Διόρθωση για αστέρα νετρονίων.

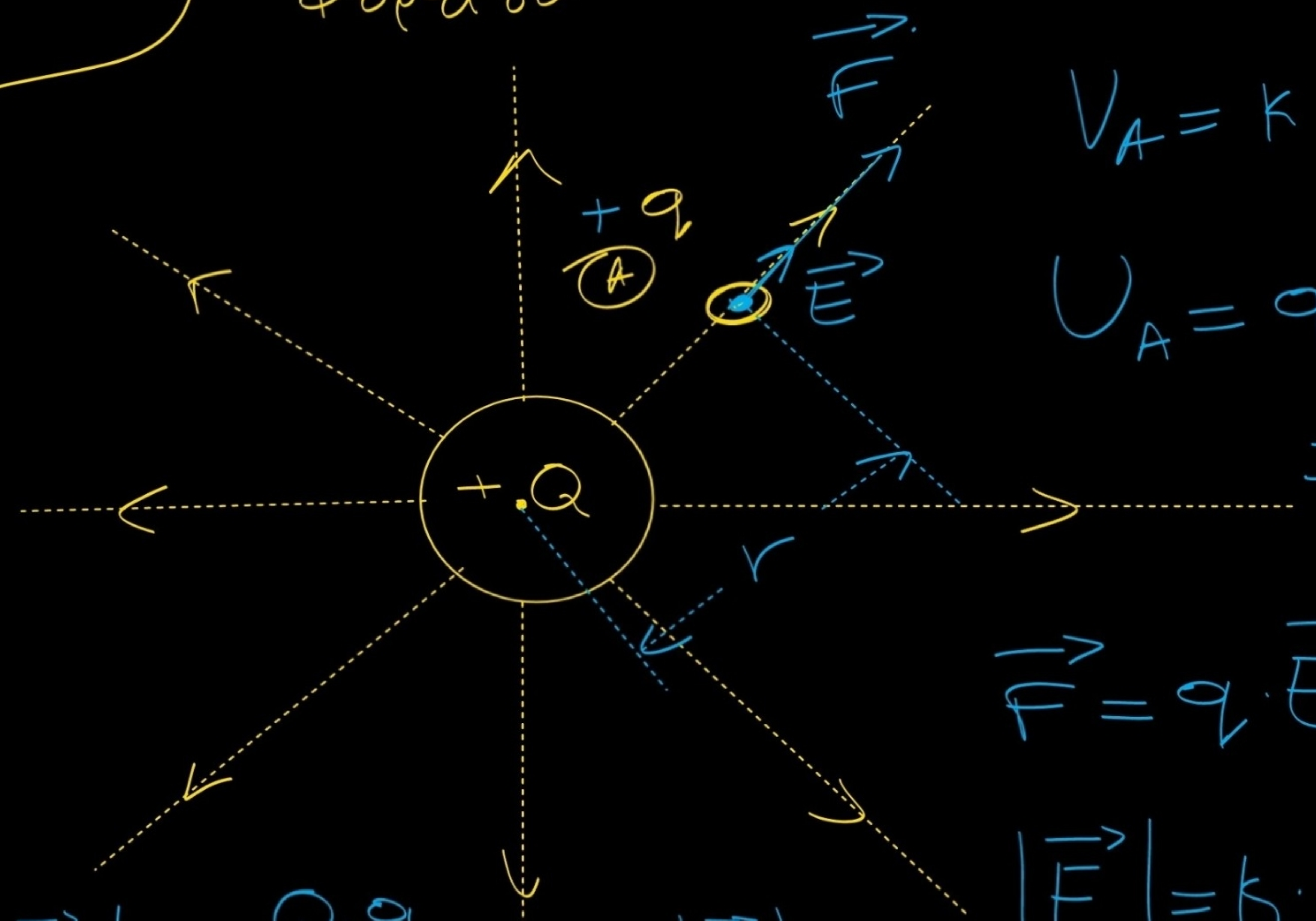
$$\frac{1}{2} m \upsilon_\delta^2 = \frac{GMm}{R} \Rightarrow$$

$$\upsilon_\delta^2 = \frac{2GM}{R} = \frac{2 \cdot 2 \cdot 10^{20}}{10^4} \Rightarrow$$

$$\upsilon_\delta^2 = 4 \cdot 10^{16} \Rightarrow \upsilon_\delta = 2 \cdot 10^8 \, m/s.$$

$$\frac{\upsilon_\delta}{c} = \frac{2 \cdot 10^8}{3 \cdot 10^8} = \frac{2}{3}.$$

Ηλεκτρικό πεδίο σημειακού φορτίου.



