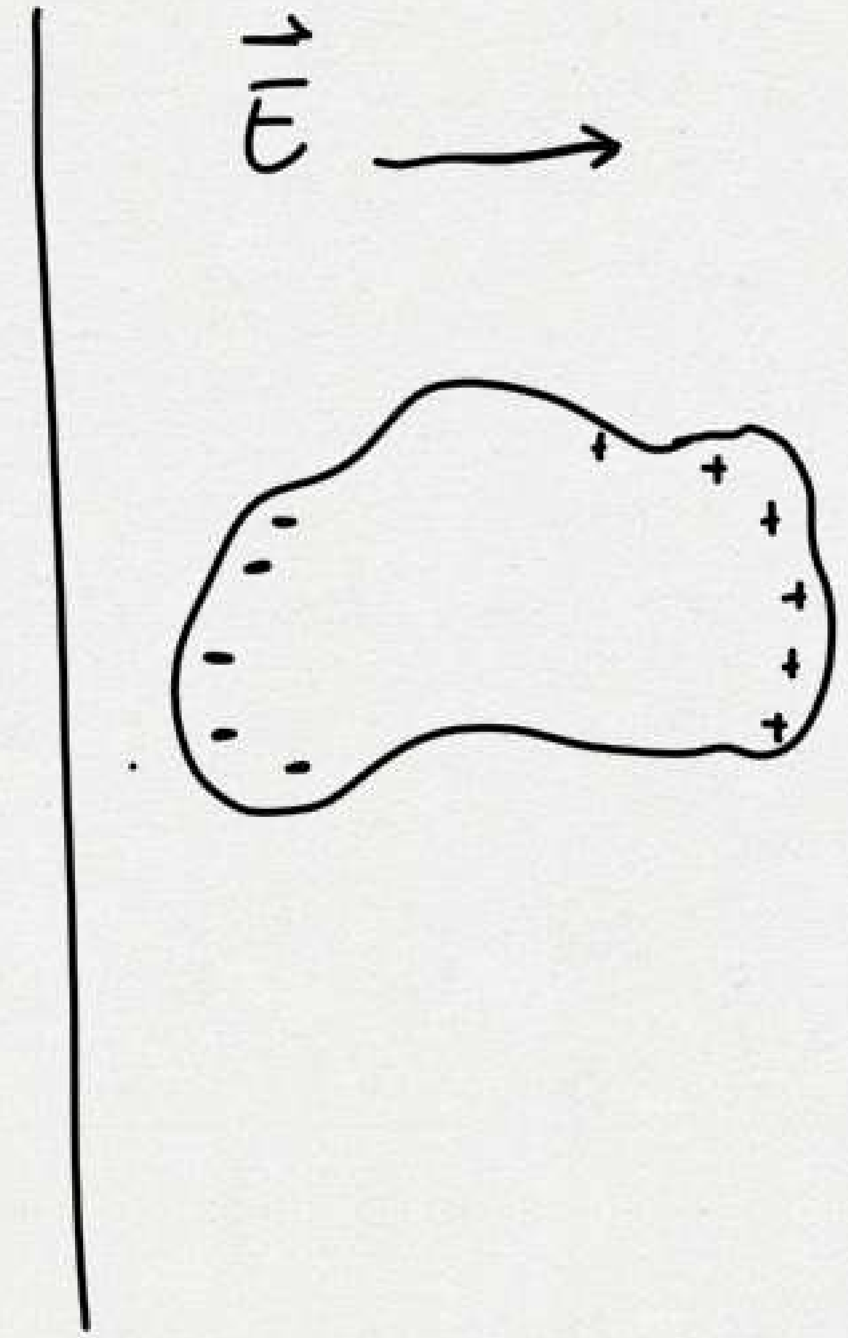
4

$$\oint_{\Sigma} \vec{E} \cdot \hat{n} \, d\Sigma = \frac{Q_{\Sigma}}{\varepsilon_0}$$

