A flow of 10^7 electrons per second in a conducting wire constitutes a current of

(a) 1.6×10^{-12} A (b) 1.6×10^{26} A

(c) 1.6×10^{-26} A (d) 1.6×10^{12} A

10^7 electron per second

$q = ne$

$= 10^7 \times 1.6 \times 10^{-19}$ c

$q = 1.6 \times 10^{-12}$ c

$i = \frac{q}{t} = \frac{1.6 \times 10^{-12}}{1}$ c/sec = A

$i = 1.6 \times 10^{-12}$ A

A charged particle having drift velocity of 7.5×10^{-4} m s^{-1} in an electric field of 3×10^{-10} V m^{-1}, has a mobility in m^2 V^{-1} s^{-1} of

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(a) 2.25×10^{15}

(b) 2.5×10^{6}

(c) 2.5×10^{-6}

(d) 2.25×10^{-15}

$V_d = 7.5 \times 10^{-4}$ m/s

$E = 3 \times 10^{-10}$ V/m

$\mu = \frac{V_d}{E} = \frac{7.5 \times 10^{-4}}{3 \times 10^{-10}}$

$\mu = \frac{7.5}{3} \times 10^{-4+10} = \frac{75}{3} \times 10^{+5} = \underline{2.5 \times 10^{6}}$

Specific resistance of a conductor increases with

(a) increase in temperature

(b) increase in cross-section area

(c) increase in cross-section and decrease in length

(d) decrease in cross-section area.

$$\boxed{\rho = \frac{m}{ne^2\tau}}$$

$T\uparrow \quad \tau\downarrow \quad \rho\uparrow$

$T\downarrow \quad \tau\uparrow \quad \rho\downarrow$

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Two bulbs are of (40 W, 200 V), and (100 W, 200 V). Then correct relation for their resistances is

(a) $R_{40} < R_{100}$

(b) $R_{40} > R_{100}$

(c) $R_{40} = R_{100}$

(d) no relation can be predicted.

$\boxed{40W, 200V}$

$P = \frac{V^2}{R}$ $R = \frac{V^2}{P}$

$R_{100} = \frac{2\cancel{0}\cancel{0} \times 200}{1\cancel{0}\cancel{0}}$

$\boxed{R_{100} = 400\Omega}$

$R_{40\Omega} = \frac{200 \times \cancel{200}^{5}}{\cancel{40}} = 1000\Omega$

An electric bulb is rated 60 W, 220 V.

The resistance of its filament is

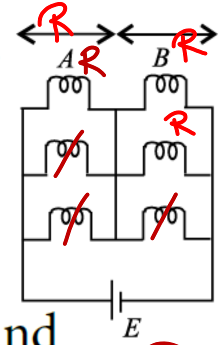
(a) 870 Ω (b) 780 Ω

(c) 708 Ω (d) 807 Ω

$$R = \frac{\overset{110}{\cancel{220}} \times 22\cancel{0}}{\underset{3}{\cancel{60}}}$$

$$R = \frac{22 \times 110}{3}$$

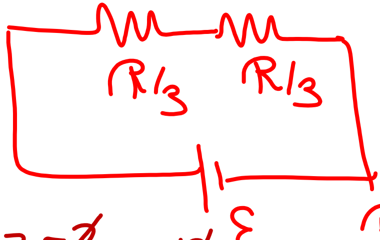
Six similar bulbs are connected as shown in the figure with a DC source of emf E, and zero internal resistance. The ratio of power consumption by the bulbs when (i) all are glowing and (ii) in the situation when two from section A and one from section B are glowing, will be

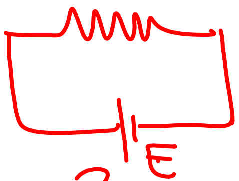


(a) 2 : 1 (b) 4 : 9

(c) 9 : 4 (d) 1 : 2

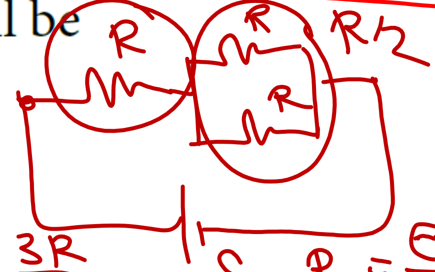
$P = \frac{V^2}{R}$





$P = \frac{E^2 \times 3}{2R}$

$P_1 = \frac{3E^2}{2R}$

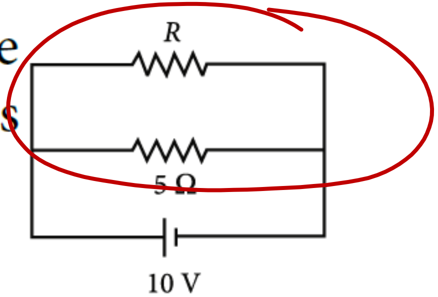


$R + \frac{R}{2} = \frac{3R}{2}$

$P_2 = \frac{E^2 \times 2}{3R}$

$\frac{P_1}{P_2} = \frac{3\cancel{E^2} \times 3\cancel{R}}{2\cancel{R} \times 2\cancel{E^2}} = \frac{9}{4}$

The power dissipated in the circuit shown in the figure is 30 watts. The value of R is



(a) 20 Ω

(b) 15 Ω

(c) 10 Ω

(d) 30 Ω

$=$

$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{5}$$

$$R_{eq} = \frac{5R}{(5+R)}$$

$$P = \frac{V^2}{R} = \frac{100(5+R)}{5R}$$

$$30 = \frac{500+100R}{5R}$$

$$150R = 500 + 100R$$

$$50R = 500$$

$$R = 10\Omega$$

Two 220 volt, 100 watt bulbs are connected first in series and then in parallel. Each time the combination is connected to a 220 volt a.c. supply line. The power drawn by the combination in each case respectively will be