$$|\vec{F}| = k \cdot \frac{Q \cdot q}{r^2} = q \cdot |\vec{E}|$$

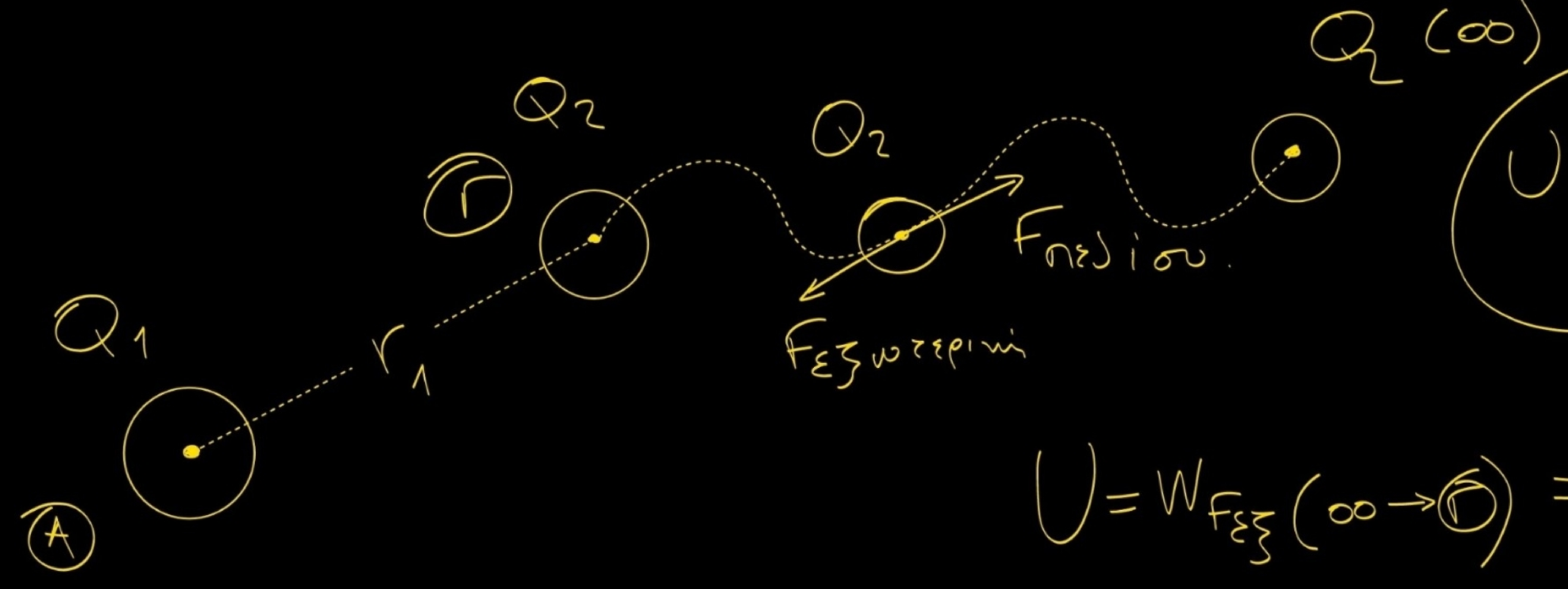
$$V_A = k \frac{Q}{r}$$

$$U_A = q \cdot V_A = \frac{kQq}{r}$$

$$\vec{F} = q \cdot \vec{E}$$

$$|\vec{E}| = k \cdot \frac{|Q|}{r^2}$$

Δυναμική ενέργεια
πολλών σημειακών φορτίων.



