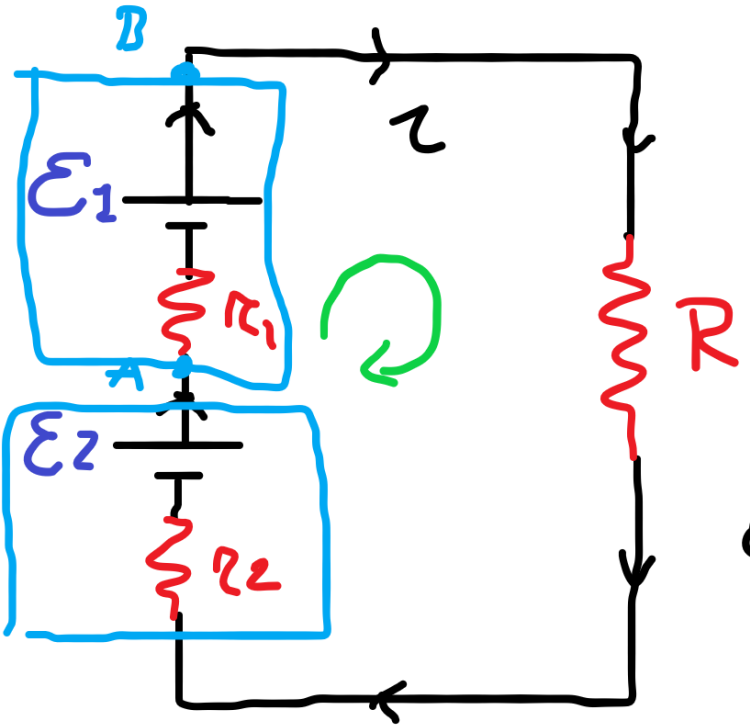
27.21: $\mathcal{E}_1 = 12\,V$, $\mathcal{E}_2 = 12\,V$, $r_1 = 0.016\,\Omega$, $r_2 = 0.012\,\Omega$ 27.4.70 (1)



α) ΠΟΙΑ ΤΙΜΗ ΤΟ R ΜΗΔΕΝΙΖΕ ΤΗΝ ΤΑΣΗ ΣΤΑ ΑΚΡΑ ΜΙΑΣ ΑΠΟ ΤΙΣ ΜΠΑΤΑΡΙΕΣ;

(β) ΠΟΙΑ ΕΙΝΑ ΑΥΤΗ Η ΜΠΑΤΑΡΙΑ; → ΕΙΝΑΙ ΑΥΤΗ ΠΟΥ ΕΧΕΙ ΤΗΝ ΜΕΓΑΛΥΤΕΡΗ ΕΣΩΤΕΡΙΚΗ ΑΝΤΙΣΤΑΣΗ, ΔΗΛΑΔΗ Η $\mathcal{E}_1$ (ΟΙ ΠΗΓΕΣ ΕΧΟΥΝ ΙΔΙΑ ΦΟΡΤΙΣΗ)

α) $\mathcal{E}_1 - iR - ir_2 + \mathcal{E}_2 - ir_1 = 0 \Rightarrow \boxed{i = \dfrac{\mathcal{E}_1 + \mathcal{E}_2}{R + r_1 + r_2}}$