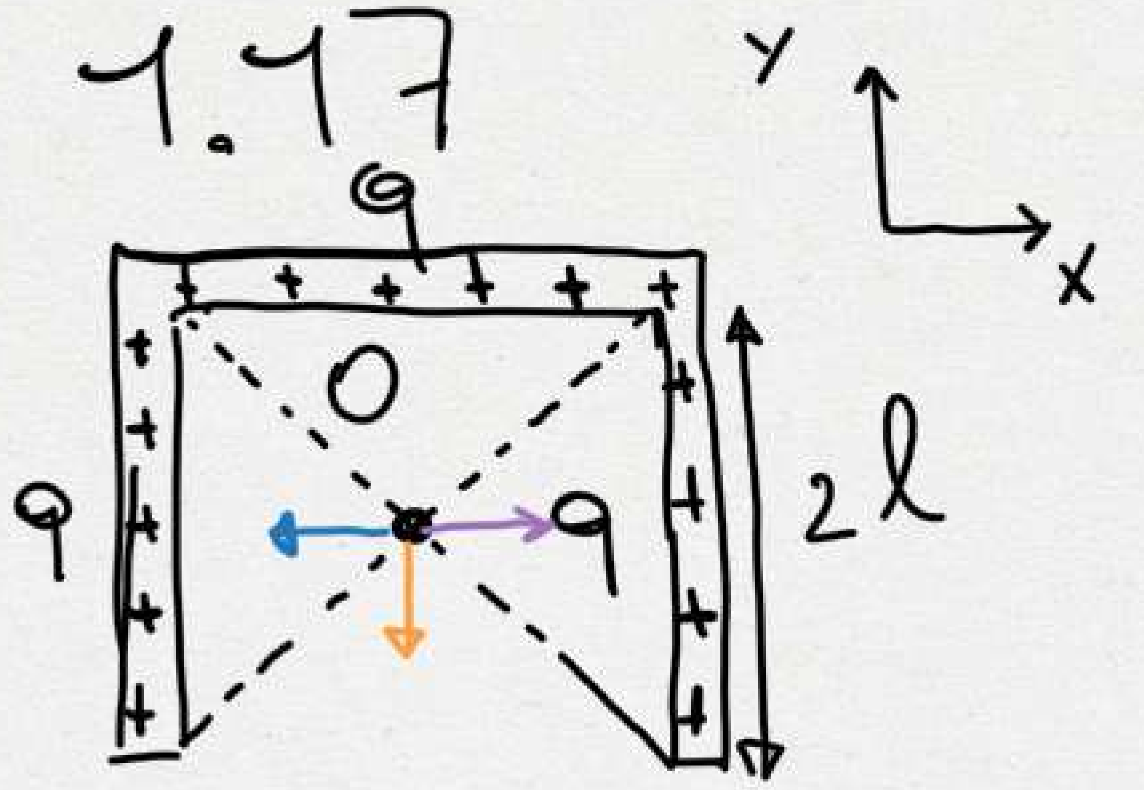
CHIUSA

5

$\sigma > 0$



1.47



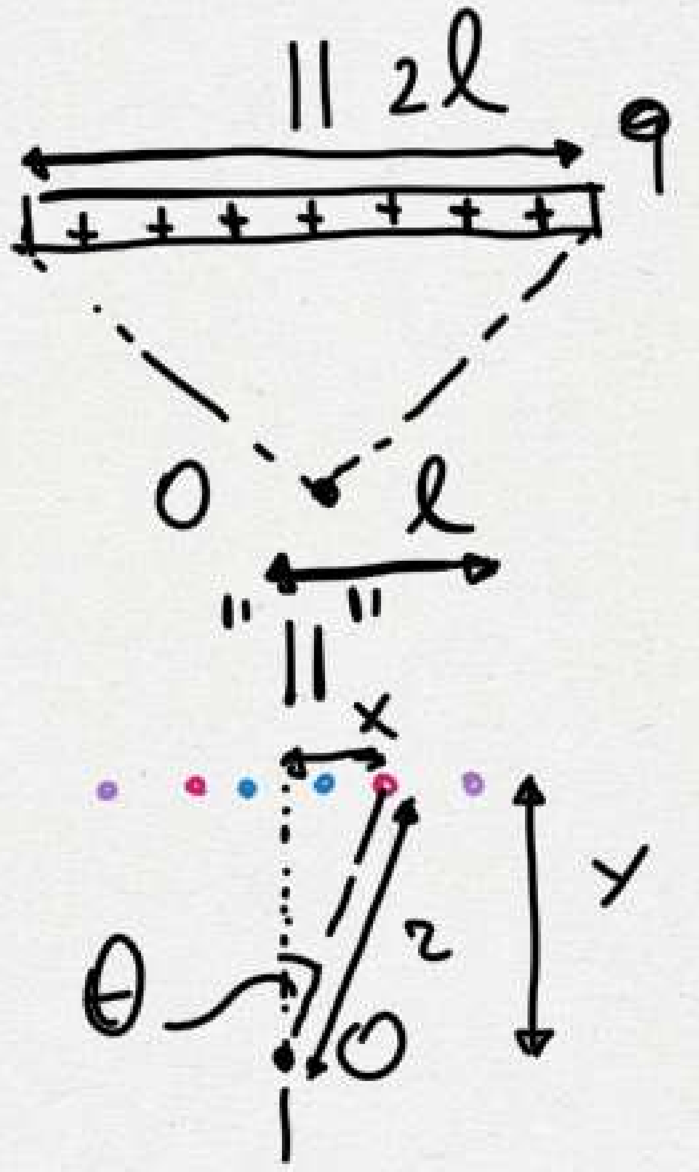
$$E_y = \frac{1}{2\pi\varepsilon_0}\int_{\text{SBARRETTA}} \frac{dq\cos\theta}{r^2} = \frac{\lambda}{2\pi\varepsilon_0}\int_{\text{SBARRETTA}}\frac{dx\cos\theta}{r^2} = \frac{\lambda}{2\pi\varepsilon_0}\int_{\text{SBARRETTA}}\frac{dx\cos^3\theta}{y^2} =$$

$$= \frac{\lambda}{2\pi\varepsilon_0}\int_{\text{SBARRETTA}}\frac{d\theta\cos\theta}{y} = \frac{\lambda}{2\pi\varepsilon_0 y}\int d\theta\cos\theta = \frac{\lambda}{2\pi\varepsilon_0 y}\int_0^{\theta_\ell} d\theta\cos\theta =$$

$$= \frac{\lambda}{2\pi\varepsilon_0 y}\sin\theta_\ell \quad ,$$

$$r\sin\theta_\ell = \ell = \sqrt{2}\,\ell\sin\theta_\ell \Rightarrow$$

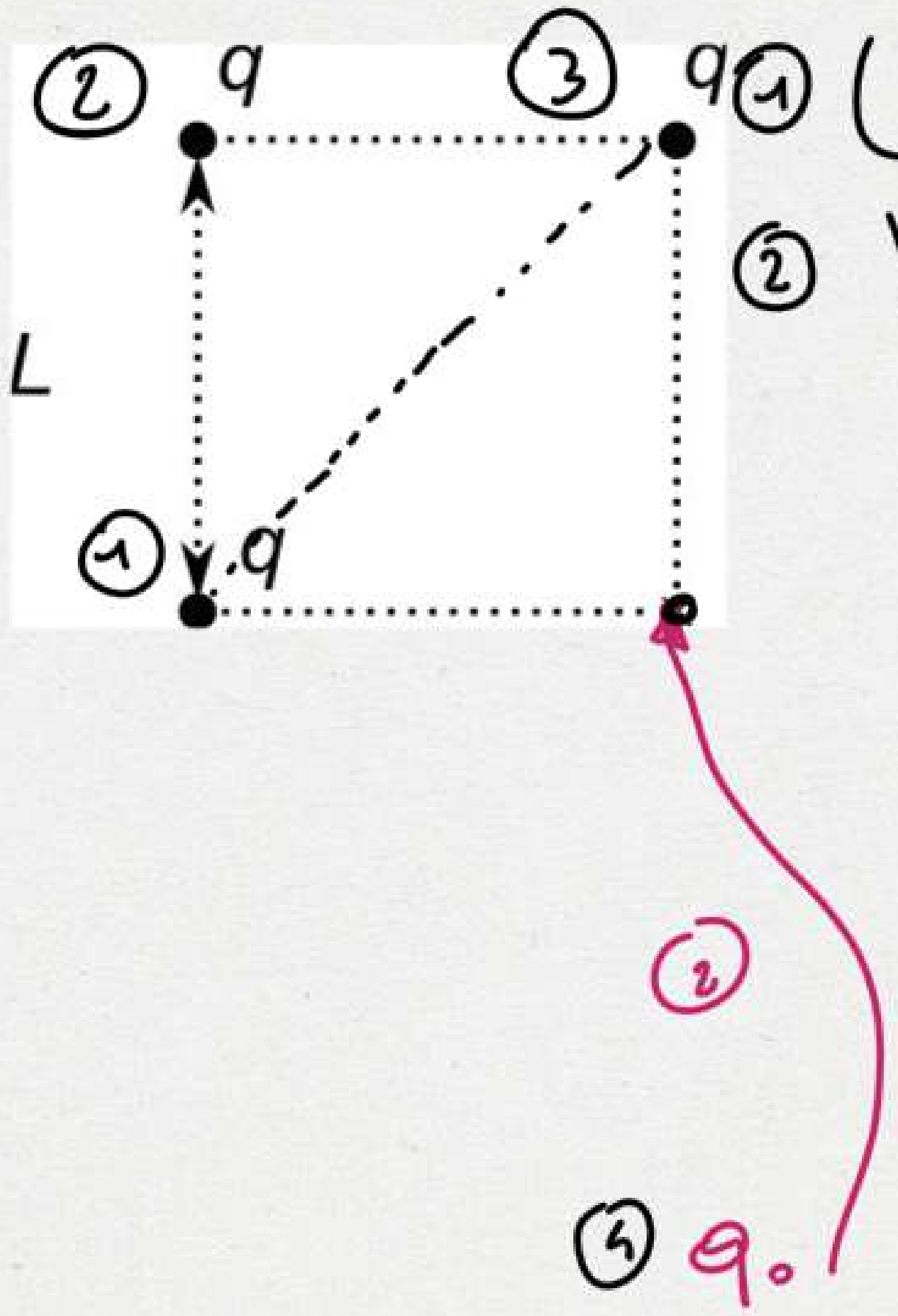
$$\sin\theta_\ell = \frac{1}{\sqrt{2}}$$