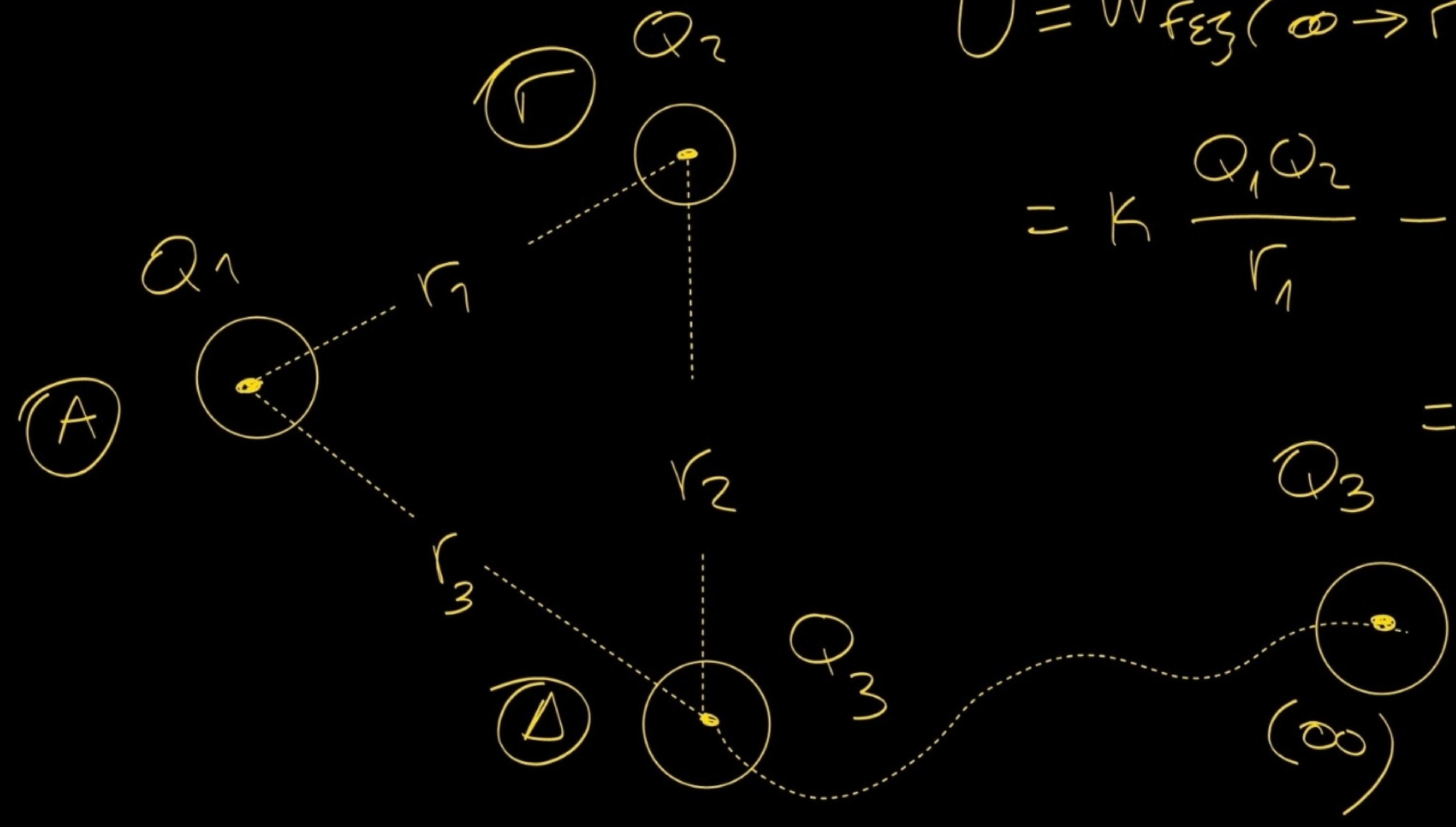
$$U = k\frac{Q_1 Q_2}{r}$$

Για να τοποθετήσουμε το Q_2 από το (∞)
στο Γ αργά και ημιστατικά, πρέπει
να ασκούμε δύναμη $\vec{F}_{εξ}$ αντίθετη της $\vec{F}_{πεδίου}$.

$$U = W_{F_{εξ}}(\infty \to \Gamma) =$$

$$- W_{F_{πεδίου}}(\infty \to \Gamma) =$$

$$- Q_2(\cancel{V_\infty}^{0} - V_\Gamma) = Q_2 \cdot V_\Gamma = Q_2 \cdot k \cdot \frac{Q_1}{r} \Rightarrow$$



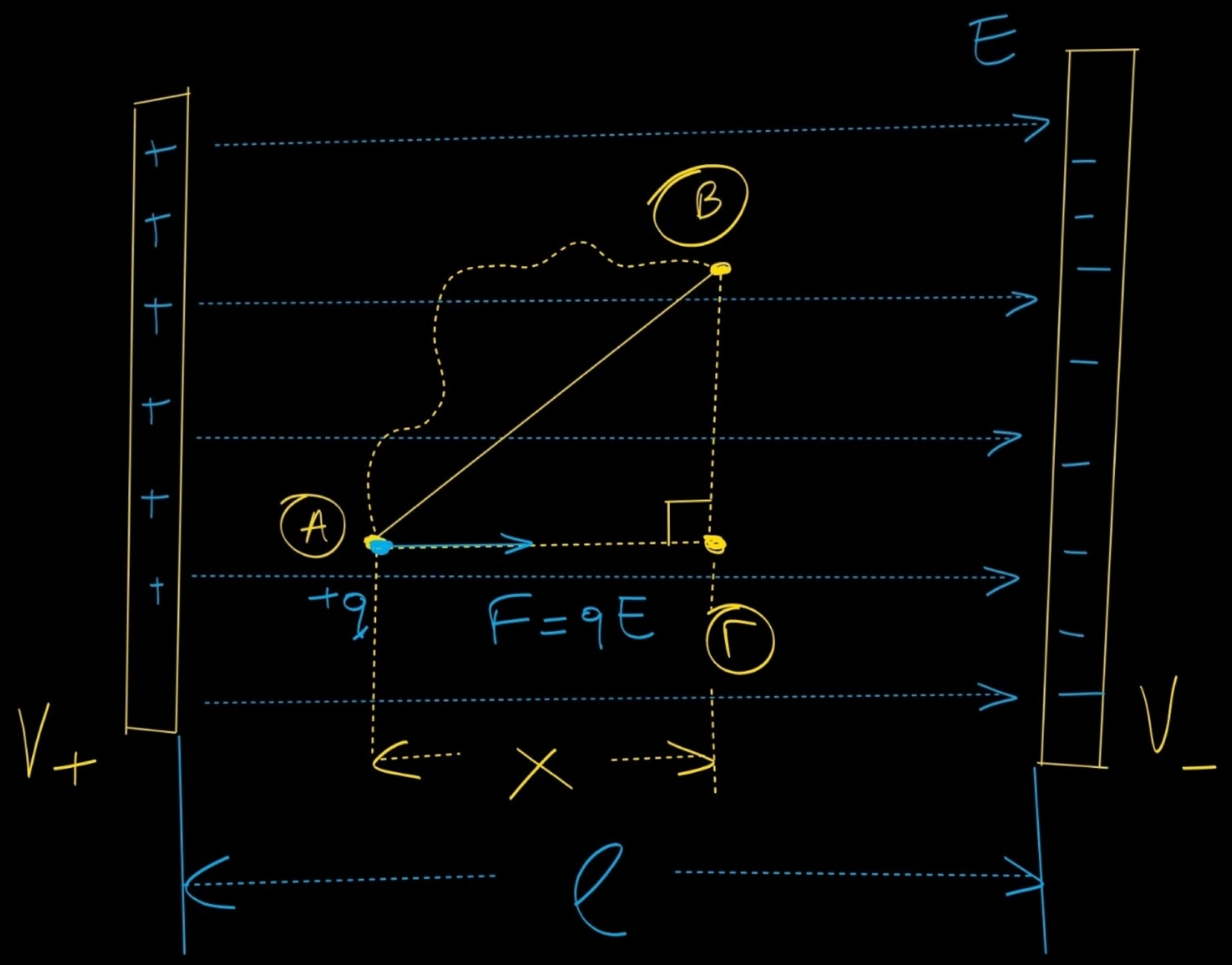
$$U = W_{F_{\varepsilon\xi}(\infty \to \Gamma)} + W_{F_{\varepsilon\xi}(\infty \to \Delta)} =$$

