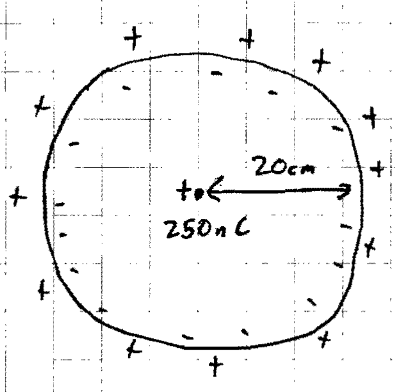
24.47



a) the electric field inside a conductor is 0, so the ~~bound~~ charges in the conductor will rearrange to cancel the ext. field

~~using gaussds law however is simpler in practice~~

~~4π~~ since there is no free charge a the conductor the net charge on its surface will be exactly equal to the net charge inside the sphere $\sigma = \frac{250nC}{4\pi r^2}$

b) using gausses law $4\pi r^2 E = \frac{250nC}{\varepsilon_0}$

$\underset{\sim}{E} = \frac{250nC}{4\pi r^2 \varepsilon_0}\hat{r}$ $r = 20cm$

24.41 $E = 2\pi K\sigma\left(1 - x/\sqrt{x^2+a^2}\right)$

a) for an ∞ disc $E = 2\pi K\sigma(1)$ so we want x for which $1 - x/\sqrt{x^2+a^2}$ is ~~between .1 and 1.1~~ greater than .9

b) for a point charge $E = \frac{K\pi a^2\sigma}{x^2}$ $\Delta E = K\sigma\left(2\pi\left(1 - \frac{x}{\sqrt{x^2+a^2}}\right) - \frac{\pi a^2}{x^2}\right)$

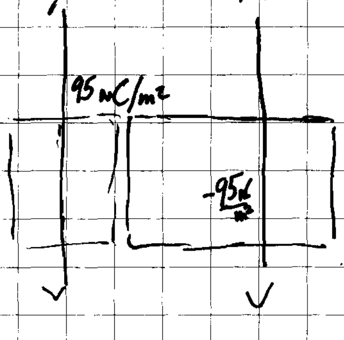
$1 - x/\sqrt{x^2+a^2} \approx 1 - \frac{1}{u\sqrt{1/u^2+a^2}} \approx 0$

$u = 1/x$

$.1 = \frac{\Delta E}{E} = K\sigma\pi\left[\cancel{2}\left(1 - \frac{x}{\sqrt{x^2+a^2}}\right) - \frac{\cancel{\pi}a^2}{x^2}\right]$

solve for x

24.52

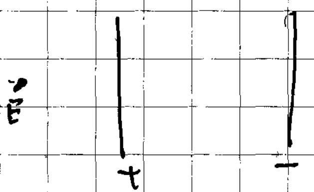


$$E_{in} = \frac{95\,nC/m^2}{2\varepsilon_0}\hat{n} + \frac{-95\,nC/m^2}{2\varepsilon_0}(-\hat{n})$$

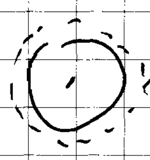
$$= \frac{190\,nC/m^2}{2\varepsilon_0} = \frac{95\,nC/m^2}{\varepsilon_0}\hat{n}$$

you have to add up the contributions from each plate to find the field any where

b) outside $E_{out} = \frac{95\,nC/m^2(-\hat{n})}{2\varepsilon_0} + \frac{-95\,nC/m^2(-\hat{n})}{2\varepsilon_0} \doteq 0$

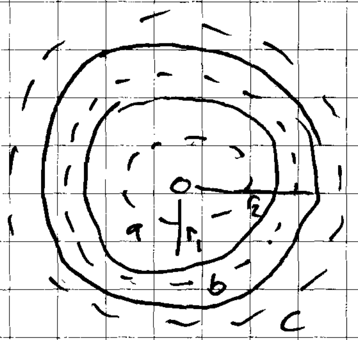


24.54



take a gaussian surface directly above the outer conductor's skin ~~and one directly below it~~

$2\pi r l E = 0$ (no net charge)



lets say there is charge on the outer (say e surface, by gauss's law above we know that the electric field outside is 0 (c)
now lets consider the electric field inside the conductor (a)

