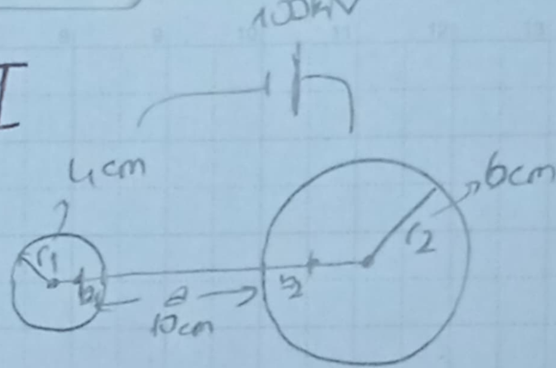
Sera ERSOY
040200434
3ema

HW-I



1) Analytical

$$\frac{b_1}{a+b_2} = \frac{2r_1-b_1}{2r_1+a+b_2} = \frac{8-b_1}{18+b_2}$$

$$\frac{a+b_1}{b_2} = \frac{2r_2+a+b_1}{2r_2-b_2} = \frac{22+b_1}{12-b_2}$$

$$\frac{b_1}{10+b_2} = \frac{8-b_1}{18+b_2} \longrightarrow 2b_1b_2+28b_1-8b_2=80$$

$$\frac{10+b_1}{b_2} = \frac{22+b_1}{12-b_2} \longrightarrow 120 = 32b_2-12b_1+2b_1b_2$$

↓ subtract

$$b_2-b_1=1$$

put on the eqs above ← $\boxed{b_2 = 1+b_1}$

$$\underbrace{\frac{b_1}{10+b_1+1} = \frac{8-b_1}{18+1+b_1}}$$

$$b_1^2+11b-44=0 \longrightarrow \Delta = 121+4\cdot 44 = 297$$

$x_1 = -14,11$

$\boxed{x_2 = 3,117}$

this is $b_1 = 3,117$ cm

$b_2 = 1+3,117 = 4,117$ cm

Seno ERSO1
040200434
3eña

$$U = V_2 - V_1 = \frac{q}{2\pi\varepsilon}\underbrace{\left[\ln\left(\frac{10+3{,}117}{4{,}117}\right) - \ln\left(\frac{3{,}117}{10+4{,}117}\right)\right]}_{2{,}669}$$

$$100\,k = \frac{q}{2\pi\,\varepsilon}\cdot 2{,}669$$

$$\frac{100000\cdot 2\pi(8{,}854\times10^{-12})}{2.669} = q = 2.08\times10^{-6}\,C/m$$

$$E_{max} = \underbrace{\frac{q}{2\pi\varepsilon}\cdot\frac{2p}{p^2-(p-b)^2}}$$

$$p \rightarrow \frac{\overbrace{a+b_1+b_2}^{17{,}234}}{2} = 8{,}617$$

$$\frac{2.08\times10^{-6}}{2\pi(8{,}854\times10^{-12})}\cdot\frac{2(8{,}617)}{(8{,}617)^2-(8{,}617-3{,}117)^2}$$

$$\boxed{= 14{,}674\left[\frac{kV}{cm}\right]}$$

Approximation

$$E'_{max} = \frac{U/2}{r_2\ln\left(\frac{r_2+\frac{a}{2}}{r_1}\right)} = \frac{50}{4\ln\left(\frac{4+5}{4}\right)} = 15.414\left[\frac{kV}{cm}\right]$$

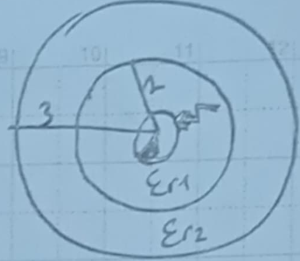
$$E_{max} = k\,E'_{max} \longrightarrow k = 0{,}952$$

Sena ERSOY
040200434
3lna

2) $r_1 = 6\,cm \quad r_2 = 14\,cm \quad r_3 = 20\,cm$

$U = 100\,kV \quad \varepsilon_{r1} = 4$

$\varepsilon_{r2} = 2$



$$C_n = 4\pi\, \varepsilon_{r1} \frac{r_n \cdot r_{n+1}}{r_{n+1} - r_n}$$

$$C_1 = \frac{4\pi \cdot 4 \cdot (8{,}854 \cdot 10^{-12})\, 6 \cdot 14}{14-6} = 4{,}673 \times 10^{-11} F$$

$$C_2 = \frac{4\pi\, 2 \cdot (8{,}854 \times 10^{-12}) \cdot 14 \cdot 20}{20-14} = 1{,}038 \times 10^{-10} F$$

$$C_{eq} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2}} = \frac{(4{,}673 \times 10^{-9})(1{,}038 \times 10^{-8})}{(4{,}673 \times 10^{-9} + 1{,}038 \times 10^{-8})}$$

$$= 3{,}222 \times 10^{-11} F$$

$$U_1 = \frac{C_{eq} \cdot U}{C_1} = \frac{3{,}222 \times 10^{-11} \cdot 100}{4{,}673 \times 10^{-11}} = 68{,}95\ kV$$

$$U_2 = \frac{C_{eq} \cdot U}{C_2} = \frac{3{,}222 \times 10^{-11} \cdot 100}{1{,}038 \times 10^{-10}} = 31{,}04\ kV$$

$$E_{1max} = \frac{U_1 \cdot r_2}{r_1 (r_2 - r_1)} = 20{,}11 \left[kV/cm\right] \quad E_{1min} = \frac{U_1 r_1}{r_2 (r_2 - r_1)} = 3{,}69 \left[\frac{kV}{cm}\right]$$

$$E_{2max} = \frac{U_2 \cdot r_3}{r_2 (r_3 - r_2)} = 7{,}39 \left[\frac{kV}{cm}\right] \quad E_{2min} = \frac{U_2 r_2}{r_3 (r_3 - r_2)} = 3{,}62 \left[\frac{kV}{cm}\right]$$