$$= k\frac{Q_1 Q_2}{r_1} - Q_3\left(\cancelto{0}{V_\infty} - V_\Delta\right) =$$

$$= k\frac{Q_1 Q_2}{r_1} + Q_3 \cdot V_\Delta =$$

$$= k\frac{Q_1 Q_2}{r_1} + Q_3\left(k\frac{Q_1}{r_3} + k\frac{Q_2}{r_2}\right)$$

$$= k\frac{Q_1 Q_2}{r_1} + k\frac{Q_1 Q_3}{r_3} + k\frac{Q_2 Q_3}{r_2}$$



$$V_A - V_B = V_A - V_\Gamma = E \cdot x$$

$$E = \frac{V_A - V_\Gamma}{x}$$

$$V_+ - V_- = E \cdot \ell \Rightarrow E = \frac{V}{\ell}$$

$V =$ τάση πυκνωτή.

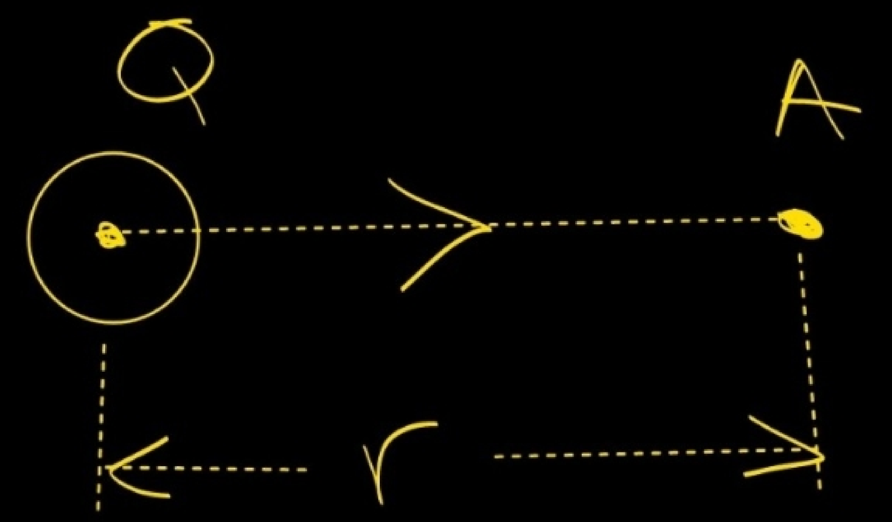
Ασκ. 51 (σελ. 194)

$Q = 2 \cdot 10^{-7}\,C$

$V = 300\,V$

$k_c = 9 \cdot 10^{9}\,\dfrac{N \cdot m^2}{C^2}$

$$V = k_c \frac{Q}{r} \Rightarrow 300 = 9 \cdot 10^{9} \cdot \frac{2 \cdot 10^{-7}}{r} \Rightarrow r = \frac{2 \cdot 9 \cdot 10^{9} \cdot 10^{-7}}{3 \cdot 10^{2}} \Rightarrow$$