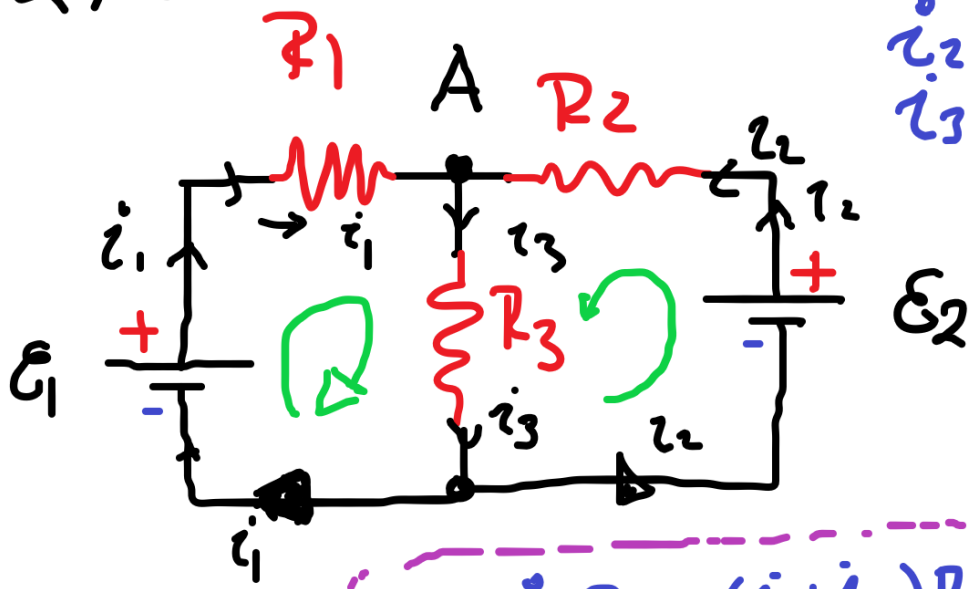
$V_B - V_A = 0 = \mathcal{E}_1 - r_1 \cdot i \Rightarrow$

$0 = \mathcal{E}_1 - r_1 \dfrac{\mathcal{E}_1 + \mathcal{E}_2}{R + r_1 + r_2} \Rightarrow \mathcal{E}_1 (R + r_1 + r_2) = r_1 (\mathcal{E}_1 + \mathcal{E}_2) \Rightarrow$

$\Rightarrow \mathcal{E}_1 R + \mathcal{E}_1 r_1 + \mathcal{E}_1 r_2 = r_1 \mathcal{E}_1 + r_1 \mathcal{E}_2 \Rightarrow$

$\mathcal{E}_1 R = \mathcal{E}_2 r_1 - \mathcal{E}_1 r_2 \Rightarrow R = (\mathcal{E}_2 r_1 - \mathcal{E}_1 r_2)/\mathcal{E}_1 = 0.004\,\Omega$

27.32 $\mathcal{E}_1 = 10\,V$, $\mathcal{E}_2 = 5\,V$, $R_1 = R_2 = R_3 = R = 4\,\Omega$ 27.4.20 (2)



$i_2 = ?$

$i_3 = ?$

Κομβος Α → $i_1 + i_2 = i_3$ (1)

Βροχος-ΑΡΙΣΤΕΡΑ → $\mathcal{E}_1 - i_1 R - i_3 R = 0$ (2)

Βροχος-ΔΕΞΙΑ → $\mathcal{E}_2 - i_2 R - i_3 R = 0$ (3)

(2)(1) → $\mathcal{E}_1 - i_1 R - (i_1 + i_2) R = 0 \rightarrow \mathcal{E}_1 - i_1 R = (i_1 + i_2) R$

(3)(1) → $\mathcal{E}_2 - i_2 R - (i_1 + i_2) R = 0 \rightarrow \mathcal{E}_2 - i_2 R = (i_1 + i_2) R$

$\rightarrow \dfrac{\mathcal{E}_1 - i_1 R}{\mathcal{E}_2 - i_2 R} = 1 \rightarrow$

$\rightarrow \boxed{i_1 = \dfrac{\mathcal{E}_1 - \mathcal{E}_2 + i_2 R}{R}}$ (4)

