SOLUZIONI – 5ª CLASSICO (23/03/2017)

1) $i = \frac{\Delta Q}{\Delta T} \Rightarrow i = \frac{n \cdot e}{\Delta T} \Rightarrow n = \frac{i \cdot \Delta T}{e} \Rightarrow$

$\Rightarrow n = \frac{(15 \cdot 10^{-3}) \cdot (2 \cdot 10^{-3})}{1{,}6 \cdot 10^{-19}} \cong \boxed{1{,}9 \cdot 10^{14} \text{ elettroni}}$

2) $i = \frac{\Delta Q}{\Delta T} \Rightarrow i = \frac{(5{,}0 \cdot 10^{21}) \cdot (1{,}6 \cdot 10^{-19})}{0{,}15} \text{ A}$

$\Rightarrow \boxed{i \cong 5{,}3 \cdot 10^{3} \text{ A}}.$

3) $R = \rho \cdot \frac{l}{S} \Rightarrow R = (2{,}2 \cdot 10^{-7} \, \Omega \cdot m) \cdot \frac{10 \, m}{(10^{-2} m)^2} \Rightarrow$

$\Rightarrow \boxed{R = 2{,}2 \cdot 10^{-2} \, \Omega}.$

4) $R = R_0 \cdot (1 + \alpha \cdot (T - T_0)) \Rightarrow$

$\Rightarrow 140 = 19 \cdot (1 + 4{,}5 \cdot 10^{-3} \cdot (T - 20)) \Rightarrow$

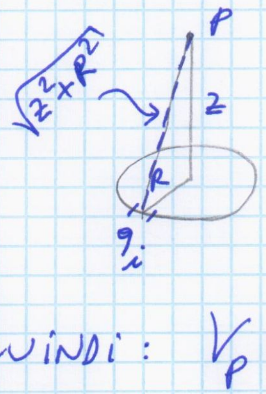
$\Rightarrow \frac{140}{19} = 1 + 4{,}5 \cdot 10^{-3} \cdot (T - 20) \Rightarrow$

$\Rightarrow \frac{140}{19} - 1 = 4{,}5 \cdot 10^{-3} \cdot (T - 20) \Rightarrow$

$\Rightarrow \frac{\frac{140}{19} - 1}{4{,}5 \cdot 10^{-3}} = T - 20 \Rightarrow T = 20 + \frac{140/19 - 1}{4{,}5 \cdot 10^{-3}} \Rightarrow$

$\Rightarrow \boxed{T \cong 1{,}44 \cdot 10^{3} \, °C}$

5)



$V_P = V_1 + V_2 + V_3 + \ldots + V_n$

$V_i = \frac{K \cdot q_i}{\sqrt{z^2+R^2}}$

QUINDI: $V_P = \frac{K q_1}{\sqrt{z^2+R^2}} + \frac{K q_2}{\sqrt{z^2+R^2}} + \ldots + \frac{K q_n}{\sqrt{z^2+R^2}}$

(PROSEGUE...)

$$\Rightarrow V_p = \frac{k}{\sqrt{z^2+R^2}} \cdot \underbrace{(q_1 + q_2 + \ldots + q_n)}_{Q_{TOT} \text{ dell'ANELLO}} = \frac{k\, Q_{TOT}}{\sqrt{z^2+R^2}} \; ;$$

D'ALTRA PARTE SAPPIAMO CHE $Q_{TOT} = \underbrace{2\pi R}_{\text{LUNGH. ANELLO}} \cdot \underbrace{\lambda}_{\text{DENSITÀ LINEARE di CARICA}}$

QUINDI:

$$V_p = \frac{k \cdot (2\pi R \lambda)}{\sqrt{z^2+R^2}} = \frac{2\pi R \lambda k}{\sqrt{z^2+R^2}} .$$

