

4B 3-10-14

Lab due dates

Fri - 3-14:

Formal lab write up -
Lab 3 Equipotentials.

Fri - 3-7:

- ① Formal Ohm's LAW
write up
- ② Informal lab 3
(Questions, graph only)

Quiz 3 CH 24 Themes

8
62
66) PLANAR

10-cylindrical

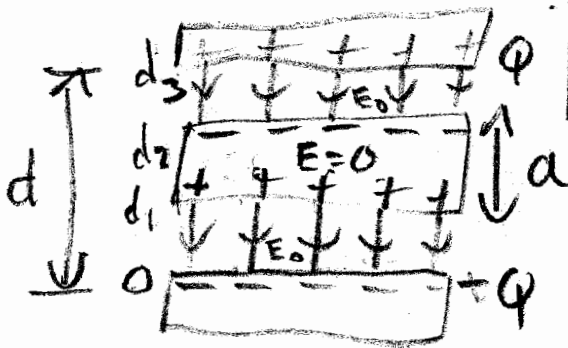
13
67) spherical

27
34
29
61
30
31

ENERGY

Networking - 22, 21, 35, 37, 44

(66.) integrative



$$\begin{aligned}
 |\Delta V| &= \left| \int_0^{d_1} \vec{E} \cdot d\vec{l} - \int_{d_1}^{d_1+d_2} \vec{E} \cdot d\vec{l} - \int_{d_1+d_2}^{d_1+d_2+d_3} \vec{E} \cdot d\vec{l} \right| \\
 &= E_0 \cdot d_1 + 0 + E_0 (d_3 - d_2) \\
 &= E_0 (d_1 + d_3 - d_2) = E_0 (d - a)
 \end{aligned}$$

(66) - CH 24

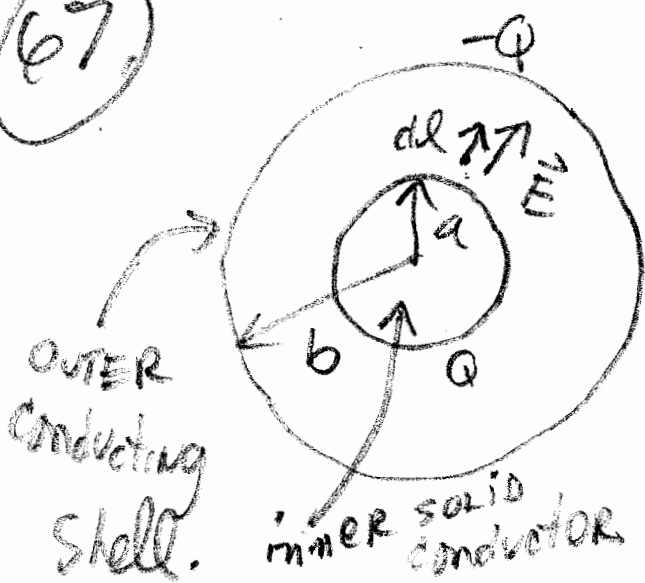
$$C = \frac{Q}{E_0(a-a)} = ?$$

HINT: depends only on A, ϵ_0, d, q .

$$C > \frac{A\epsilon_0}{d}$$

$C \rightarrow \infty$ as $a \rightarrow d$

(67)



$$C = \frac{Q}{\left| -\int_a^b \vec{E} \cdot d\vec{l} \right|}$$

$$C = \frac{Q}{\left| -\int_a^b \frac{kQ}{r^2} dr \right|}$$

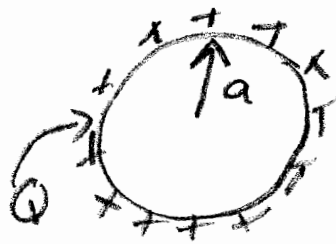
$$C = \frac{1}{k \left[\frac{1}{a} - \frac{1}{b} \right]} = \frac{ab}{k[b-a]}$$