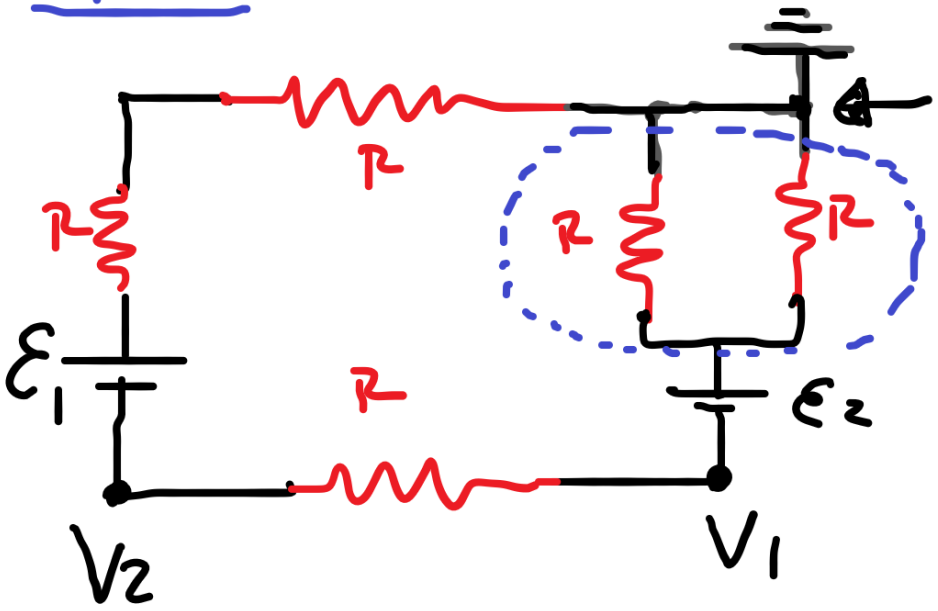
$\rightarrow \mathcal{E}_1 - \dfrac{\mathcal{E}_1 - \mathcal{E}_2 + i_2 R}{R} R = \left(\dfrac{\mathcal{E}_1 - \mathcal{E}_2 + i_2 R}{R} + i_2\right) R \rightarrow \boxed{i_2 = 0}$

$\rightarrow \mathcal{E}_1 - 2 i_1 R = 0 \Rightarrow \boxed{i_1 = \dfrac{10\,V}{8\,\Omega} = 1.25\,A}$

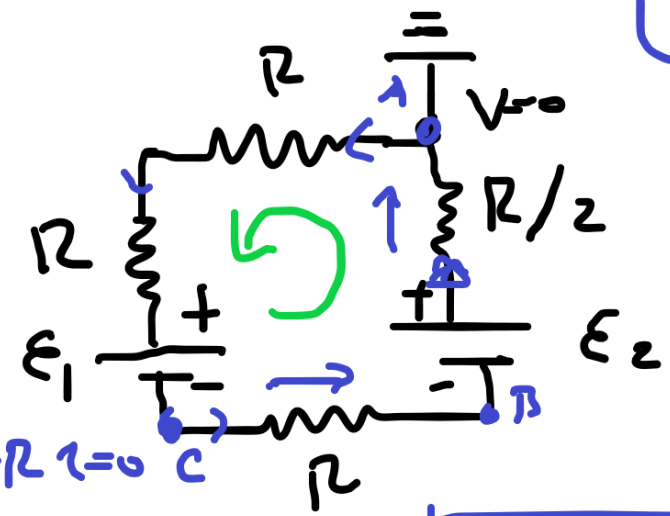
(1) → $\therefore \boxed{i_3 = 1.25\,A}$

27.33 $R = 2\,\Omega$ $\varepsilon_1 = 5\,V$, $\varepsilon_2 = 12\,V$ $V_2 = ?$, $V_1 = ?$

27.4.20 (3)



$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R} \Rightarrow R_0 = R/2$



$\varepsilon_2 - R/2\, i - R i - R i - \varepsilon_1 - R\, i = 0$

$\rightarrow i = \frac{\varepsilon_2 - \varepsilon_1}{R/2 + 3R} = \frac{12 - 5}{1\,\Omega + 6\,\Omega} = 1\,A \rightarrow \boxed{i = 1\,A}$