$$r = 6 \cdot \frac{10^2}{10^2} \Rightarrow r = 6\,m$$

Ασκ. 57 σελ. 194

$Q = 100\mu C = 10^{2}\cdot 10^{-6}\,C \Rightarrow$

$Q = 10^{-4}\,C$

$m = 10g = 10\cdot 10^{-3}\,kg \Rightarrow$

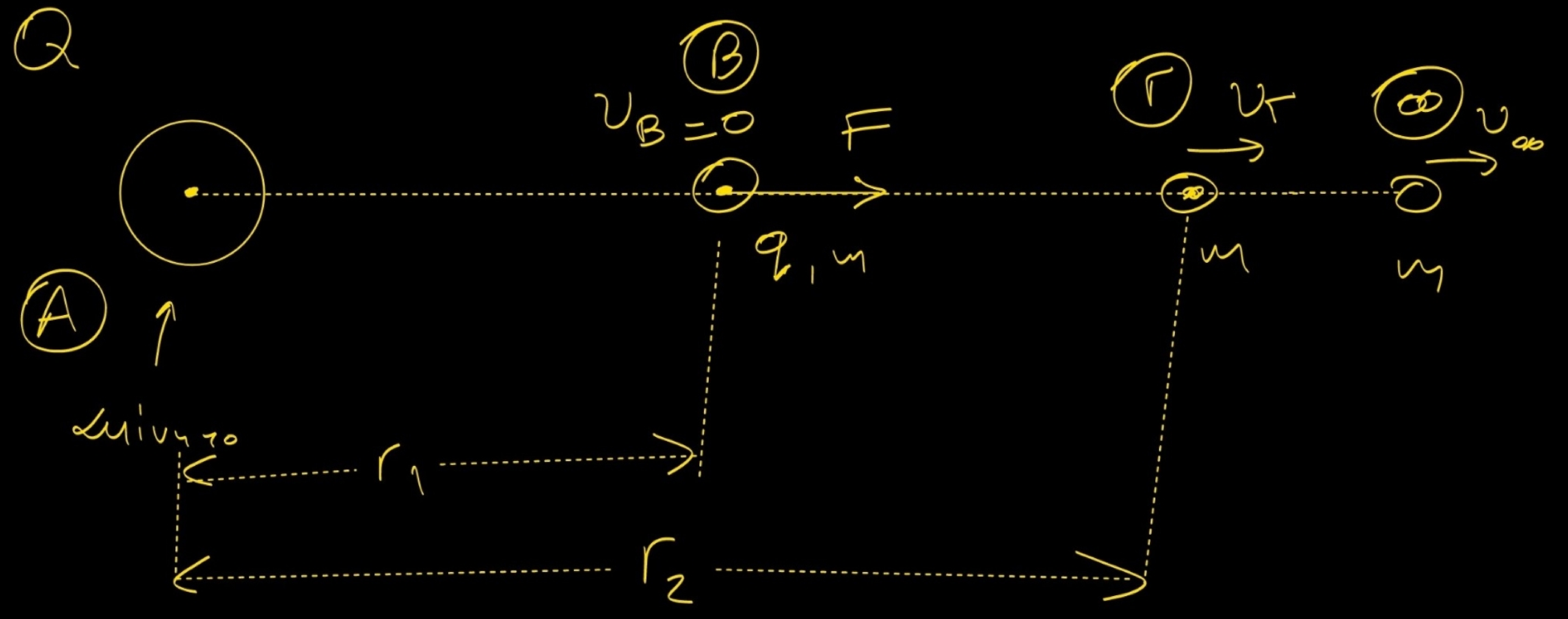
$m = 10^{-2}\,kg.$

$q = 20nC = 20\cdot 10^{-9}\,C \Rightarrow$

$q = 2\cdot 10^{-8}\,C$

$r_1 = 30cm = 0{,}3m$

$\upsilon_\Gamma = ; \quad \upsilon_\infty = ;$



α) ΘΜΚΕ: (Β) → (Γ): $\Delta K = W_{F(B\to\Gamma)} \Rightarrow$

$K_\Gamma - K_B = q(V_B - V_\Gamma) \Rightarrow \frac{1}{2}m\upsilon_\Gamma^2 - 0 = q\left(k_c\frac{Q}{r_1} - k_c\frac{Q}{r_2}\right) \Rightarrow$

$\frac{1}{2}m\upsilon_\Gamma^2 = k_c Q q\left(\frac{1}{r_1} - \frac{1}{r_2}\right) \Rightarrow \frac{1}{2}m\upsilon_\Gamma^2 = k_c Q q\left(\frac{r_2 - r_1}{r_2\cdot r_1}\right)$

$$\frac{1}{2}mv_r^2 = k_c Q q \cdot \frac{r_2 - r_1}{r_2 \cdot r_1} \Rightarrow$$

$$\frac{1}{2} \cdot 10^{-2} \cdot v_r^2 = 9 \cdot 10^9 \cdot 10^{-4} \cdot 2 \cdot 10^{-8} \cdot \frac{0,6 - 0,3}{0,6 \cdot 0,3}$$

$$\frac{1}{2} \cdot 10^{-2} \cdot v_r^2 = \cancel{18}^{10^2} \cdot 10^{-3} \cdot \frac{0,3}{\cancel{0,18}}$$

$$\frac{1}{2} \cdot 10^{-2} \cdot v_r^2 = 10^2 \cdot 10^{-3} \cdot 0,3 \Rightarrow$$

$$\frac{1}{2} \cdot 10^{-2} \cdot v_r^2 = 10^{-1} \cdot 3 \cdot 10^{-1} \Rightarrow$$

$$\frac{1}{2} \cdot 10^{-2} \cdot v_r^2 = 3 \cdot 10^{-2} \Rightarrow v_r^2 = 6 \Rightarrow v_r = \sqrt{6}\ m/s$$