(67) - CH24

$$C = \frac{4\pi\epsilon_0 ab}{[b-a]}$$

let $b \rightarrow \infty$

$$C = ?$$

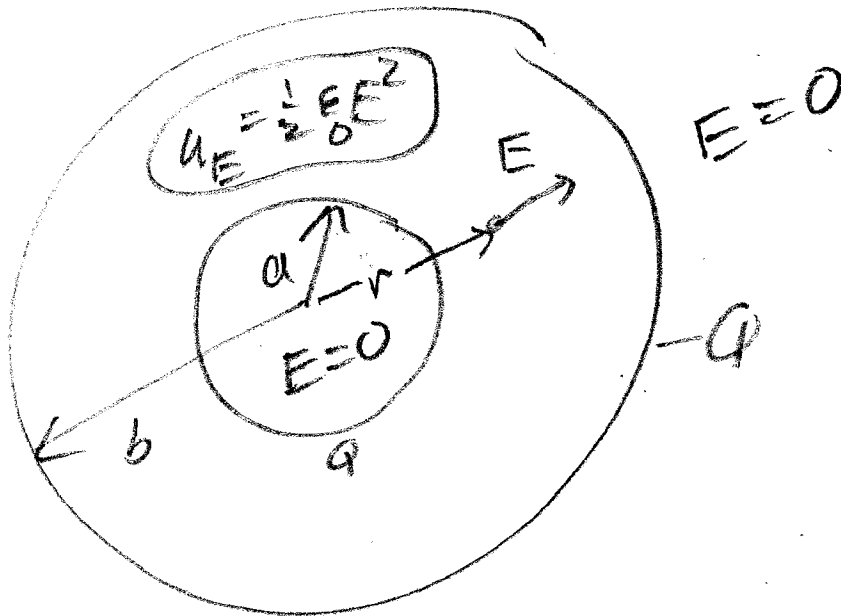


34.

-CH24

$$a \leq r \leq b$$

$$E = \frac{kQ}{r^2}$$



Test 2
type of
problem

$$a < r < b$$

$$u_E = \frac{1}{2} \epsilon_0 \frac{k^2 Q^2}{r^4} = \frac{1}{2} \epsilon_0 E^2$$

$$U_E = \int_a^b \frac{1}{2} \epsilon_0 \frac{k^2 Q^2}{r^4} \cdot (4\pi r^2 dr), \quad dV = 4\pi r^2 dr$$

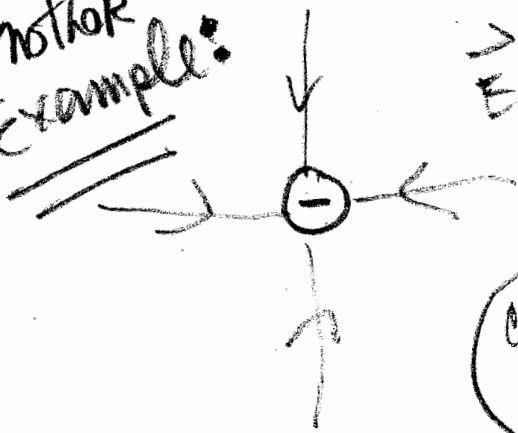
34. Follow up:

SHOW

$$\int_a^b u_E = 4\pi r^2 dr = \frac{Q^2}{2\epsilon_0}$$

where ϵ_0 is given in # 67

Another Example:



calculate energy in the field of an electron.

$$\frac{1}{2} \epsilon_0 E^2$$

$$u_E = \frac{\epsilon_0 k^2 Q^2}{2r^4}$$

$$\Rightarrow U_E = \int_a^{\infty} \frac{\epsilon_0 k^2 Q^2}{2r^4} 4\pi r^2 dr$$

a = electron radius.

$$k = \frac{1}{4\pi\epsilon_0}$$

$$U_E = \frac{4\pi\epsilon_0 k^2 Q^2}{2a} = \frac{Q^2}{8\pi\epsilon_0 a}$$

note: $\sigma_E \rightarrow \infty$
as $a \rightarrow 0$

reason: impossible to
to "squeeze" a finite
charge into a
single point.