$0 - R\cdot 1 - R\,i - \varepsilon_1 = V_C$

$-2 \quad -2 \quad -3 \rightarrow$

$V_C = -9\,V = V_2$

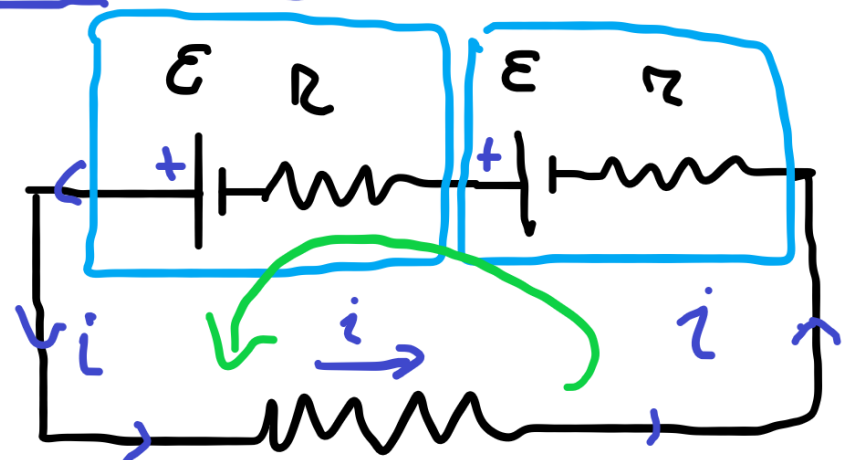
$(A \rightarrow B) \rightarrow V_B - V_1 + \varepsilon_2 - \frac{R}{2} i - V_A = 0 \Rightarrow V_1 + 12 - 1 = 0$

$\boxed{V_1 = -11\,V}$

$(C - B) \rightarrow V_2 = V_C = V_B + R\cdot 1 = -11 + 2 = -9 = V_2$

27.4.2 : $\mathcal{E}=12V$ $r=0.2\Omega$ $R=2R=0.4\Omega$ $i=?$ 27.4.20 (4)

α)

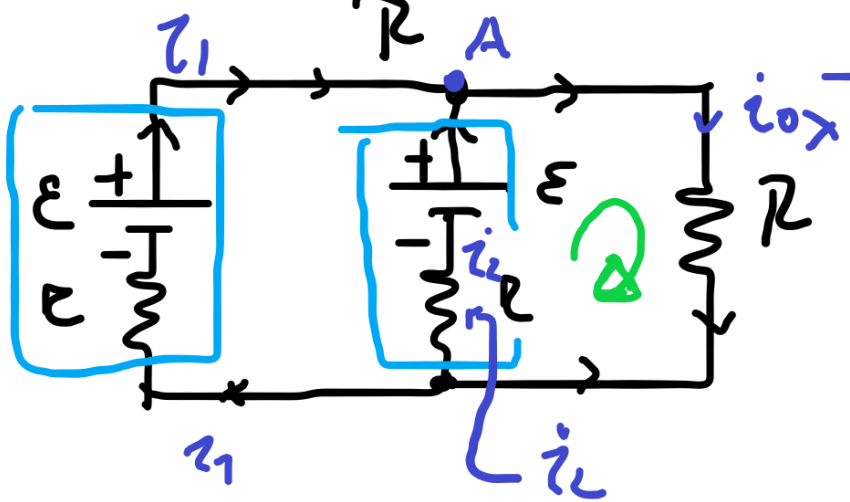


$$\mathcal{E}-Ri-Ri+\mathcal{E}-ri=0$$

$$i=\frac{2\mathcal{E}}{R+2R}=\frac{24V}{(0.4+0.4)\Omega}=\frac{24}{0.8}V$$

$$\boxed{i=30A}$$

β)



$i_1+i_2=i_{ολ}$ (ΚΟΜΒΟΣ Α)

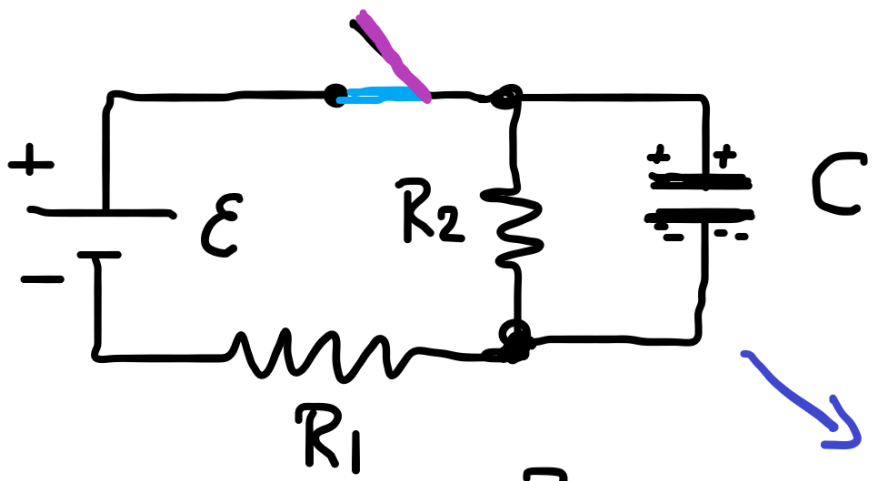
ΟΙ ΜΠΑΤΑΡΙΕΣ ΕΙΝΑΙ ΙΔΙΕΣ $\Rightarrow i_1=i_2=i'$