B) ΑΔΜΕ : B → ∞

$$K_B + U_B = K_\infty + U_\infty \Longrightarrow$$

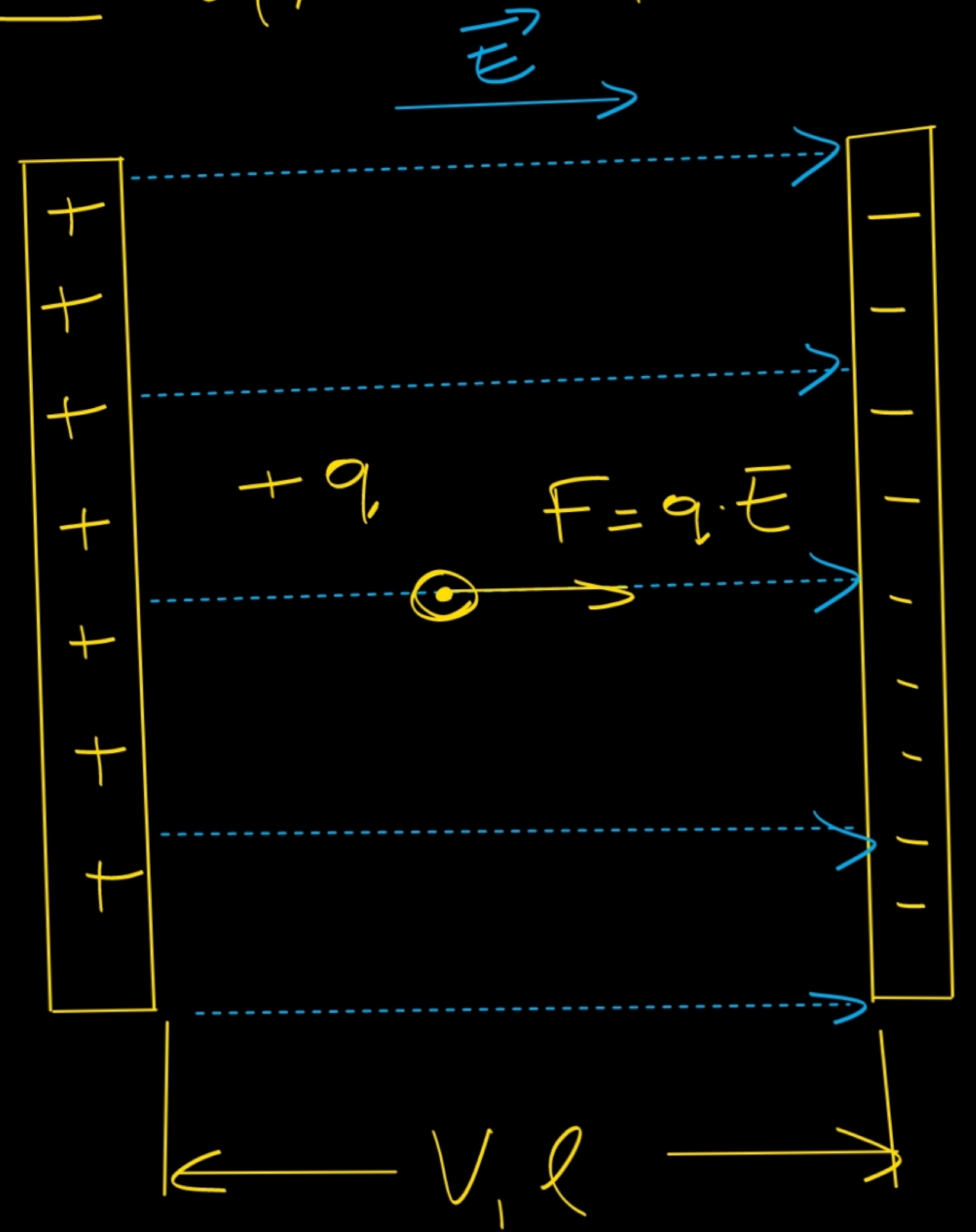
$$0 + k_c \frac{Q \cdot q}{r_1} = \frac{1}{2} m v_\infty^2 + 0 \Longrightarrow$$

$$9 \cdot 10^9 \cdot \frac{10^{-4} \cdot 2 \cdot 10^{-8}}{0,3} = \frac{1}{2} \cdot 10^{-2} \cdot v_\infty^2 \Rightarrow$$

$$\frac{\cancel{9}^{30} \cdot 2}{\cancel{0,3}_{1}} \cdot \frac{10^{-3}}{1} = \frac{1}{2} \cdot 10^{-2} \cdot v_\infty^2 \Rightarrow$$

$$\frac{120 \cdot 10^{-3}}{10^{-2}} = v_\infty^2 \Rightarrow v_\infty^2 = 12 \Rightarrow v_\infty = 2\sqrt{3}\ m/s.$$

Κίνηση σε ομογενές ηλ. πεδίο
χωρίς αρχική ταχύτητα.



$$E=\frac{V}{l}$$

$$a=\frac{F}{m}=\frac{q\cdot E}{m}=\frac{q\cdot V}{m\cdot l}$$

Αν $l=d$ τότε $a=\dfrac{q\cdot V}{m\cdot d}$.

$$v=at$$

$$x=\frac{1}{2}at^2$$

1. Χρόνος κίνησης (από τη μία στην άλλη πλάκα)