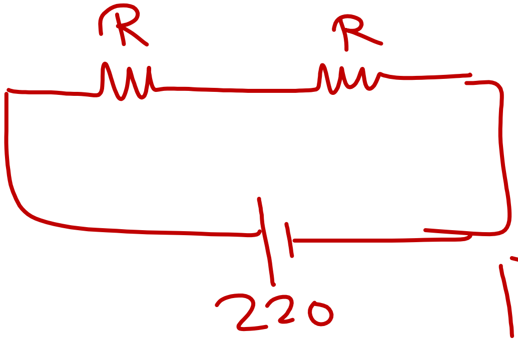
Rating

(a) 50 watt, 100 watt

(b) 100 watt, 50 watt

(c) 200 watt, 150 watt

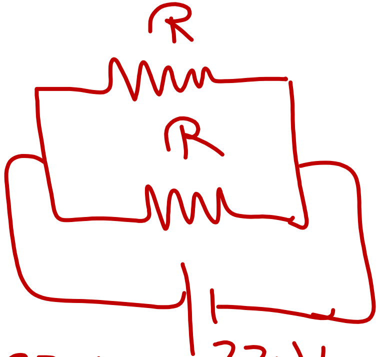
(d) 50 watt, 200 watt ✓

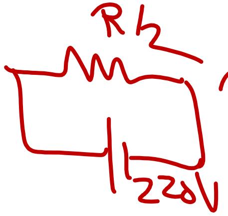


$$R = \frac{V^2}{P} = \frac{220 \times 220}{100}$$

$$\boxed{R = 22 \times 22\,\Omega}$$

$$P_1 = \frac{V^2}{2R} = \frac{\cancel{220} \times \cancel{220}}{\cancel{2} \times \cancel{22} \times \cancel{22}} = 50\,W$$



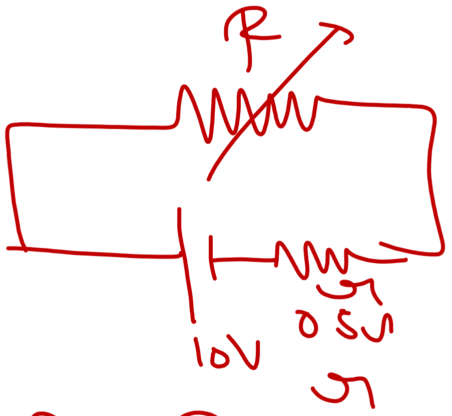


$$P_2 = \frac{220 \times 220 \times 2}{R} = \frac{\cancel{220} \times \cancel{220} \times 2}{\cancel{22} \times \cancel{22}} = 100 \times 2 = 200\,W$$

A battery of e.m.f 10 V and internal resistance 0.5 Ω is connected across a variable resistance R. The value of R for which the power delivered in it is maximum is given by

(a) 0.5 Ω (b) 1.0 Ω

(c) 2.0 Ω (d) 0.25 Ω



$r = R$

$R = 0.5\,\Omega$

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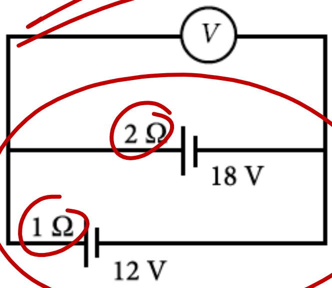
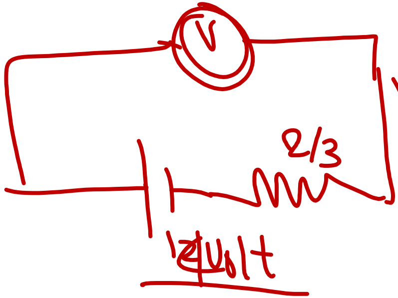
Two batteries, one of emf 18 volts and internal resistance 2 Ω and the other of emf 12 volts and internal resistance 1 Ω, are connected as shown. The voltmeter V will record a reading of



(a) 30 volt
(b) 18 volt
(c) 15 volt
(d) 14 volt

$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2} = \frac{2}{3}$$



$$\varepsilon_{net} = \frac{\varepsilon_1/r_1 + \varepsilon_2/r_2}{\frac{1}{r_1} + \frac{1}{r_2}}$$

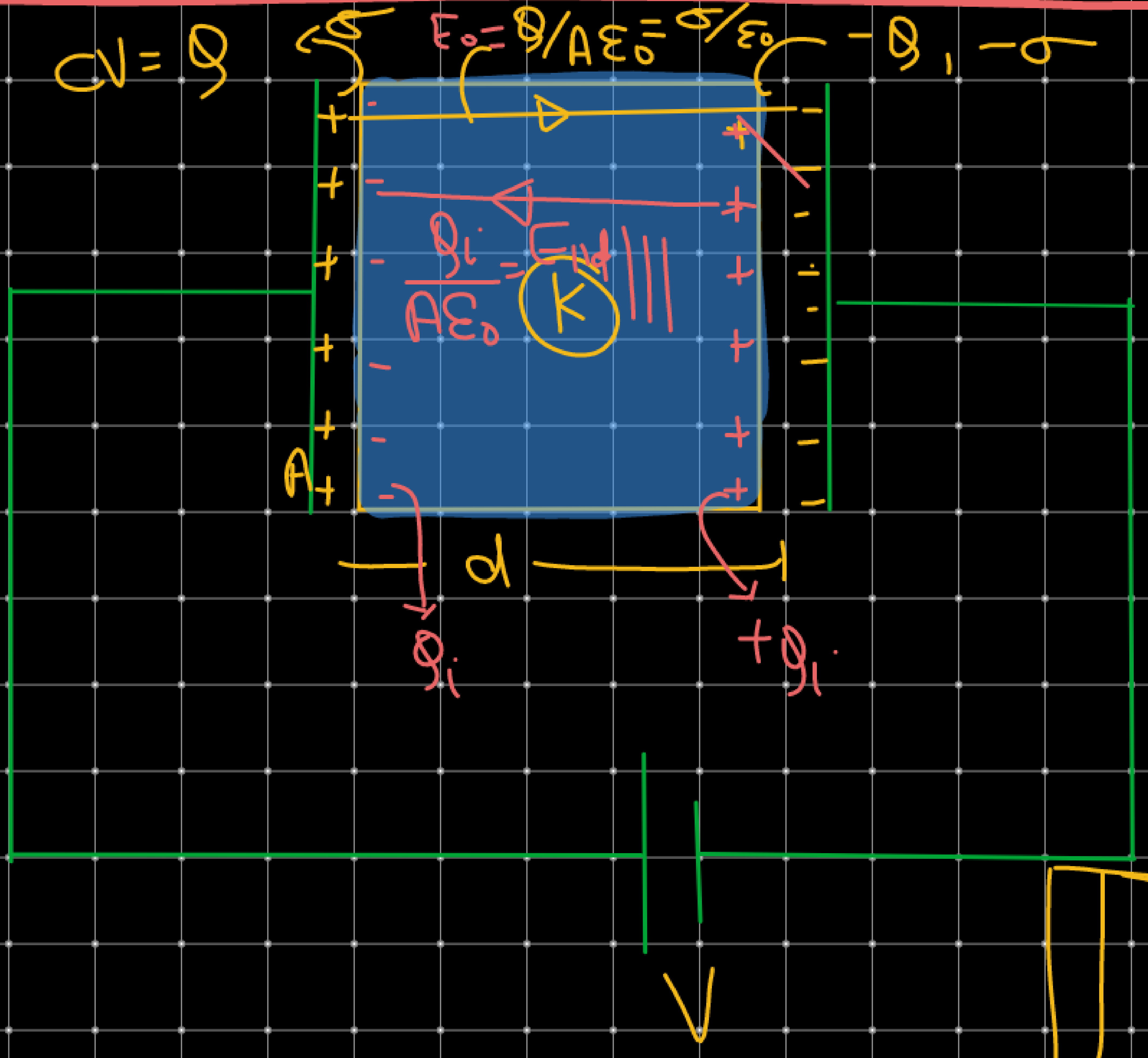
$$\varepsilon_{net} = \frac{18/2 + 12/1}{\frac{1}{2} + \frac{1}{1}}$$