$$\left.\begin{array}{l}\boxed{i_{ολ}=2i'}\\ -Ri'+\mathcal{E}-R\cdot i_{ολ}=0\end{array}\right\}\Rightarrow -Ri'+\mathcal{E}-R2i'=0$$

$$i'=\frac{\mathcal{E}}{R+2R}=\frac{12V}{(0.2+0.1)\Omega}$$

$i'=12A \Rightarrow \boxed{i_{ολ}=24A}$

27.67 $R_1 = 10\,k\Omega$, $R = 15\,k\Omega$, $C = 0.4\,\mu F$, $\mathcal{E} = 20V$ 27.4.20 (5)

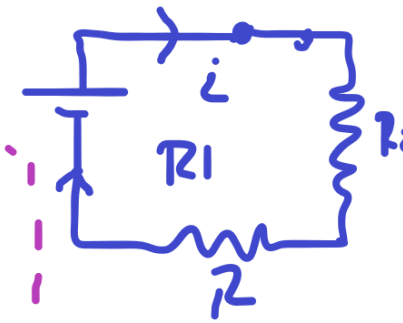


$I_2(t = 4\,ms) = ?$

ΑΡΧΙΚΑ: ON → C ΦΟΡΤΙΣΜΕΝΟΣ ΜΕ V_2 ←

ΤΕΛΟΣ: OFF → R, C ⇒ ΕΚΦΟΡΤΙΣΗ

→ ΑΡΧΙΚΑ



$\rightarrow i = \frac{\mathcal{E}}{R_1 + R_2}$ (1)

$V_2 = V_C = i R_2 = \frac{\mathcal{E} R_2}{R_1 + R_2} = 12V$

$Q_0 = 0.4\,\mu F \times 12V = 4.8\,\mu C$

$V_0 = 12V$

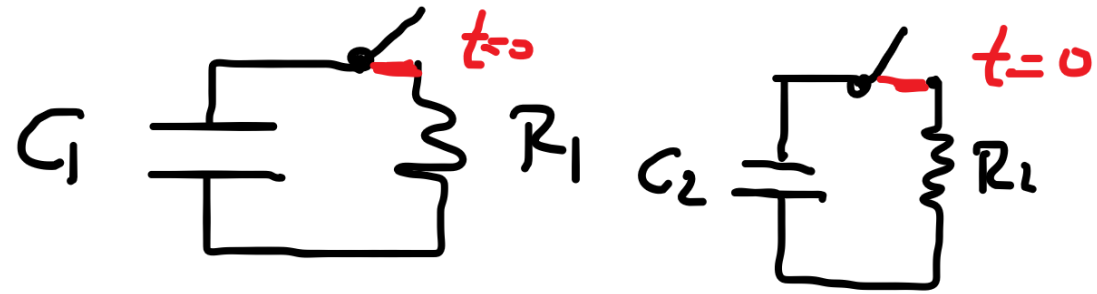
ΤΕΛΟΣ:

$V = V_0 e^{-t/RC} = 12V\, e^{-\frac{4\cdot 10^{-3}\,s}{15\times 10^3 \cdot 0.4\cdot 10^{-6}}}$

$= 12V \exp\left[-\frac{4}{15\times 0.4}\right] = 6.16V$

$I_2 = \frac{6.16}{15\,k\Omega} = 4.11\cdot 10^{-4}\,A$

27.66



$R_1 = 20\Omega$ $C_1 = 5\mu F$ $R_2 = 10\Omega$, $C_2 = 8\mu F$

$t = 0$ (ΑΝΟΙΓΟΥΝ ΤΟΥΣ ΔΙΑΚΟΠΤΕΣ)

