PHYS 2212 Homework #3
Chap. 22 #5, 29, 52, 61, 70
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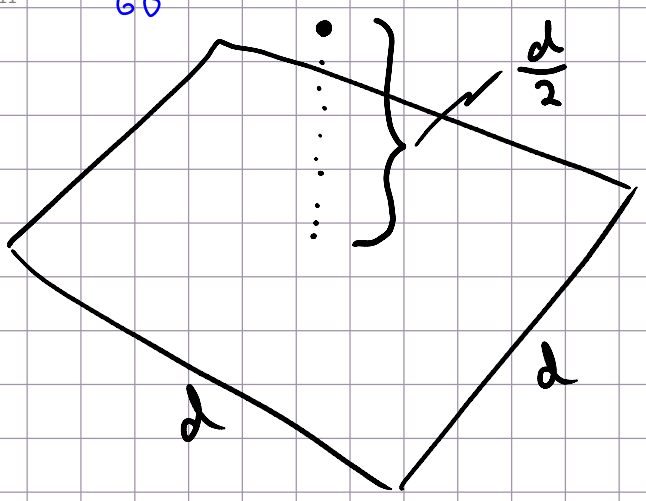

for a Cube

$$\Phi = \frac{q}{\epsilon_0}$$

for 1 side

$$\Phi = \frac{1}{6}\frac{q}{\epsilon_0}$$

$$\Phi = \frac{1}{6}\frac{1.6\times10^{-19}\,C}{8.85\times10^{-12}\,\frac{C^2}{N\cdot m^2}}$$

$$\Phi = 3.01\times10^{-9}\,\frac{N\cdot m^2}{C}$$

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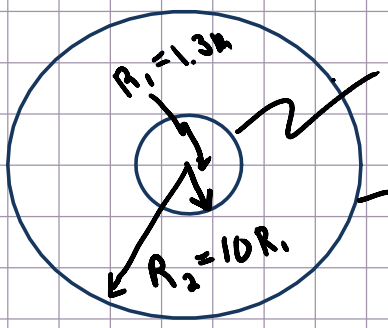
$L = 11m$



$Q_1 = 3.4 \times 10^{-12} C$

$Q_2 = -2Q_1$

a+b) E at $2R_2$

$$\Phi = \frac{q_{enc}}{\epsilon_0}$$

$$\oint E \cdot dA = \frac{q_{enc}}{\epsilon_0}$$

$$E(2\pi r)L = \frac{q_{enc}}{\epsilon_0}$$

$$E = \frac{Q_1 - 2Q_1}{2\pi r L \epsilon_0} = -.214 \frac{N}{C}$$

c) $r = 5R_1$

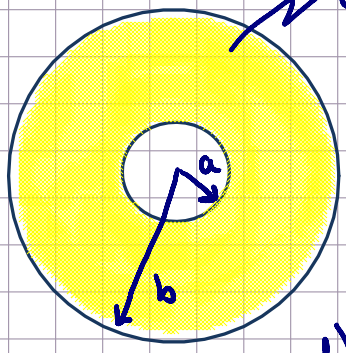
$q_{enc} = Q_1$

so from above

$2\pi r \epsilon_0 L E = q_{enc}$

$$E = \frac{q_{enc}}{2\pi \epsilon_0 L r} = .855 \frac{N}{C} \text{ (out ward)}$$

e) $Q_{in} = -Q_1$ $\quad Q_{out} = -Q_1$



$e = 1.84 \times 10^{-9} \frac{C}{m^2}$

$a = 10\,cm = .1\,m$

$b = 2a = .2\,m$

a) E at $r = 0$

$E = 0$ ($q_{enc} = 0$)

b) E at $r = \frac{a}{2}$

$E = 0$ ($q_{enc} = 0$)

c) E at $r = a$

$E = 0$ ($q_{enc} = 0$)

d) $r = 1.5\,a$

$q_{enc} = Ve = \left(\frac{4}{3}\pi r^3 - \frac{4}{3}\pi a^3\right) e$

so $(4\pi r^2) E = \frac{q_{enc}}{\epsilon_0}$

$E = \frac{1}{4\pi\epsilon_0} \frac{q_{enc}}{r^2} = \frac{e}{4\pi\epsilon_0 r^2} \left(\frac{4\pi r^3}{3} - \frac{4\pi a^3}{3}\right) = \frac{e}{3\epsilon_0} \frac{r^3 - a^3}{r^2}$

for $r = 1.5\,a$ $E = 7.32 \frac{N}{C}$

e) $r = 2a$ $E = 12.1 \frac{N}{C}$

f) for $r \geq b$ $E = \frac{q_{tot}}{4\pi\epsilon_0 r^2} = \frac{e}{3\epsilon_0} \frac{b^3 - a^3}{r^2}$

for $r = 3b$

$E = 1.35 \frac{N}{C}$

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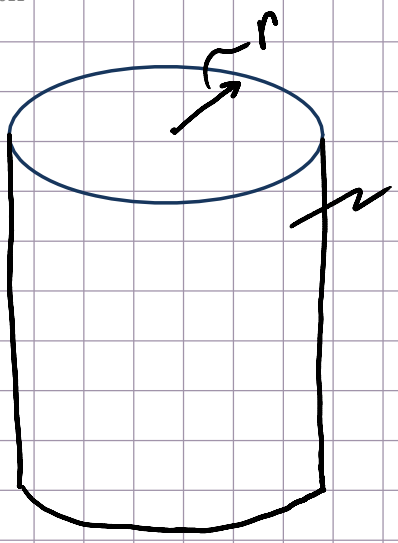

$\rho = 1.1 \times 10^{-3} \frac{C}{m^3}$

a) $E A_s = \frac{q_{inc}}{\epsilon_0}$

$E(2\pi r L) = \frac{\rho \pi r^2 L}{\epsilon_0}$

$E = \frac{\rho r}{2\epsilon_0}$

b) increased with r

c) increased

d) $E_{max} = \frac{\rho R}{2\epsilon_0} = 3.1 \times 10^6 N/C$

e) for spark $E = 3 \times 10^6 N/C$ so sparking could occur near edge.

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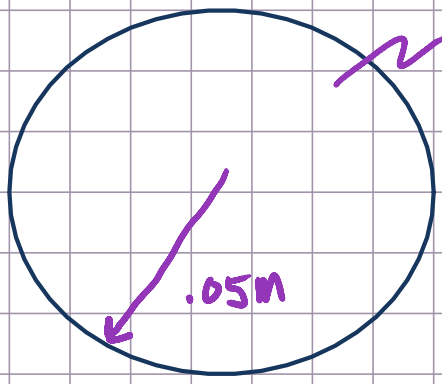

$\rho = 3.2 \times 10^{-6} \frac{C}{m^3}$

a) $r = .035m$ (inside)

$$EA_s = \frac{q_{enc}}{\epsilon_0}$$

$$E(4\pi r^2) = \frac{\rho(\frac{4}{3}\pi r^3)}{\epsilon_0}$$

$$E = \frac{\rho r}{3\epsilon_0} = 4.2 \times 10^3 \frac{N}{C}$$

b) $r = .08m$

$$EA_s = \frac{q_{enc}}{\epsilon_0}$$

$$E(4\pi r^2) = \frac{\frac{4}{3}R^3\pi\rho}{\epsilon_0}$$

$$E = \frac{R^3\rho}{3r^2\epsilon_0} = 2.4 \times 10^3 \frac{N}{C} //$$