$$dE_y = \frac{dq}{2\pi\varepsilon_0}\,\frac{y}{r^3} = \frac{dq}{2\pi\varepsilon_0}\,\frac{\cos\theta}{r^2}$$

$$r^2 = x^2 + y^2,\quad x = r\sin\theta \Rightarrow x = y\,tg\,\theta \quad , \quad \frac{dx}{d\theta} = \frac{y}{\cos^2\theta} \Rightarrow dx = \frac{y}{\cos^2\theta}\,d\theta$$

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



① $U_e = ?$

② $W = ?$

$$U_e = \underbrace{\sum_{i>j} \frac{q_i q_j}{4\pi\varepsilon_0 r_{ij}}}$$

SOMMA SU TUTTE LE COPPIE

① $$\boxed{U_e = \frac{2q^2}{4\pi\varepsilon_0 L} + \frac{q^2}{4\pi\varepsilon_0 \sqrt{2} L}} > 0$$

② $$\boxed{W = -\Delta U_e}$$

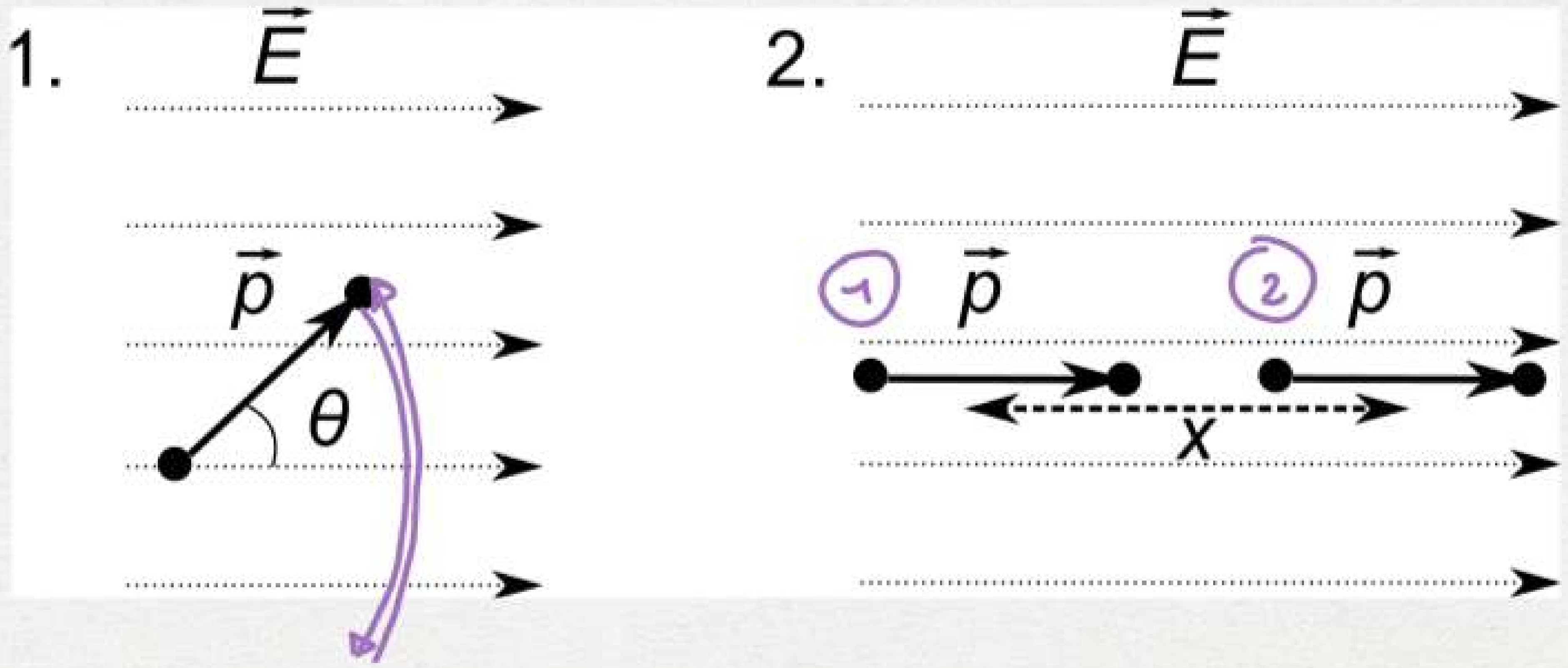
$$\Delta U_e = U_e^{q_0} - U_e^{\cancel{q_0}} = \boxed{\frac{2 q q_0}{4\pi\varepsilon_0 L} + \frac{q q_0}{4\pi\varepsilon_0 \sqrt{2} L}} \Longrightarrow$$

$$W = -\left(\frac{q q_0}{2\pi\varepsilon_0 L} + \frac{q q_0}{4\pi\varepsilon_0 \sqrt{2} L}\right)$$