$$= \frac{(9+12)2}{3}$$

$$= \frac{21 \times 2}{3} = 14 \text{ Volt}$$

1	2	3	4	5	6	7	8	9	10
A	B	A	B	D	C	C	D	A	D

Dielectric inside the PPC :-



$$C = \frac{A\varepsilon_0 K}{d}$$

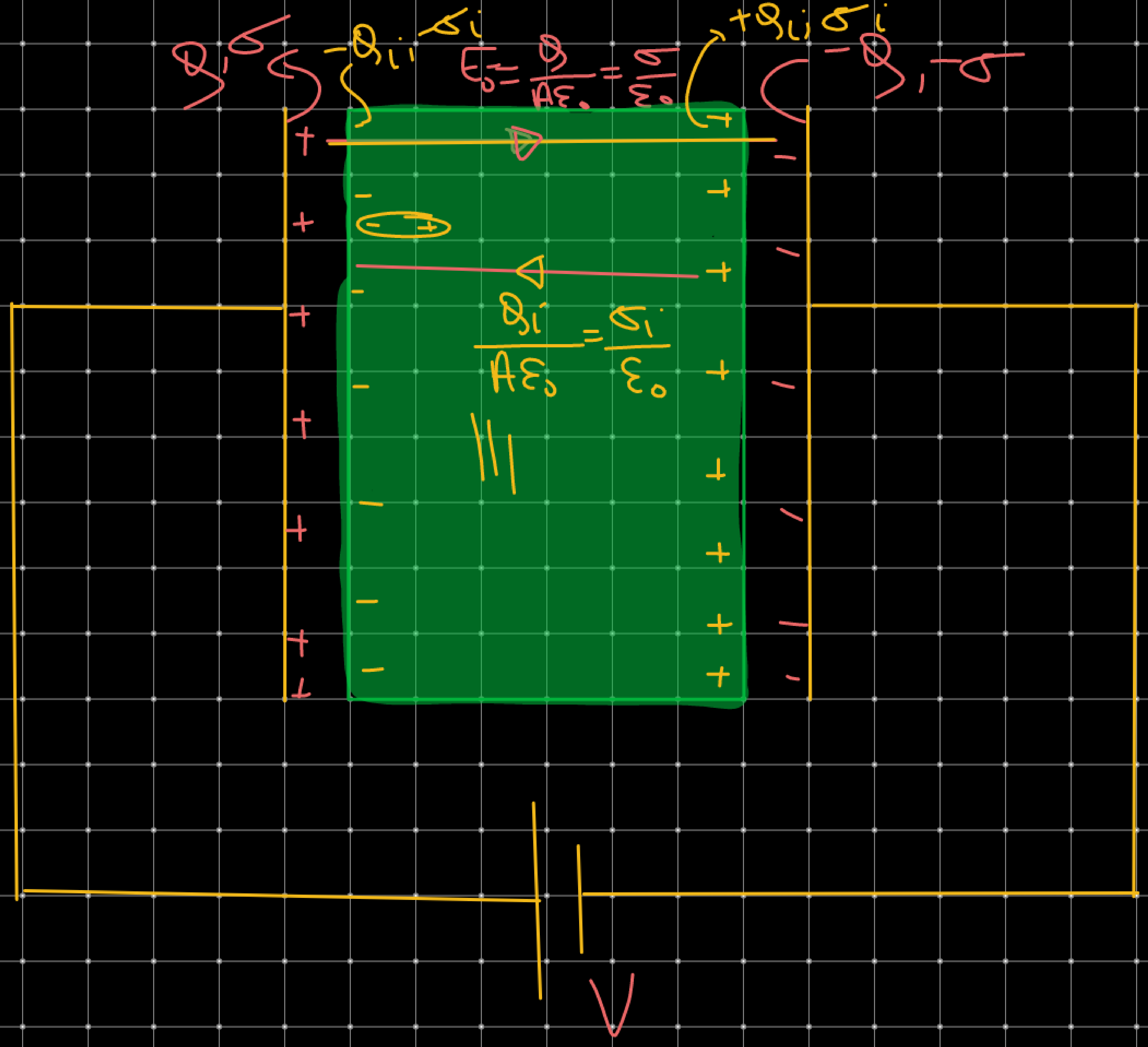
(ii) $$E = \frac{Q}{A\varepsilon_0 K} = \frac{\sigma}{\varepsilon_0 K}$$