$\frac{Q_{02}}{Q_{01}} = 1.5$

ΣΕ ΠΟΙΑ ΧΡΟΝΙΚΗ ΣΤΙΓΜΗ ΘΑ ΠΕΡΑΣΕΙ ΤΟ ΔΙΠΛΑΣΙΟ ΤΗΣ ΑΡΧΙΚΗΣ ΤΙΜΗΣ;

$Q_2(t) = Q_{02} e^{-t/R_2C_2} = Q_{02} e^{-t/\tau_2}$

$Q_1(t) = Q_{01} e^{-t/R_1C_1} = Q_{01} e^{-t/\tau_1}$

$\Rightarrow \frac{Q_2(t)}{Q_1(t)} = 1.5 = \frac{Q_{02}}{Q_{01}} \frac{e^{-t/\tau_2}}{e^{-t/\tau_1}} \Rightarrow$

$\rightarrow \frac{Q_{10}}{Q_{20}} = e^{-t\left(\frac{1}{\tau_2} - \frac{1}{\tau_1}\right)} \rightarrow \ln\left(\frac{Q_{10}}{Q_{20}}\right) = -t\left(\frac{1}{\tau_2} - \frac{1}{\tau_1}\right)$

$-\ln(Q_{20}/Q_{10}) = -t\,(1/\tau_2 - 1/\tau_1)$

$t = \frac{\ln(Q_{20}/Q_{10})}{\frac{1}{\tau_2} - \frac{1}{\tau_1}}$

$t = 1.02 \times 10^{-4}\,sec$

27.4.20

$V(t) = V_0 e^{-t/RC}$

$Q(t) = V_0 e^{-t/RC}$

ΣΤΑΘΕΡΑ ΧΡΟΝΙΚΗ ΤΟΥ ΚΥΚΛΩΜΑΤΟΣ

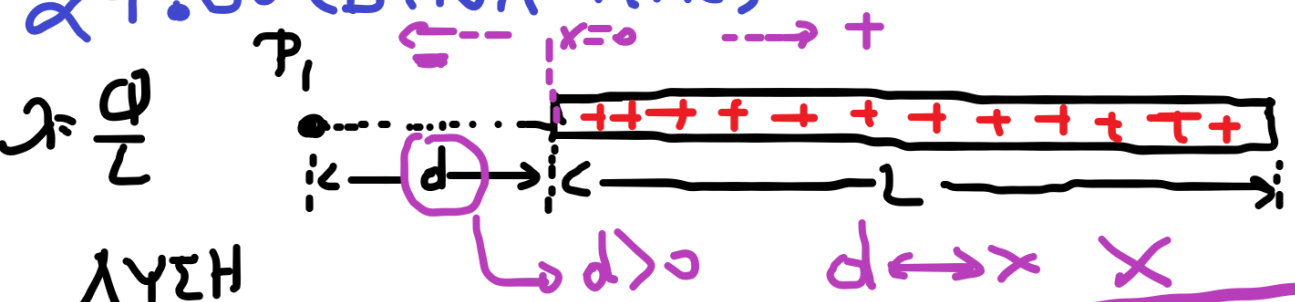
$RC = \tau$

(6)

24.38 (ΔΥΝΑΜΙΚΟ)

27.4.20

(7)



$$V = \frac{Q}{4\pi\varepsilon_0 L}\ln\left(1+\frac{L}{d}\right)$$

α) $V = V(x)$

β) $E_x = ?$

ΛΥΣΗ

α)

$$V = \frac{Q}{4\pi\varepsilon_0 L}\ln\left(1+\frac{L}{-x}\right) = \frac{Q}{4\pi\varepsilon_0 L}\ln\left(\frac{-x+L}{-x}\right) \rightarrow \boxed{V(x) = \frac{Q}{4\pi L}\ln\left(\frac{x-L}{x}\right)}$$