③ W se $q = 2 \cdot 10^{-7}\,C$, $q_0 = -10^{-8}\,C$, $\underline{L = 5\,cm}$

$$U_e^{(f)} = \underbrace{U_{12} + U_{13} + U_{23}} + \boxed{U_{14} + U_{24} + U_{34}}, \quad U_e^{(i)} = \underbrace{U_{12} + U_{13} + U_{23}}$$

ESERCIZIO 11

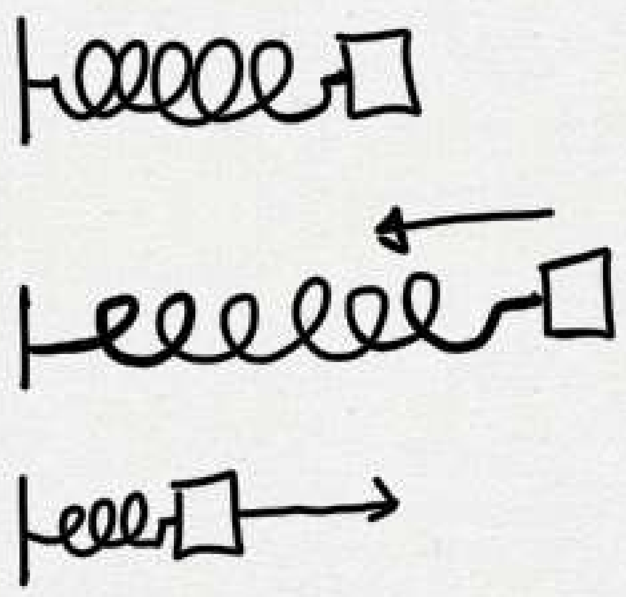


(1) calcolare ω quando $\vec p \parallel \vec E$

$$U^{(0)}_{TOT} = -\vec p(0)\cdot\vec E = -pE\cos\theta$$

$$U^{(t)}_{TOT} = -\vec p(t)\cdot \vec E + \frac{1}{2} I\omega^2(t) = -\vec p(0)\cdot\vec E \Rightarrow$$

$$-\underline{pE} + \underline{\frac{1}{2} I}\,\omega_0^2 = -\underline{pE\cos\theta}$$



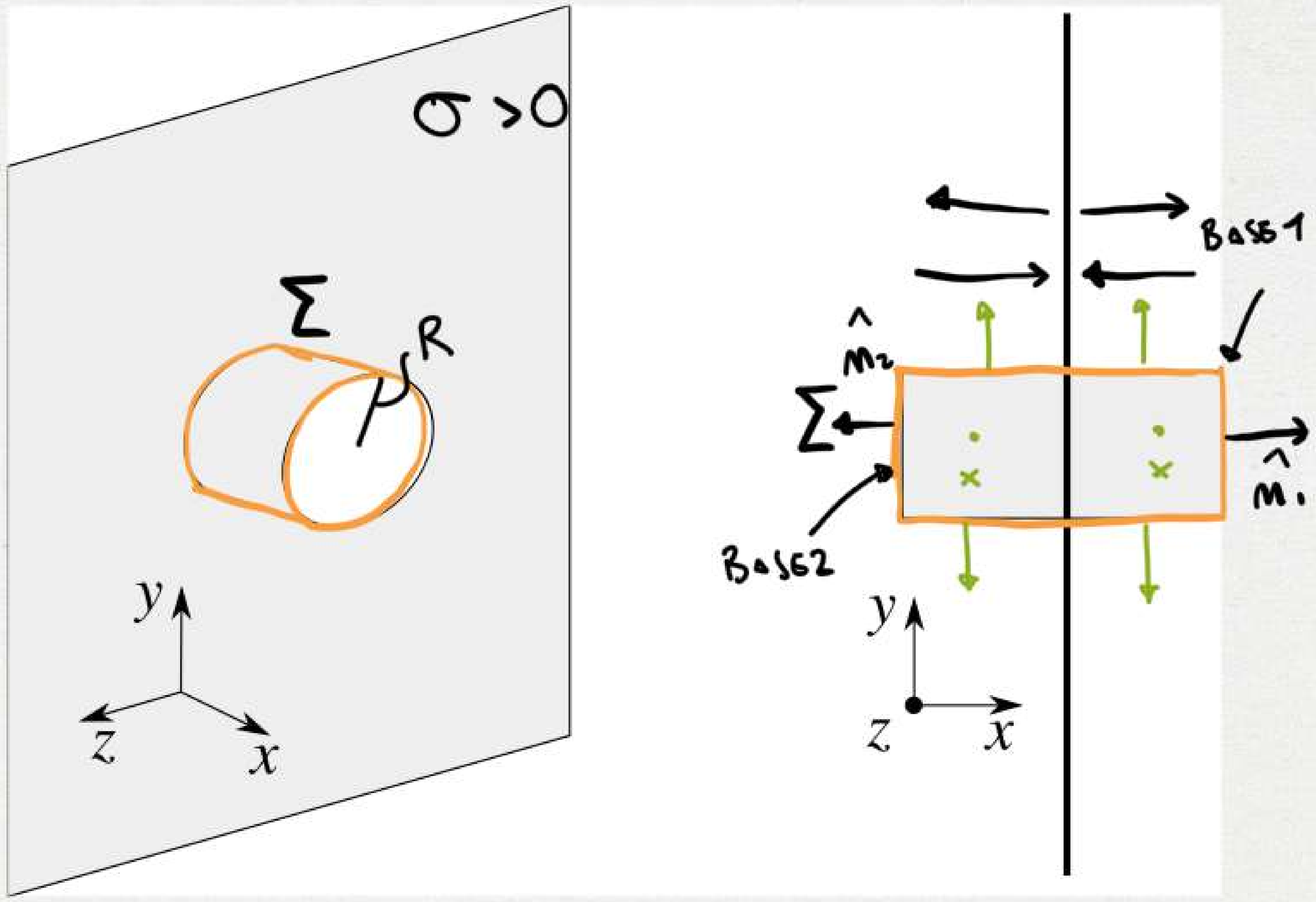
(2) $U_e^{(1)} = ?$

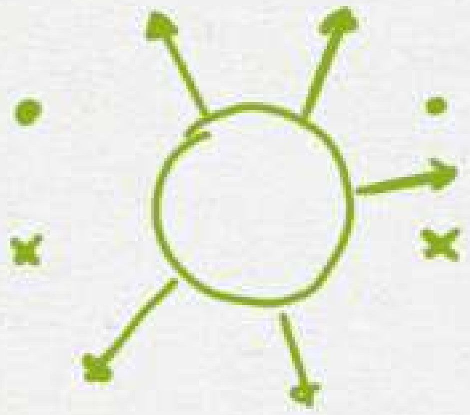
$$\vec E^{(1)}_{TOT} = \vec E + \vec E_{(2)}(\vec x)$$