$$E_{net} = E_0 - E_{ind}$$

$$Q_i = Q\left(1 - \frac{1}{K}\right)$$

$$\frac{Q_i}{A} = \frac{Q}{A}\left(1 - \frac{1}{K}\right)$$

$$\boxed{\sigma_i = \sigma\left(1 - \frac{1}{K}\right)}$$



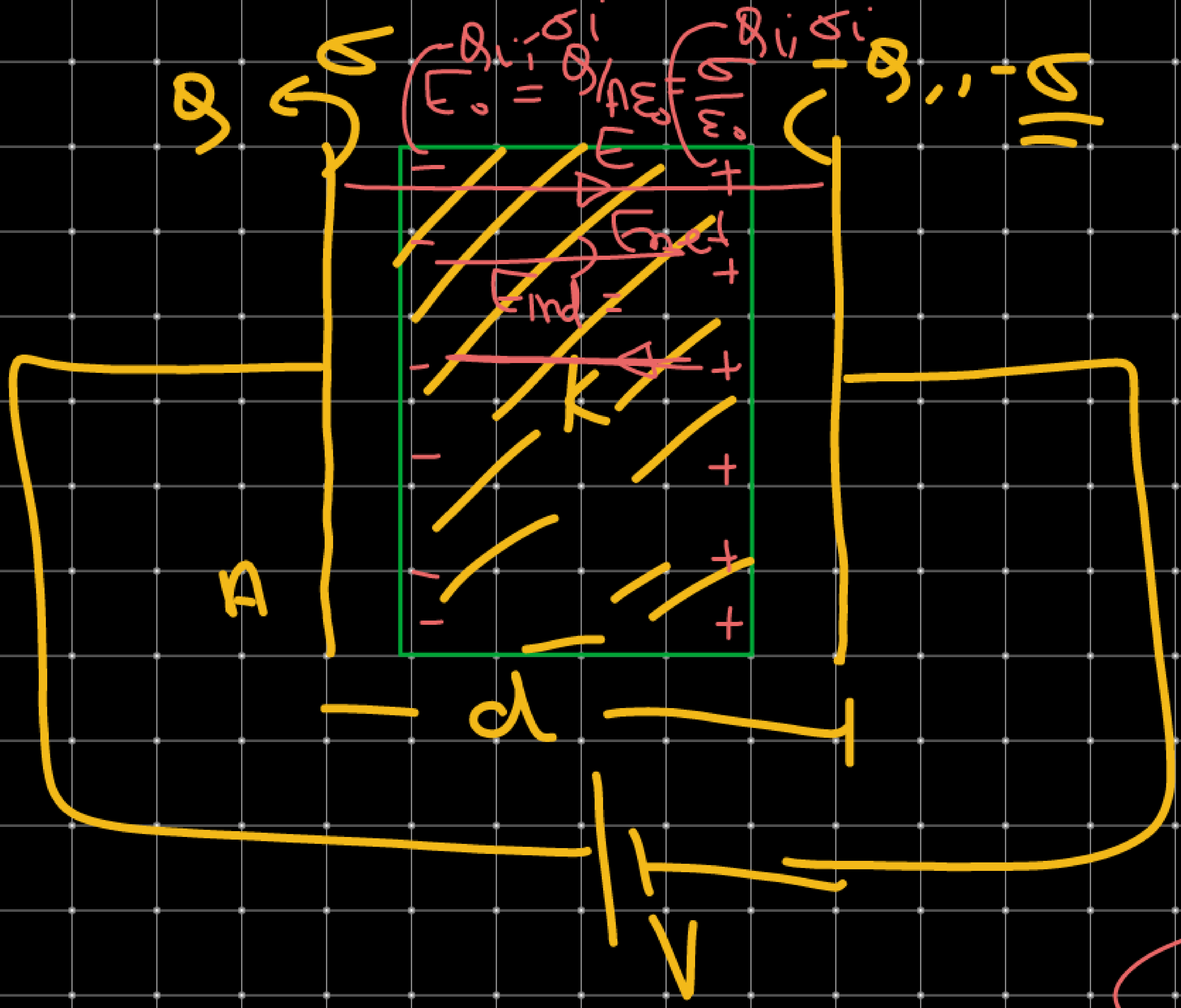
$$E_{ned} = E_0 - E_{ind}$$

$$\frac{Q}{\cancel{A\varepsilon_0}K} = \frac{Q}{\cancel{A\varepsilon_0}} - \frac{Q_{in}}{\cancel{A\varepsilon_0}}$$

$$\frac{Q}{K} = Q - Q_{in}$$

$$Q_{in} = Q - \frac{Q}{K}$$

$$\boxed{Q_{ind} = Q\left(1 - \frac{1}{K}\right)}$$



$$C = \frac{A\varepsilon_0 K}{d}$$

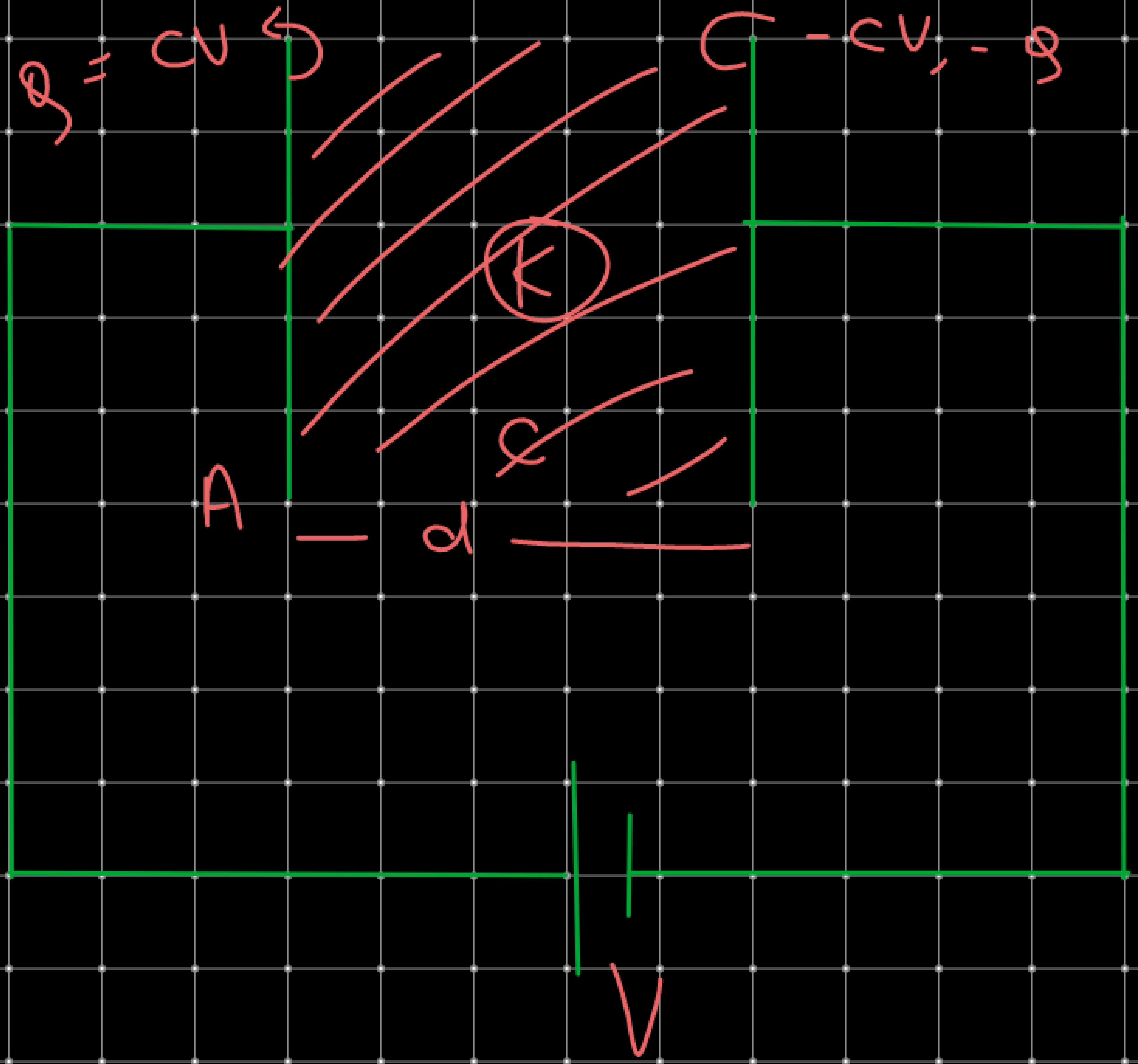
$$E_{net} = E_0 - E_{ind}$$

$$\frac{Q}{A\varepsilon_0 K} = \frac{Q}{A\varepsilon_0} - \frac{Q_i}{A\varepsilon_0}$$