$E = -V' \Rightarrow$ OSSERVIAMO CHE π, R, λ, k sono <u>COSTANTI</u>

QUINDI $V = \underbrace{2\pi R \lambda k}_{\text{COSTANTE}} \cdot (z^2+R^2)^{-1/2}$

$$-V' = -\left[2\pi R \lambda k \cdot \left(-\frac{1}{2}\right) \cdot (z^2+R^2)^{-1/2-1} \cdot (2z)\right] \Rightarrow$$

$$\Rightarrow -V' = -\left[2\pi R \lambda k \cdot \left(-\frac{1}{\cancel{2}}\right) \cdot (z^2+R^2)^{-3/2} \cdot (\cancel{2}z)\right] \Rightarrow$$

$$\Rightarrow -V' = -\left[2\pi R \lambda k \cdot (-z) \cdot (z^2+R^2)^{-3/2}\right] \Rightarrow$$

$$\Rightarrow -V' = +\, 2\pi R \lambda k z \cdot (z^2+R^2)^{-3/2} \Rightarrow$$

$$\Rightarrow \boxed{E (= -V') = \frac{2\pi R \lambda k z}{\sqrt{(z^2+R^2)^3}}} .$$

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6) $V = \frac{\sigma}{2\varepsilon_0} \cdot \left(\sqrt{z^2+R^2} - z\right)$; $E = -V' \Rightarrow$

$$\Rightarrow -V' = -\left[\frac{\sigma}{2\varepsilon_0} \cdot \left(\frac{1}{2} \cdot (z^2+R^2)^{1/2-1} \cdot (2z) - 1\right)\right] \Rightarrow$$

$$\Rightarrow -V' = -\left[\frac{\sigma}{2\varepsilon_0} \cdot \left(\frac{1}{\cancel{2}} \cdot \frac{1}{\sqrt{z^2+R^2}} \cdot \cancel{2}z - 1\right)\right] \Rightarrow$$

$\Rightarrow$ (PROSEGUE...)

$$\Rightarrow -V' = -\left[\frac{\sigma}{2\varepsilon_0}\cdot\left(\frac{z}{\sqrt{z^2+R^2}}-1\right)\right] \Rightarrow$$

$$\Rightarrow -V' = -\frac{\sigma}{2\varepsilon_0}\cdot\left(\frac{z}{\sqrt{z^2+R^2}}-1\right) \Rightarrow$$

$$\Rightarrow \boxed{E(=-V') = \frac{\sigma}{2\varepsilon_0}\cdot\left(1-\frac{z}{\sqrt{z^2+R^2}}\right)}$$

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7) $$\frac{1}{2}Mv_0^2 + \frac{kQq}{d_0} = \frac{1}{2}M\cdot v_f^2 + \frac{kQq}{d_f}$$

$v_f = 0$ (la particella è ferma) $\Rightarrow$

$$\frac{1}{2}Mv_0^2 + \frac{kQq}{d_0} = \frac{kQq}{d_f} \Rightarrow \frac{1}{\frac{1}{2}Mv_0^2 + \frac{kQq}{d_0}} = \frac{d_f}{kQq}$$

$$\boxed{d_f = \frac{kQq}{\frac{1}{2}Mv_0^2 + \frac{kQq}{d_0}}}$$

Sostituendo i dati forniti si ha:

$$d_f = \frac{(9\cdot10^9)\cdot(3{,}2\cdot10^{-7})\cdot(4{,}8\cdot10^{-16})}{\frac{1}{2}\cdot(2\cdot10^{-19})\cdot(2{,}4\cdot10^4)^2 + \frac{(9\cdot10^9)\cdot(3{,}2\cdot10^{-7})\cdot(4{,}8\cdot10^{-16})}{4\cdot10^{-2}}}$$

$\Rightarrow \boxed{d_f = 1{,}5\cdot10^{-2}\,m} \rightarrow$ è la distanza <u>minima</u>.

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8) $C_{EQ} = 2{,}6\ pF = 2{,}6\cdot10^{-12}\,F$

$$\frac{1}{C_{EQ}} = \frac{1}{C} + \frac{1}{C} + \dots + \frac{1}{C} = \frac{10}{C} \Rightarrow C_{EQ} = \frac{C}{10}$$

$$\Rightarrow C = 10\cdot C_{EQ} \Rightarrow C = 10\cdot(2{,}6\cdot10^{-12}\,F)$$

$$\Rightarrow \boxed{C = 2{,}6\cdot10^{-11}\,F}$$