$$U_e^{(1)} = -\vec p\cdot \vec E^{(1)}_{TOT} = -\vec p\cdot\left(\vec E+\vec E_{(2)}(\vec x)\right) = -\vec p\cdot\left(\vec E + \frac{\vec p}{2\pi\varepsilon_0}\frac{1}{x^3}\right) =$$

$$= -pE - \frac{p^2}{2\pi\varepsilon_0 x^3}$$

ESERCIZIO 12





$E = ?$

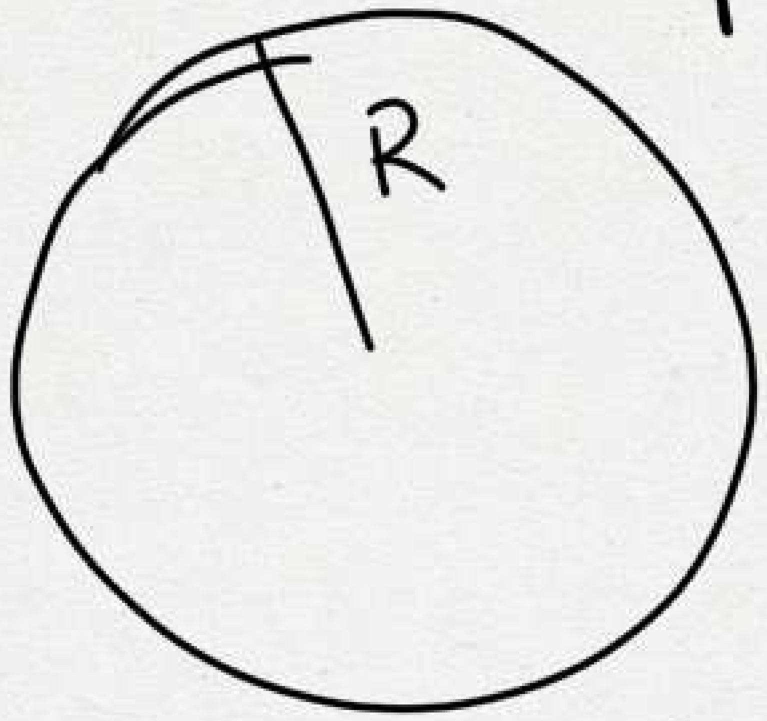
$$\int_{\Sigma} \vec{E}\cdot\hat{n}\, d\Sigma = \int_{BASE\,1} \vec{E}\cdot\hat{n}\, d\Sigma + \int_{BASE\,2} \vec{E}\cdot\hat{n}\, d\Sigma + \cancel{\int_{LATERALE} \vec{E}\cdot\hat{n}\, d\Sigma} =$$

$$= \int_{BASE\,1} E\, d\Sigma + \int_{BASE\,2} E\, d\Sigma =$$

$$= E\int_{BASE\,1} d\Sigma + E\int_{BASE\,2} d\Sigma = 2E\pi R^2$$

$$\frac{Q_\Sigma}{\varepsilon_0} = \frac{1}{\varepsilon_0}\int_{BASE} \sigma\, d\Sigma = \frac{\sigma\pi R^2}{\varepsilon_0} \Rightarrow$$

$$2E\pi R^2 = \frac{\sigma\pi R^2}{\varepsilon_0} \Rightarrow \boxed{E = \frac{\sigma}{2\varepsilon_0}}$$



q

① q distribuita sulla superficie, σ

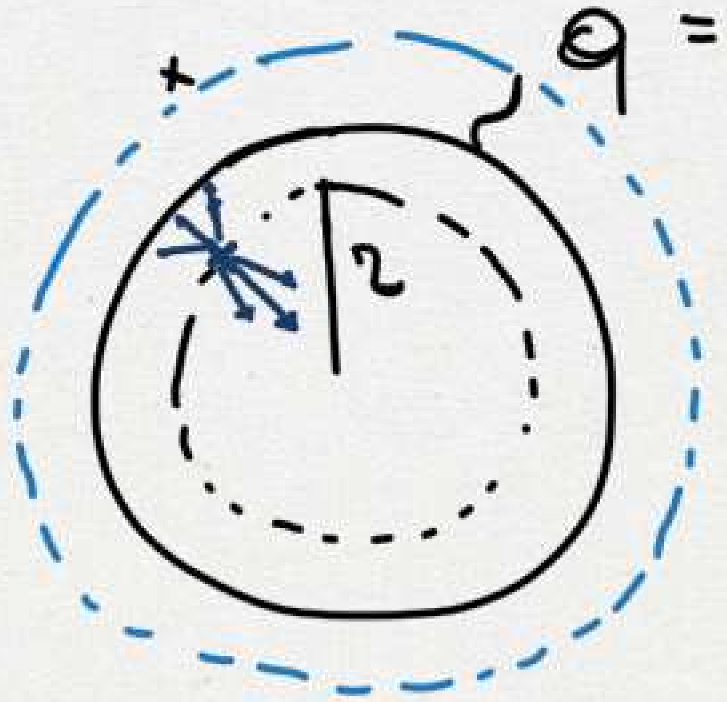
② q " nel volume, ρ

③ q " con densità $\rho(r) = A r^2$

$\Big\}\ E(r),\quad 0 \le r \le \infty$

①

$q = \sigma\, 4\pi R^2$

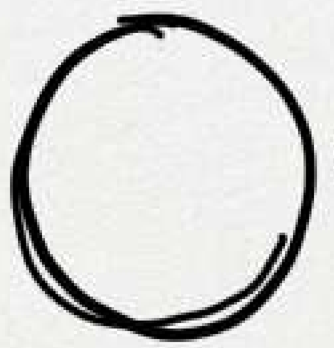


$$\oint_{\Sigma} \vec{E}\cdot\hat{n}\, d\Sigma = \frac{Q_\Sigma}{\varepsilon_0}$$