$$\frac{Q_i}{\cancel{A\varepsilon_0}} = \frac{Q}{\cancel{A\varepsilon_0}} - \frac{Q}{\cancel{A\varepsilon_0}K}$$

$$Q_i = Q\left(1 - \frac{1}{K}\right)$$

$$\sigma_i = \sigma\left(1 - \frac{1}{K}\right)$$

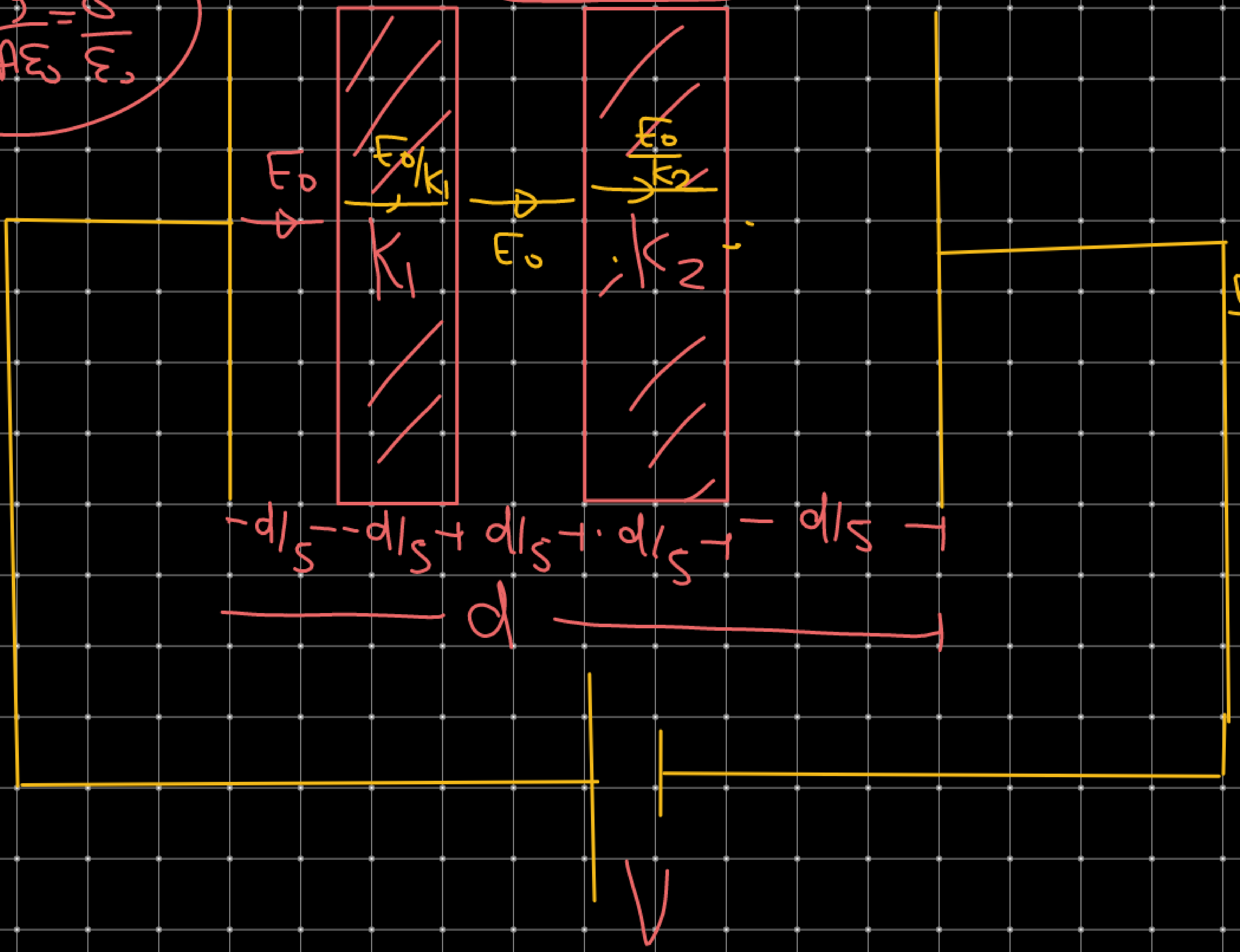


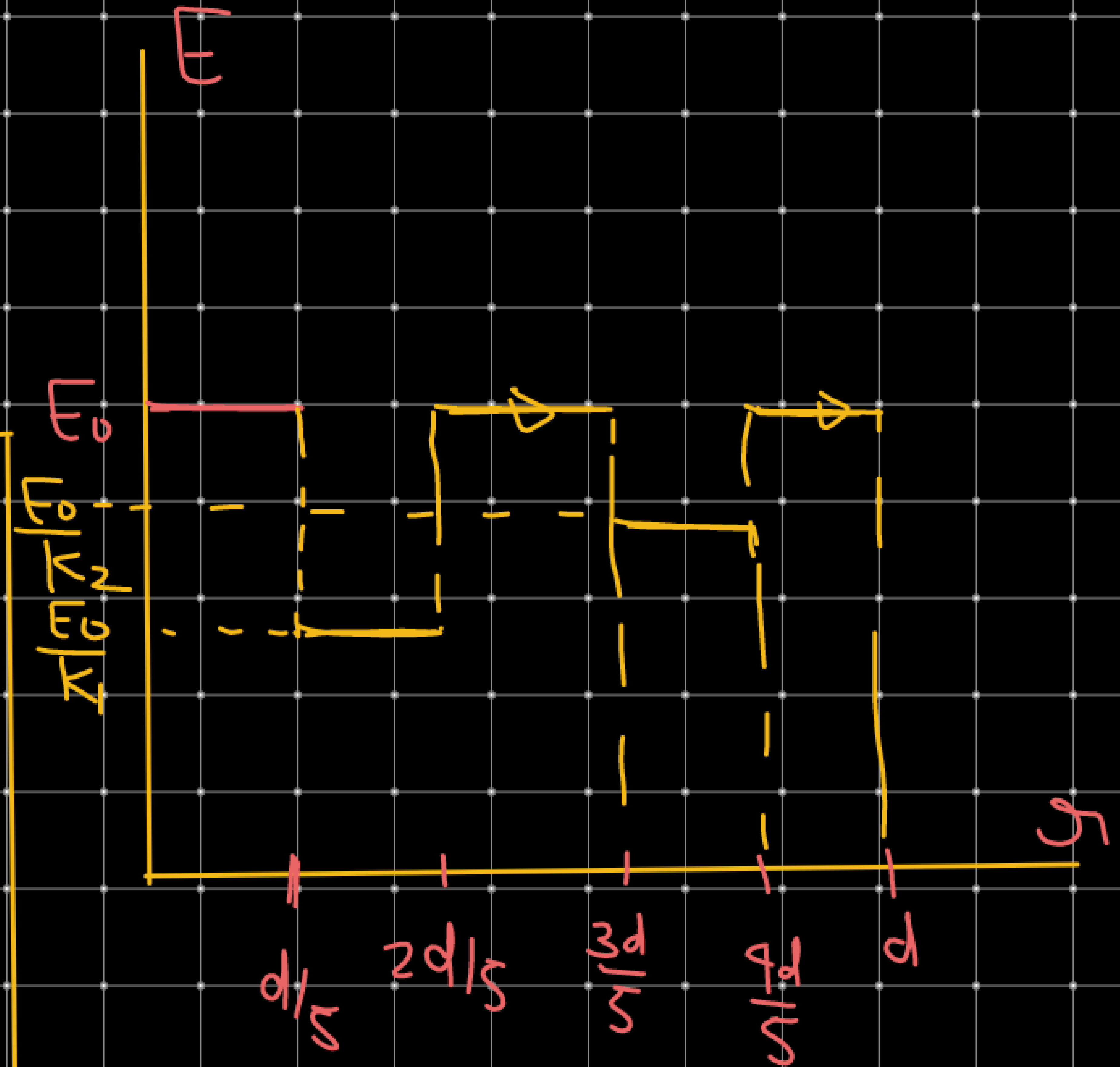
$$\boxed{E = \frac{Q}{A\varepsilon_0} = \frac{\sigma}{\varepsilon_0}}$$ E_0