β) $\vec{E} = -\vec{\nabla}V \rightarrow E_x = -\frac{\partial}{\partial x}\left(\frac{Q}{4\pi\varepsilon_0 L}\ln\left(1-\frac{L}{x}\right)\right) = -\frac{Q}{4\pi\varepsilon_0 L}\frac{x}{x-L}\frac{1\cdot x-(x-L)\cdot 1}{x^2}$

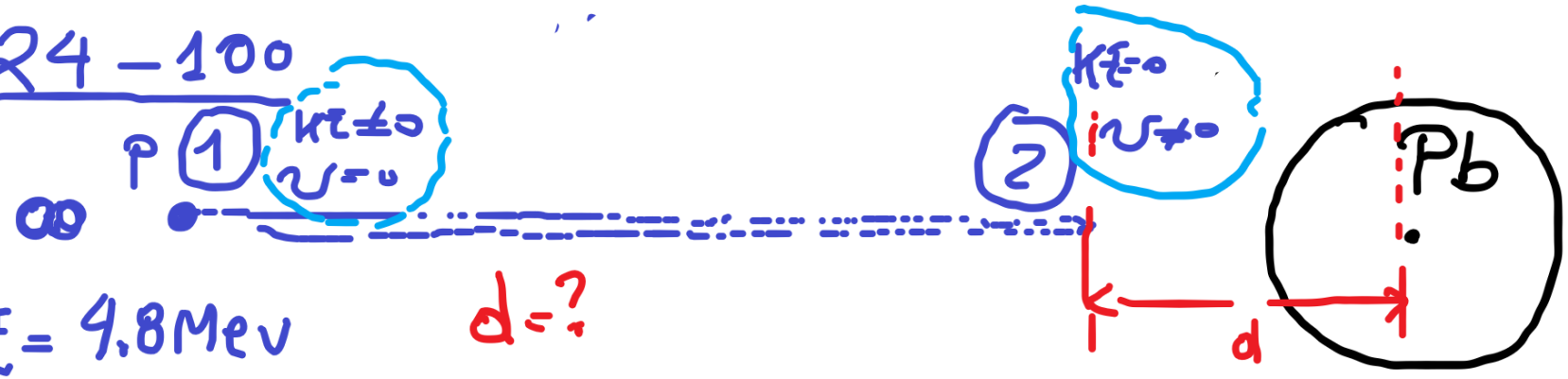
$$E_x = -\frac{Q}{4\pi\varepsilon_0 L}\frac{x}{x-L}\cdot\frac{L}{x^2} \Rightarrow E_x = -\frac{Q}{4\pi\varepsilon_0}\frac{1}{x(x-L)}$$

$$\boxed{E_x = -\frac{Q}{4\pi\varepsilon_0}\frac{1}{x(x-L)}}$$

24.4.20

8

24-100



$KE = 4.8 MeV$ $\quad d = ?$

$Z^{Pb} = 82$ (82 πρωτόνια)

$q_p = 1.6\,10^{-19}\,C$

α) ΛΥΣΗ

$1eV = 1 \cdot 1.6\,10^{-19}\,C \cdot 1V = 1.6\,10^{-19}\,Joule$

↑

$\rightarrow KE = 4.8\,10^{6}\,eV = 4.8\,10^{6} \times 1.6\,10^{-19}\,Joule = 7.68\,10^{-13}\,Joule$

$q_a = 2q_p$

$\therefore KE = U_1 \Rightarrow KE = \frac{1}{4\pi\varepsilon_0}\frac{Q_{Pb}\cdot q_p}{d} = \frac{1}{4\pi\varepsilon_0}\frac{(Z^{Pb}\cdot q_p)\,q_p}{d} = \frac{1}{4\pi\varepsilon_0}\frac{Z^{Pb}\,q_p^2}{d} \Rightarrow$

$\rightarrow \boxed{d = \frac{1}{4\pi\varepsilon_0}\frac{Z^{Pb}\,q_p^2}{KE}}$

$\boxed{d_a = \frac{1}{4\pi\varepsilon_0}\frac{Z^{Pb}\cdot 2\cdot q_p^2}{KE}}$

β) $p \leftrightarrow \alpha$ $\quad \alpha = (p^+ p^+ n^0 n^0)$