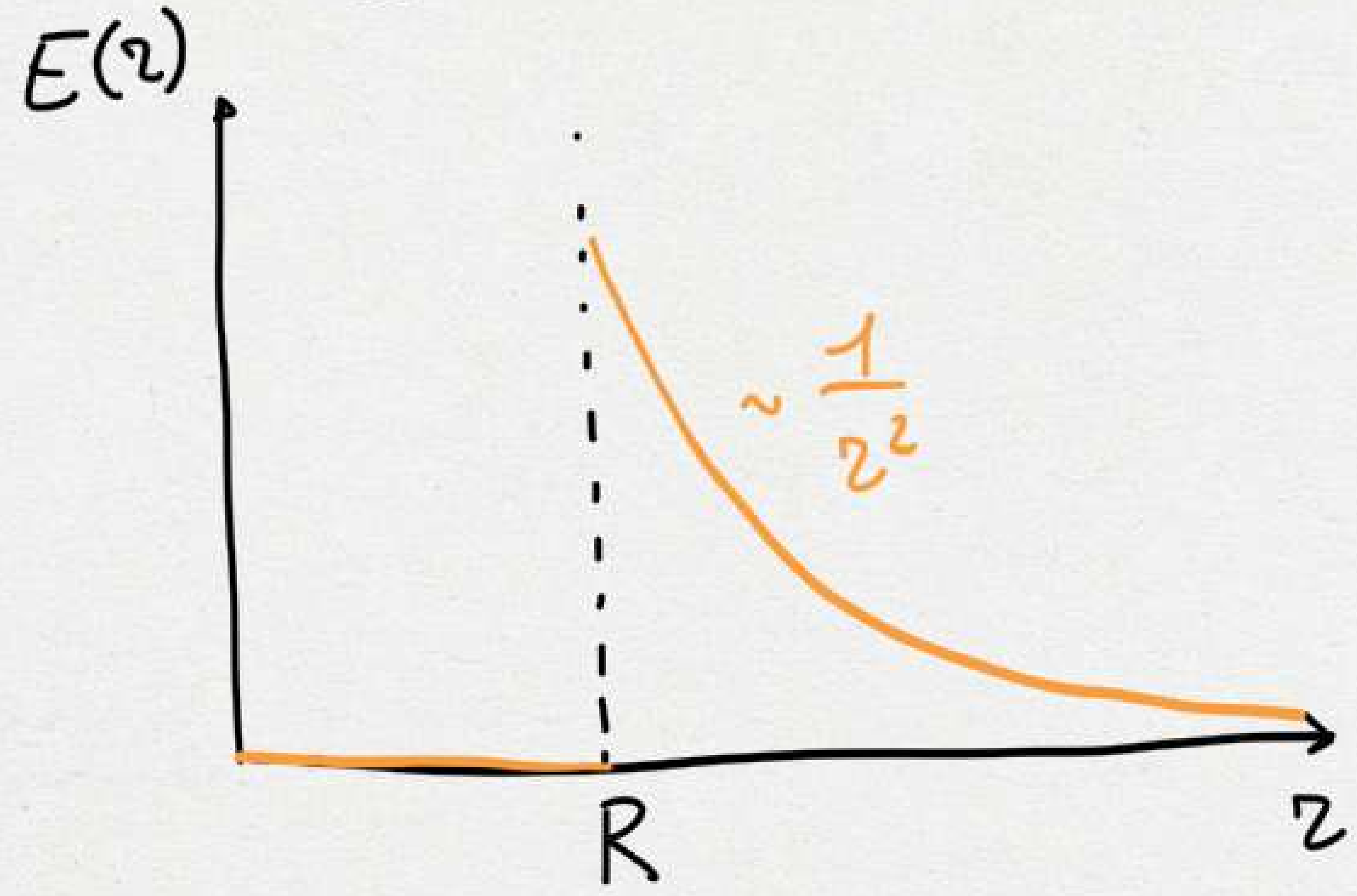
$$\oint_{\Sigma(r)} \vec{E}\cdot\hat{n}\, d\Sigma = E \oint_{\Sigma(r)} d\Sigma = E\, 4\pi r^2$$

$$Q_\Sigma(r<R) = 0 \implies E(r<R) = 0$$

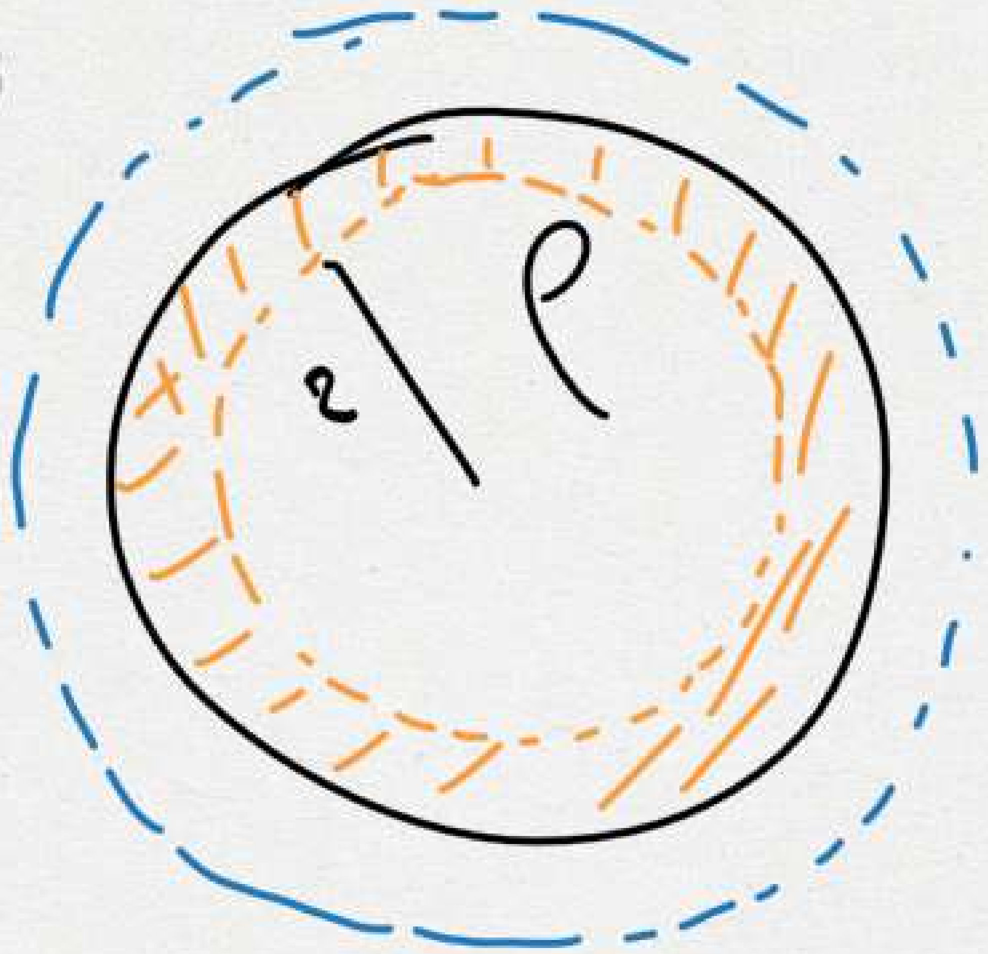
$$Q_\Sigma(r \ge R) = q \implies E(r \ge R) = \frac{q}{4\pi\varepsilon_0}\frac{1}{r^2}$$