#1 $$\boxed{E_{net} = \frac{Q}{A\varepsilon_0 K}}$$

$E_0 = \frac{q}{A\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$

$\boxed{K_1 > K_2}$ $K_1 > K_2$



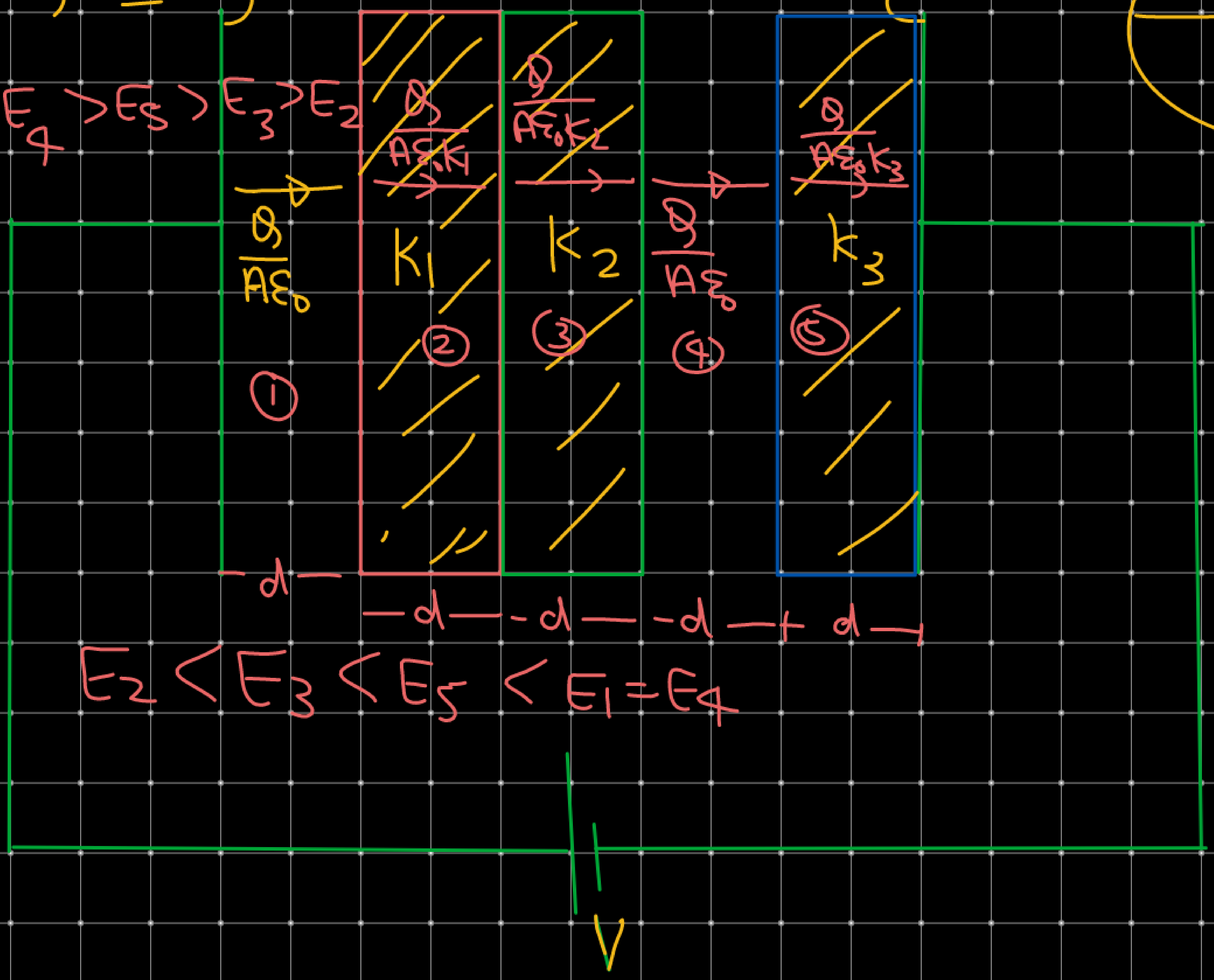


$Q = CV$

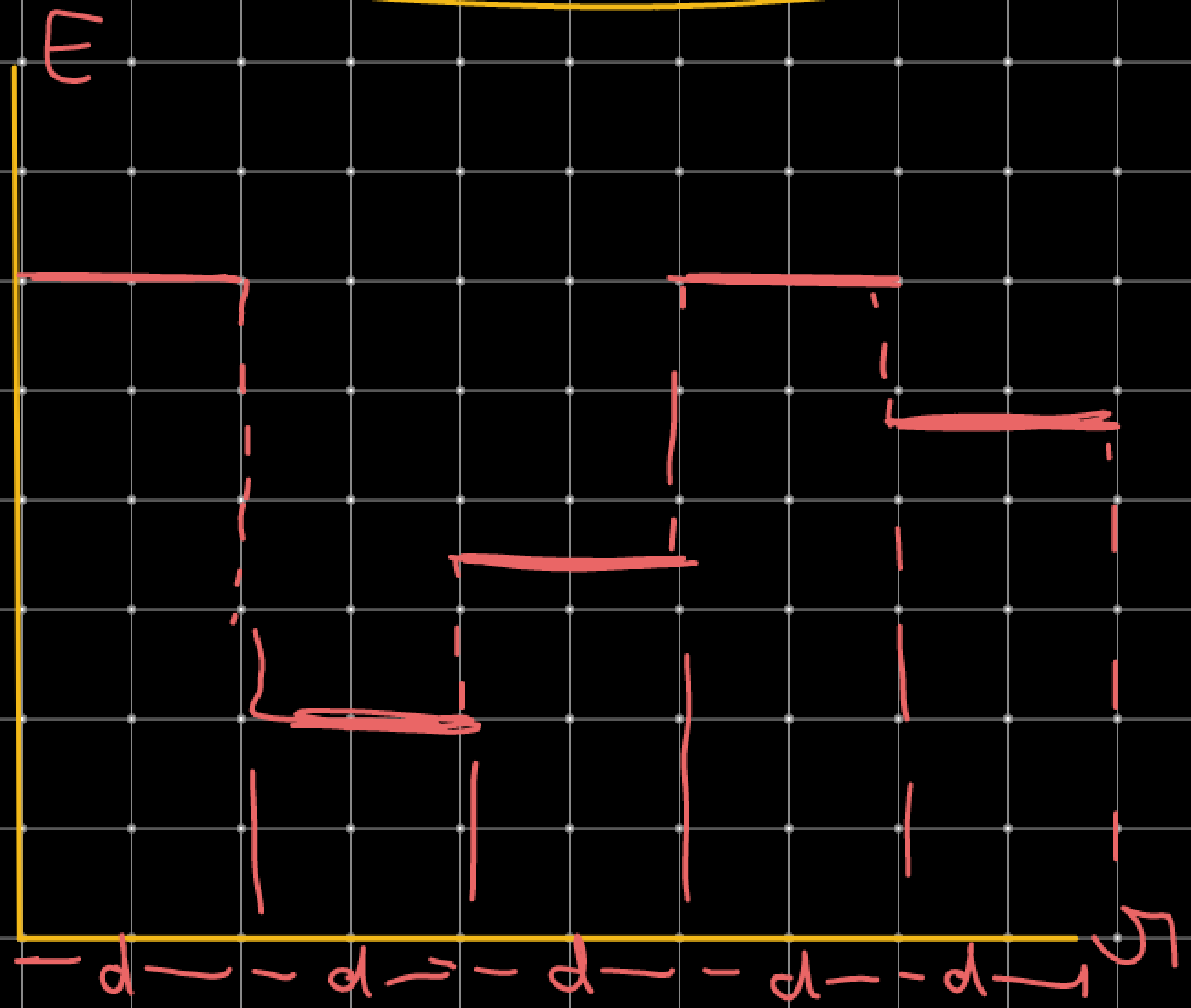