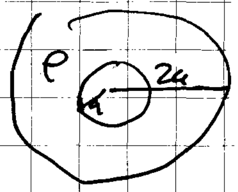
a) $2\pi r \cancel{l} E = \frac{\lambda \cancel{l}}{\varepsilon_0}$

~~and within the conductor~~

we know that for the ~~outer su~~ field to be 0 at c

$2\pi r_1 l\,\sigma_{out} + 2\pi r_1 l\,\sigma_{in} + \lambda l = 0$ (thats q_{enc}) however if

24.63 $4\pi r^2 E = \frac{Q_{enc}}{\varepsilon_0} = \frac{\int_0^r \rho(r) 4\pi r^2 dr}{\varepsilon_0}$



sphere

$\rho(r) = \Theta(r-a)\rho\,\Theta(2a-r)$ ($\Theta(x-a) = 1$ for $x \geq a$ 0, else
$\Theta'(x-a) = \delta(x-a)$)

$4\pi r^2 E(r) = \Theta(r-a)\frac{4\pi}{3\varepsilon_0}(r^3-a^3)\cancel{\Theta(2a-r)}$

$E(r) = \Theta(r-a)$ bleh $E(r) = 0 \quad r \leq a$

$\frac{\rho}{3\varepsilon_0}\frac{r^3-a^3}{r^2} \quad 2a \geq r > a$

$\frac{7\rho}{3\varepsilon_0}\frac{a^3}{r^2} \quad r \geq 2a$

25.8 $\Delta V = -\int \underset{\sim}{E}\cdot d\underset{\sim}{l}$ a) $\Delta V_{AB} = +Ed$ b) $\Delta V_{BC} = -\frac{\sqrt{2}}{2}Ed$

its against E

ΔV_{ab} means potential change from a to b

$\Delta V_{ac} = \Delta V_{ab} + \Delta V_{bc} = Ed\left(1-\frac{\sqrt{2}}{2}\right)$

25.15 that d is small compared to plate sizes is code for treat them as ∞ sheets

$|E_{inside}| = \frac{\sigma}{\varepsilon_0}$ $|\Delta V| = \int_a^b |E|\,dl = |E|d = \frac{\sigma d}{\varepsilon_0}$

25.17 $\Delta E_{nergy} = \Delta V q_1 = \frac{1}{2}m_1 v_1^2$

$q_1 = 3.8\,\mu C$ $v_1 =$
$m = 5.0\,g$

$\Delta V q_2 = \frac{1}{2}m_2(2v_1)^2$

$q_2 = q_1\frac{m_2}{m_1}\frac{4v^2}{v^2}$

25.28 $E(r) = \frac{\lambda}{2\pi r \varepsilon_0}\hat{r}$ between them

$$V(r) = -\int_a^b E(r)\,dr = \left| \frac{\lambda \ln(r)}{2\pi\varepsilon_0} \Big|_{.2}^{1.6} \right|$$

25.35 outside all the spheres $Q_{enc} = 2Q$

so $E = \frac{2Q}{4\pi\varepsilon_0 r^2}$ $V = +\frac{2Q}{4\pi\varepsilon_0 r}$

within ~~inside~~ the shell $E = 0$ so $V =$ constant $= \frac{2Q}{4\pi\varepsilon_0 c}$

inside the shell, but outside the sphere we have all the potential from before (we still came from ∞)

but now we add the part from the field inside

$E_{in} = \frac{-Q}{4\pi\varepsilon_0 r^2}$ $V_{in} = \frac{-Q}{4\pi\varepsilon_0 r}$

$V_{in} = \frac{2Q}{4\pi\varepsilon_0 c} - \frac{Q}{4\pi\varepsilon_0 r}$

$$V(r) = \begin{cases} \frac{2Q}{4\pi\varepsilon_0 r} & r > c \\ \frac{2Q}{4\pi\varepsilon_0 c} & c > r > b \\ \frac{2Q}{4\pi\varepsilon_0 c} - \frac{Q}{4\pi\varepsilon_0 r} & b > r > a \end{cases}$$

25.39 $E(x) = \int_r^b \frac{2\pi a \sigma\, da\, x}{(x^2+a^2)^{3/2}}$

$V(x) = -\int_{\infty}^{x} E(x)\,dx$ (I'll go over this one in problem session)