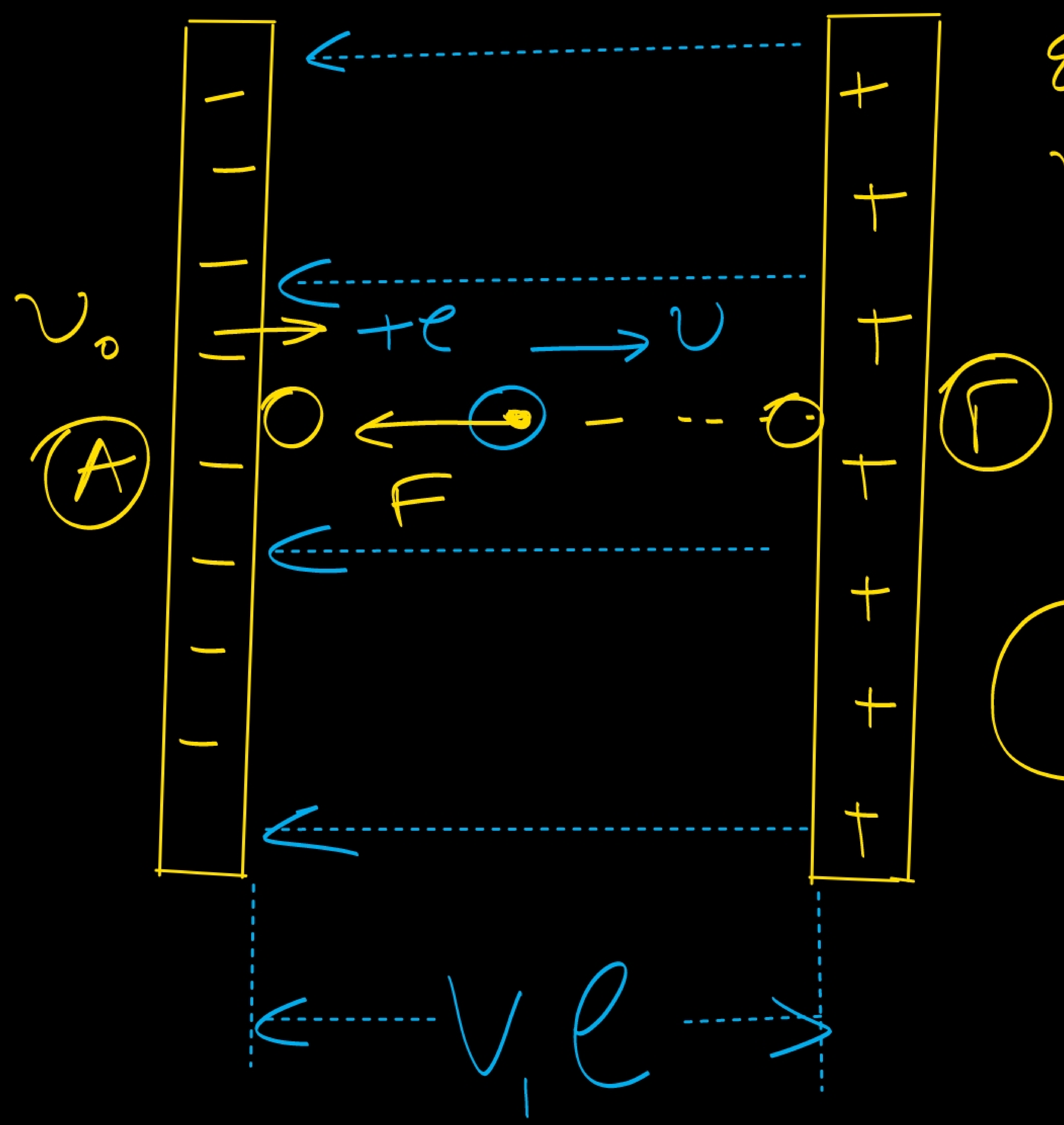
$$d=\frac{1}{2}at_1^2 \Rightarrow t_1=\sqrt{\frac{2d}{a}}$$

2. Ταχύτητα όταν φτάνει στην άλλη πλάκα:

$$v_1=a\cdot t_1=a\cdot\sqrt{\frac{2d}{a}}=\sqrt{2ad}.$$

Ασκ. 91 σελ 200

$q_p = +e$ $\qquad$ $q_p = q_{proton} = +e$



Το πρωτόνιο εκτελεί ομαλά επιβραδυνόμενη κίνηση μεταξύ των θέσεων (Α) και (Γ).

$$F = ma \Rightarrow eE = ma \Rightarrow a = \frac{eE}{m} \Rightarrow a = \frac{eV}{m\cdot l}$$

$$v = v_0 - at \Rightarrow$$

$$0 = v_0 - at_1 \Rightarrow t_1 = \frac{v_0}{a}$$ (χρόνος κίνησης)

$$(S = v_0 t - \frac{1}{2} a t^2)$$

$$l = v_0 t_1 - \frac{1}{2} a t_1^2 \Rightarrow$$

$$l = v_0 \cdot \frac{v_0}{a} - \frac{1}{2} a \cdot \frac{v_0^2}{a^2} \Rightarrow$$

$$l = \frac{v_0^2}{a} - \frac{v_0^2}{2a} \Rightarrow l = \frac{v_0^2}{2a} \Rightarrow a = \frac{v_0^2}{2l} \Rightarrow \frac{eV}{m\cdot \cancel{l}} = \frac{v_0^2}{2\cancel{l}} \Rightarrow$$

$$\boxed{V = \frac{m v_0^2}{2e}}$$

$$V = \frac{mv_0^2}{2e} = \frac{1{,}6 \cdot 10^{-27} \cdot (5 \cdot 10^5)^2}{2 \cdot 1{,}6 \cdot 10^{-19}} \Rightarrow$$