$\boxed{K_1 > K_2 > K_3}$

$$E_0 = \frac{Q}{A\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$$

$E_1 = E_4 > E_5 > E_3 > E_2$



$E_2 < E_3 < E_5 < E_1 = E_4$



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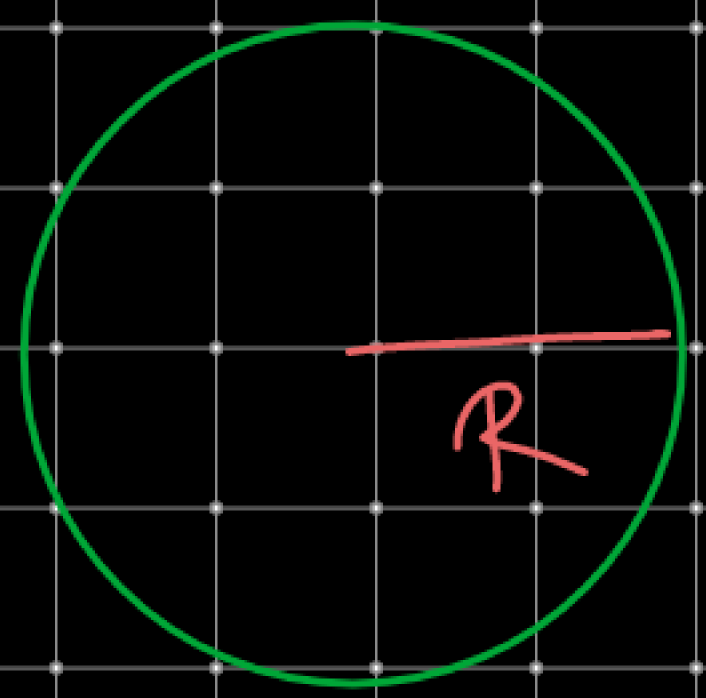