$\sigma \;=\; \cdot\; q = \sigma\, 4\pi R^2$



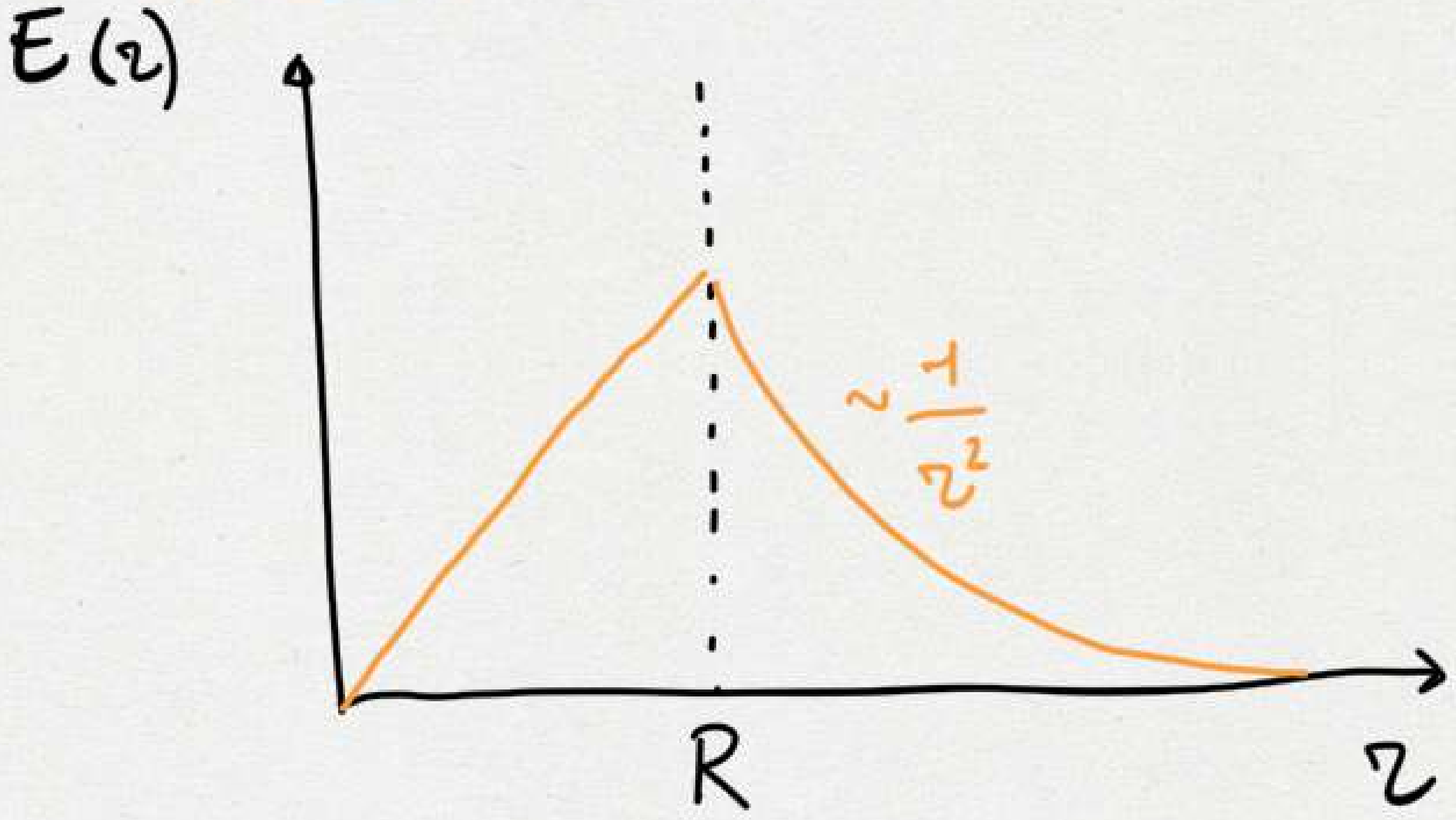
2



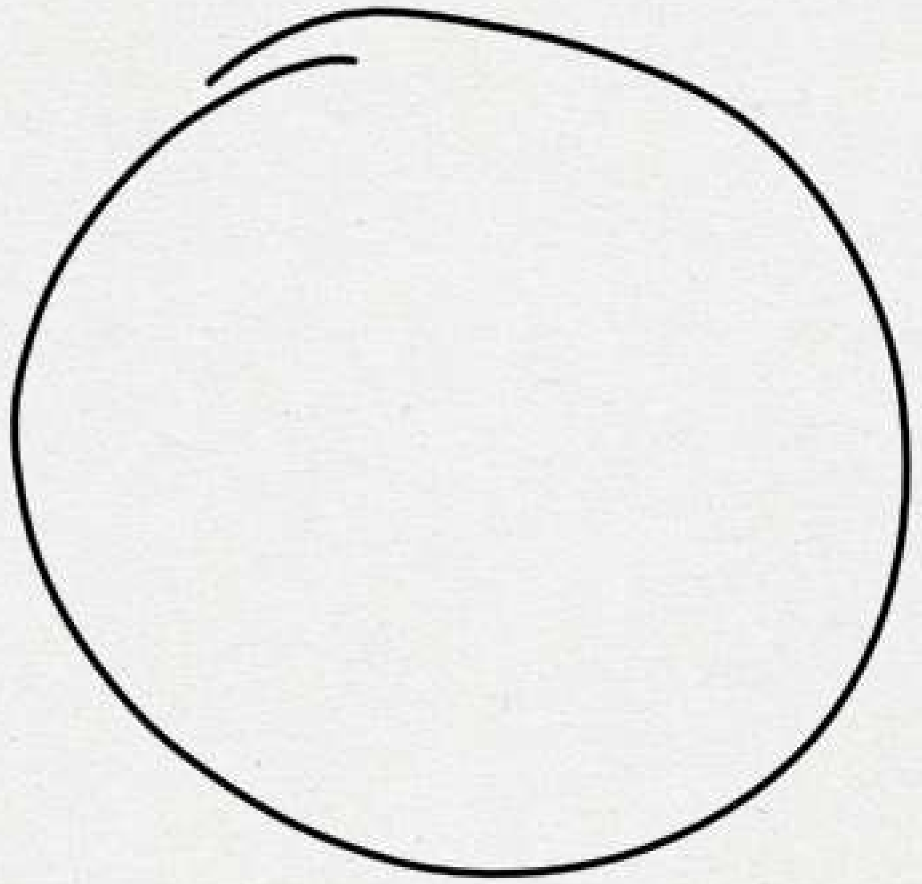
$$\int_{\Sigma(r)} \vec{E}\cdot\hat{n}\,d\Sigma = E\,4\pi r^2$$