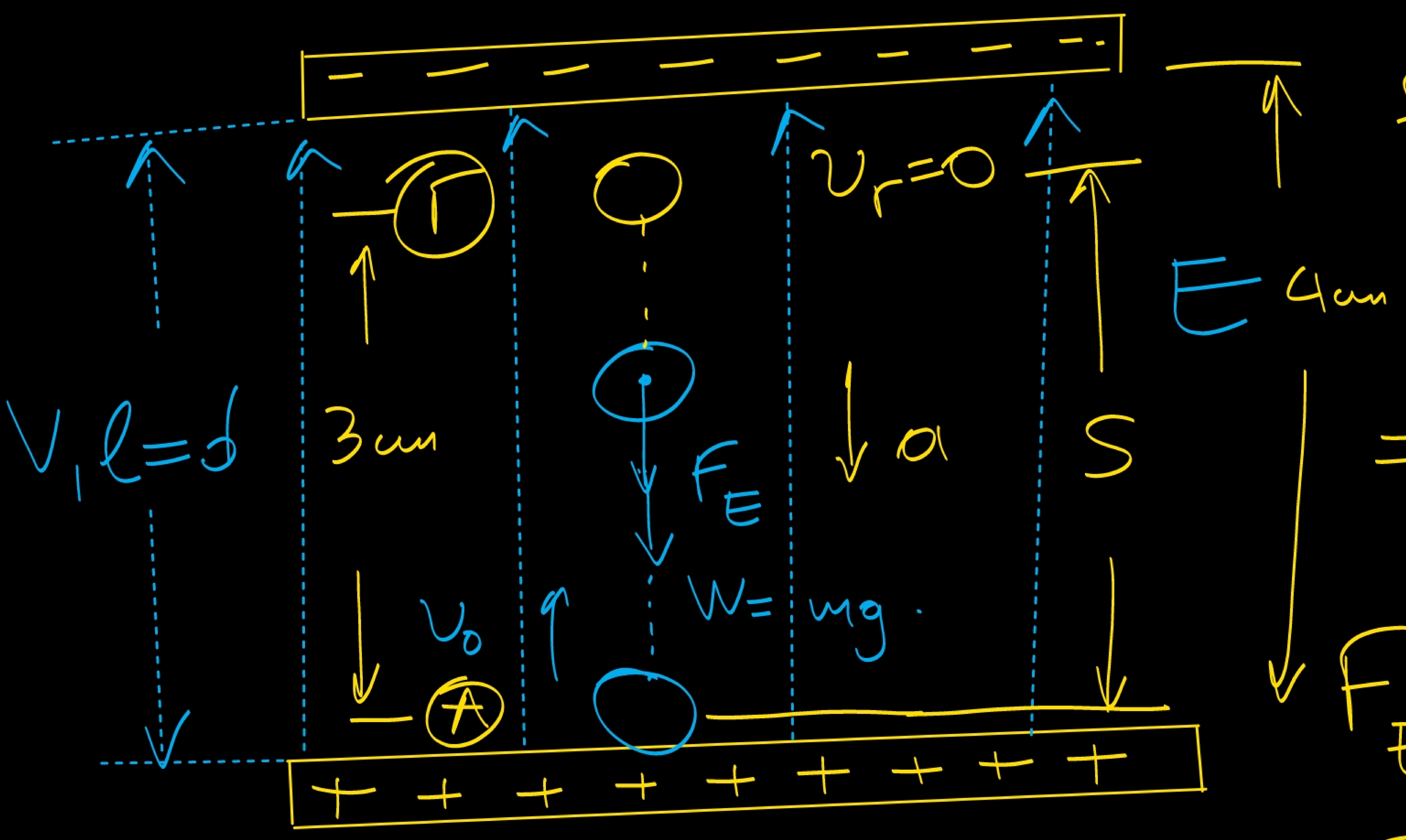
$$V = \frac{\cancel{1{,}6} \cdot 10^{-27} \cdot 25 \cdot 10^{10}}{2 \cdot \cancel{1{,}6} \cdot 10^{-19}} \Rightarrow$$

$$V = \frac{25}{2} \cdot \frac{10^{-17}}{10^{-19}} = \frac{25}{2} \cdot 10^{2} \Rightarrow$$

$$V = \frac{2500}{2} \Rightarrow V = 1250 \text{ Volt}$$

Ασκ. 92 σελ.200

$\upsilon_0 = 85\,cm/sec = 0{,}85\,m/s$.



$m = 0{,}5\,g = 0{,}5 \cdot 10^{-3}\,kg$.

$V = 4kV = 4 \cdot 10^{3}\,Volt$

$d = 4\,cm = 4 \cdot 10^{-2}\,m$.

$W = mg = 0{,}5 \cdot 10^{-3} \cdot 10 \Rightarrow$

$W = 5 \cdot 10^{-3}\,N$.

$F_E = |q| \cdot E = |q| \cdot \frac{V}{d} =$

$= 10^{-8} \cdot \frac{4 \cdot 10^{+3}}{4 \cdot 10^{-2}} \Rightarrow$

$F_E = 10^{-8} \cdot 10^{5} \Rightarrow$

$F_E = 10^{-3}\,N$

Άρα: $W = 4F_E$.

$\Sigma F = ma \Rightarrow$

$F_E + W = ma \Rightarrow$

$10^{-3} + 5 \cdot 10^{-3} = 0{,}5 \cdot 10^{-3} \cdot \alpha \Rightarrow$

$6 = 0{,}5\alpha \Rightarrow$

$\alpha = 12\,m/s^2$

$(\upsilon = \upsilon_0 - \alpha t) \Rightarrow 0 = \upsilon_0 - \alpha t_1 \Rightarrow$

$t_1 = \frac{\upsilon_0}{\alpha}$

$S = \upsilon_0 t_1 - \frac{1}{2}\alpha t_1^2 = \frac{\upsilon_0^2}{\alpha} - \frac{\upsilon_0^2}{2\alpha} = \frac{\upsilon_0^2}{2\alpha} \Rightarrow$

$S = \frac{0{,}85^2}{2 \cdot 12} = \frac{\left(\frac{1{,}7}{2}\right)^2}{2 \cdot 12} = \frac{1{,}7^2}{8 \cdot 12} =$

$= \frac{2{,}89}{96} \approx \frac{3}{100} = 0{,}03\,m = 3\,cm$

Άρα φτάνει σε απόσταση 1 cm από τον αρν. οπλισμό