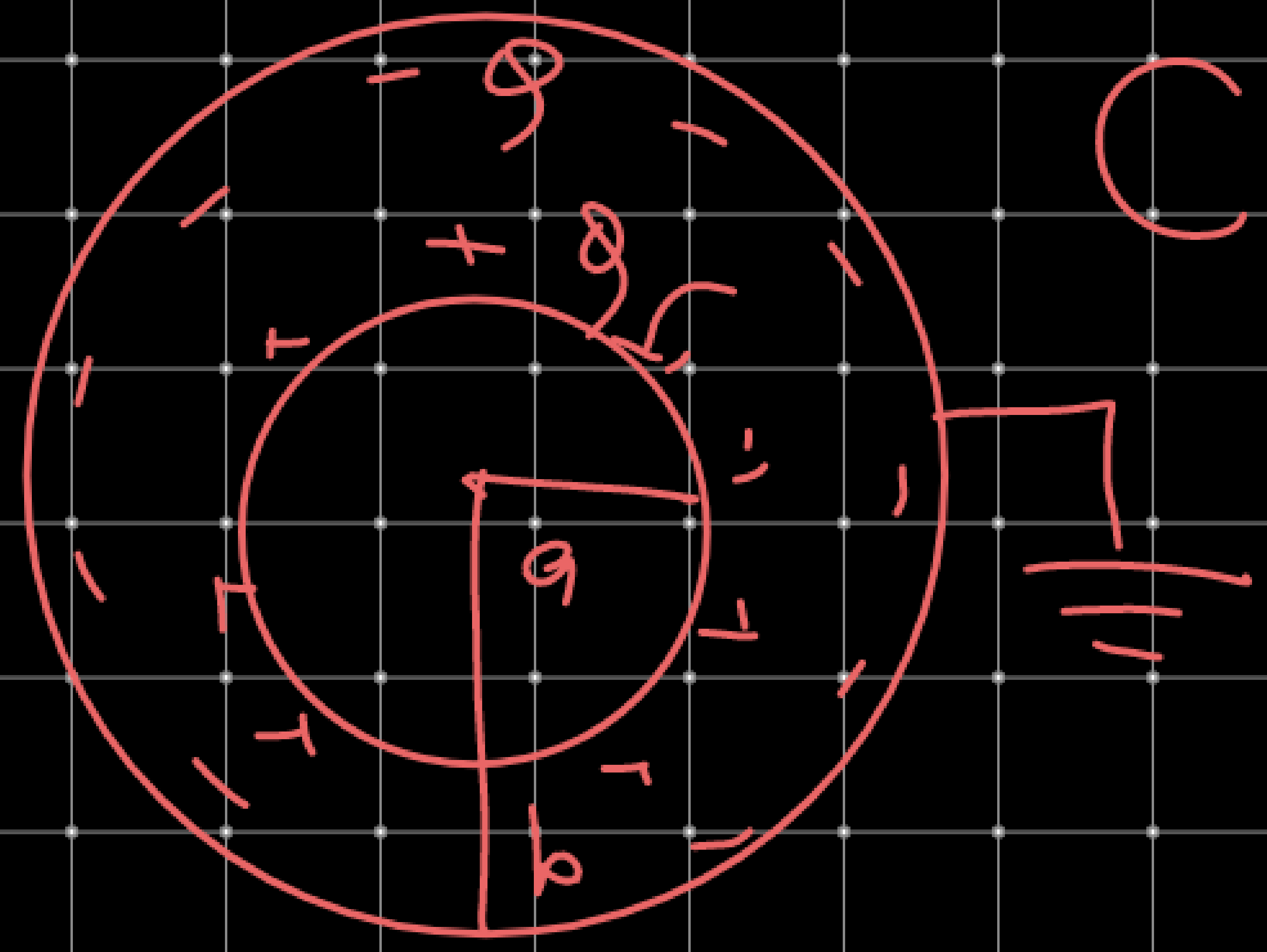
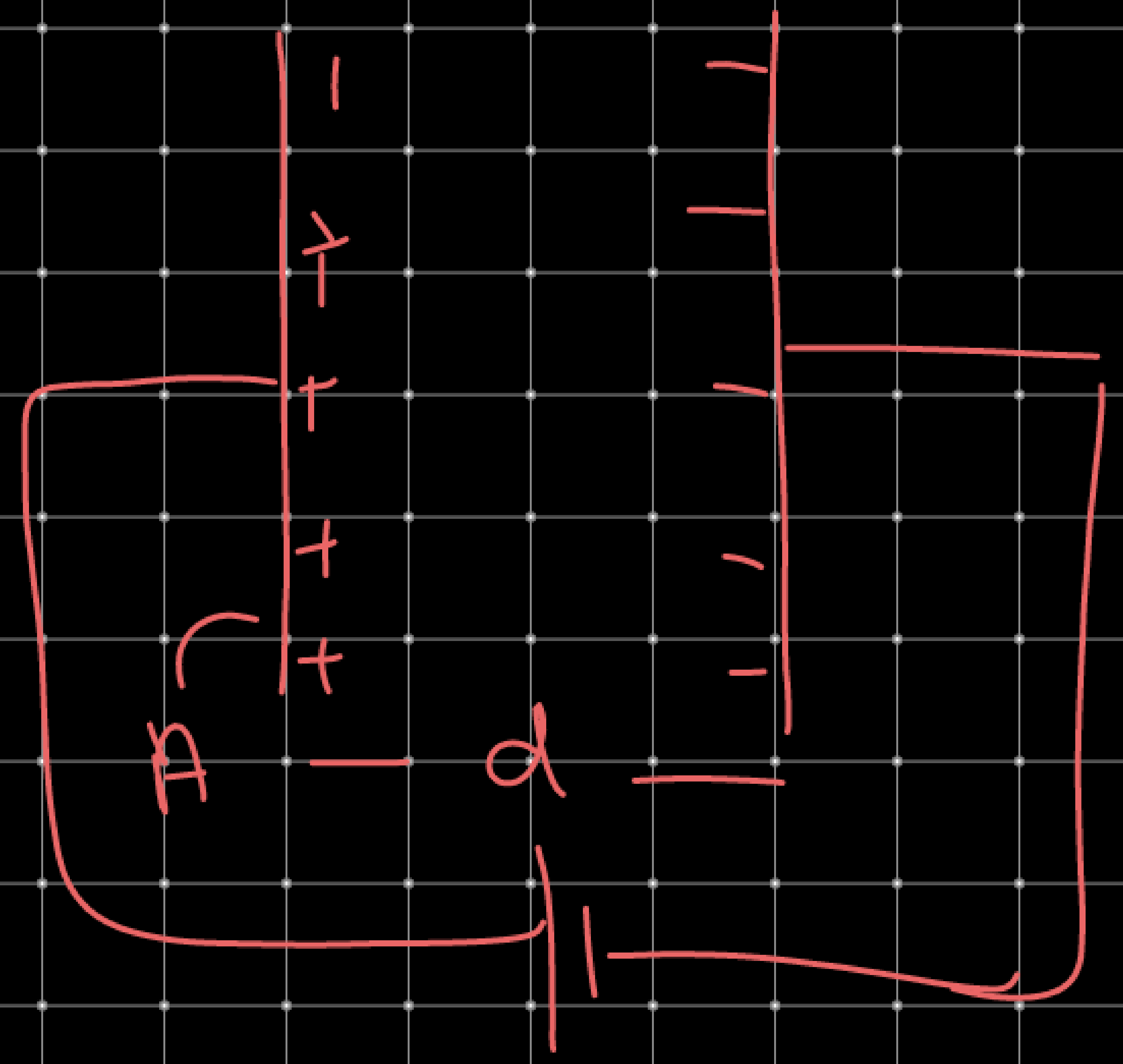


$$\boxed{C = 4\pi\varepsilon_0 R}$$



$$C = 4\pi\varepsilon_0\left(\frac{ab}{b-a}\right)$$



$$C = \frac{A\varepsilon_0}{d}$$

$$C_m = \frac{A\varepsilon_0 K}{d}$$