$$Q_\Sigma(r \geq R) = q \Rightarrow E = \frac{q}{4\pi\varepsilon_0}\frac{1}{r^2}$$

$$Q_\Sigma(r < R) = \rho\frac{4}{3}\pi r^3 \Rightarrow \cancel{4\pi r^2}\,E = \frac{\rho}{\varepsilon_0}\frac{\cancel{4}}{3}\cancel{\pi}\, r^{\cancel{3}} \Rightarrow E = \frac{\rho}{3\varepsilon_0}\, r$$



③ $\rho(r) = A r^2$



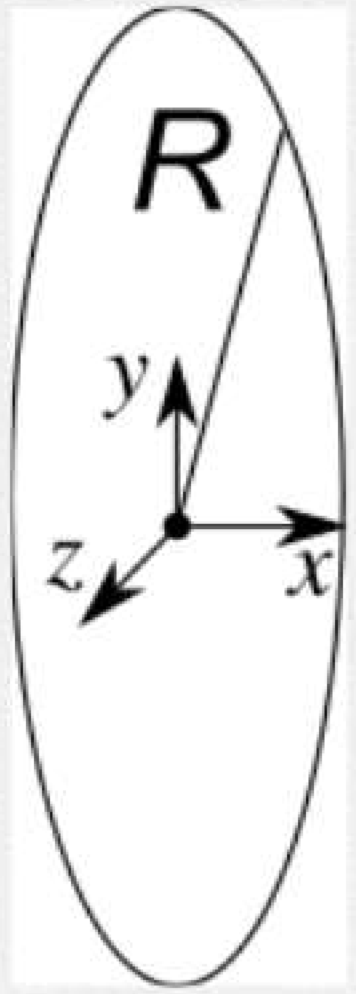
$$\int_{\Sigma(r)} \vec{E}\cdot\hat{n}\, d\Sigma = 4\pi r^2 E$$

MAGIA

$$\boxed{Q_\Sigma (r<R)} = \int_{\Sigma(r)} \rho(r)\, dx\, dy\, dz = \boxed{\int \rho(r)\, 4\pi r^2\, dr}$$

$Q_\Sigma (r>R)$

ESERCIZIO 14

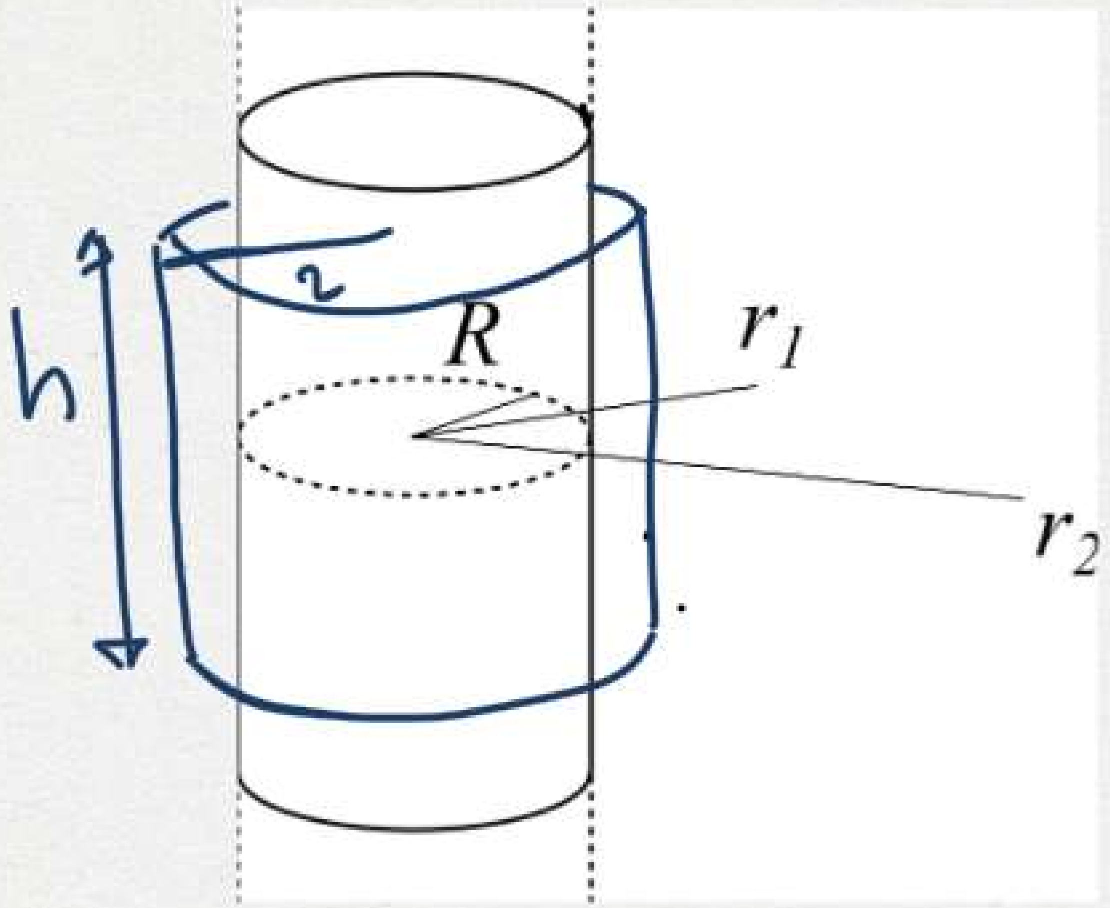


ANELLO CARICO λ

1) $V(x,0,0) = ?$

2) calcolare $E_x(x,0,0) = -\frac{\partial V}{\partial x}$

ESERCIZIO 15



1) $E(r)$ utilizzando Gauss ←

2) $V(r_2) - V(r_1)$ $\quad r_1 > R$, $r_2 > R$