Lecture # 7

Electric Potentials

Exam Schedule

Friday 6 - 8 pm

9/19, 10/17, 11/14, 12/5

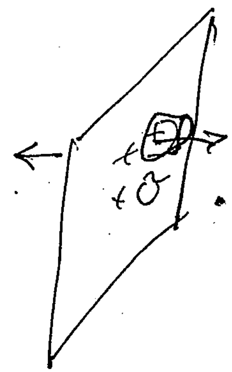
Room BUR 106

A sheet has a uniform charge density σ. What is the magnitude of the electric field on the

(a) right side of the sheet,

(b) left side of the sheet

	(a)	(b)
1.	$\frac{\sigma}{\epsilon_0}$,	$\frac{\sigma}{2\epsilon_0}$
2.	$\frac{\sigma}{2\epsilon_0}$,	$\frac{\sigma}{\epsilon_0}$
3.	σ/ϵ_0 ,	σ/ϵ_0
4.	$\sigma/2\epsilon_0$,	$\sigma/2\epsilon_0$



$E = \frac{\sigma_0}{2\epsilon_0}$

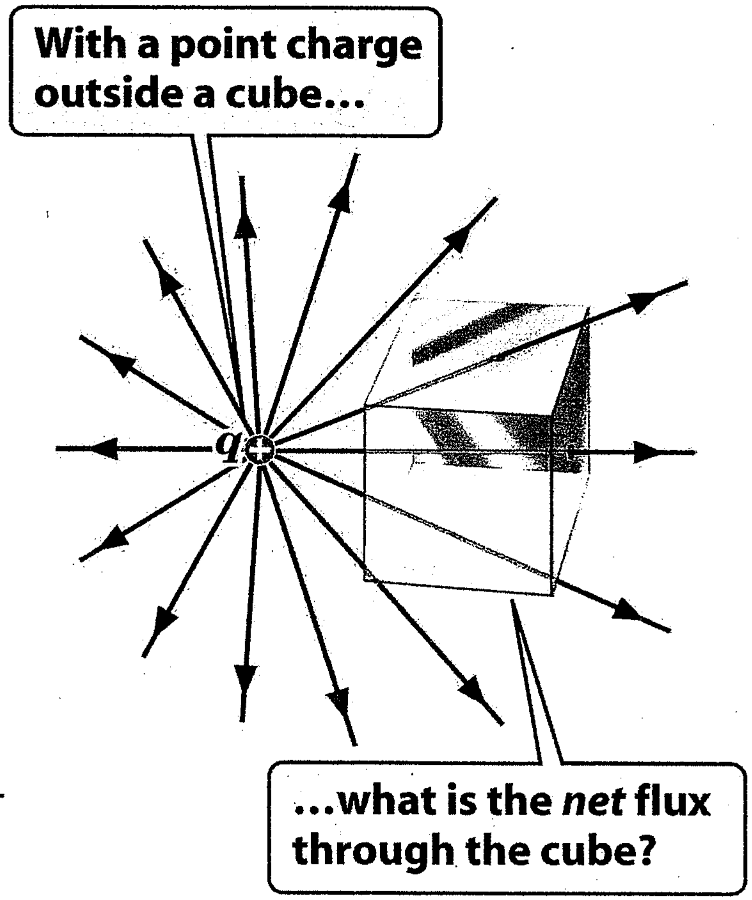
Checkup 24.1

Consider the point charge and surface of the figure above. The net flux through this surface is

a. Positive

b. Negative

c. Zero



3

We place a conductor sheet inside a uniform electric field. How can the electric field vanish inside conductor?

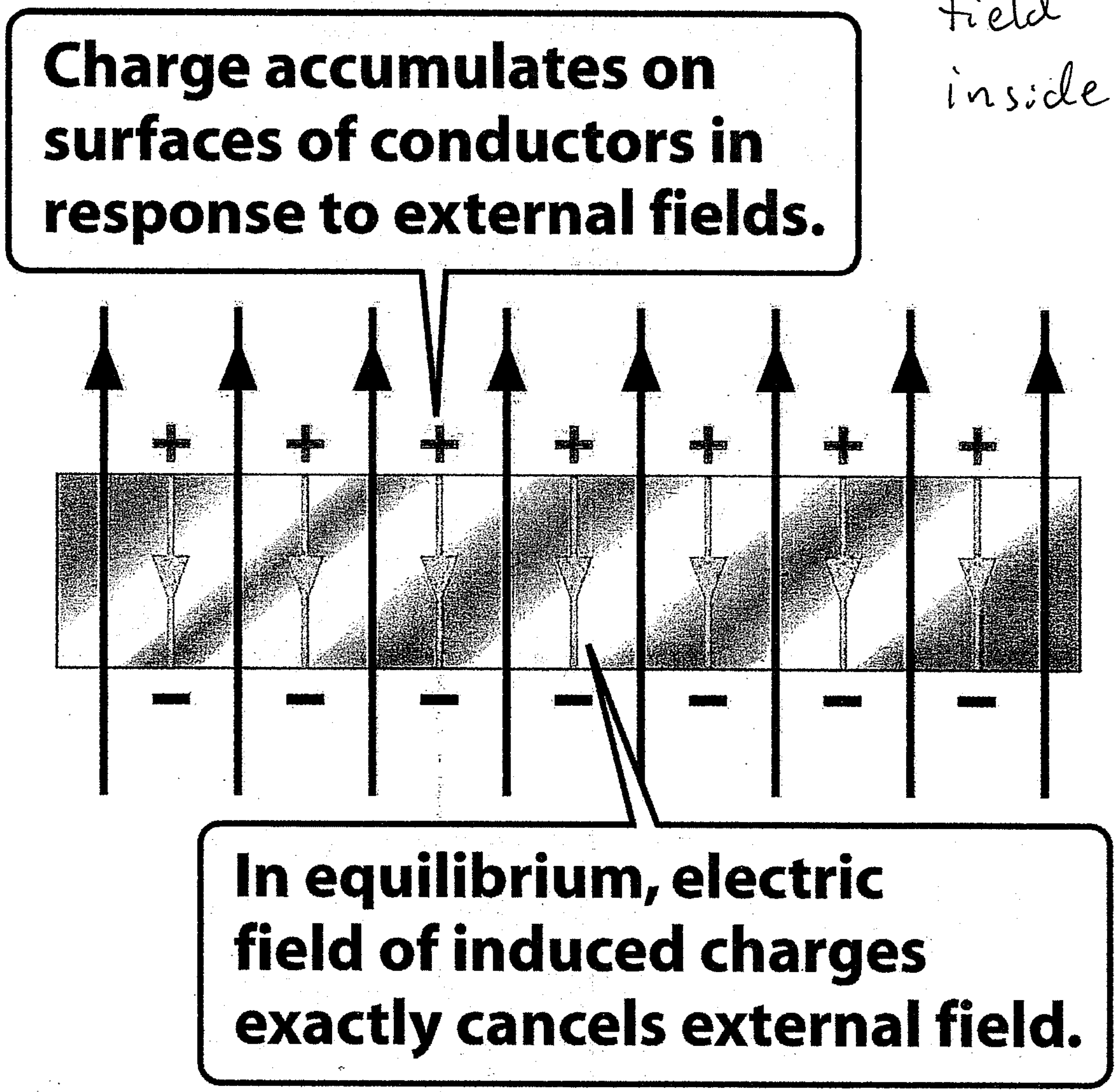


Figure 24-20 Physics for Engineers and Scientists 3/e

Charge is on this conductor.

Is there electric field on the conductor?

yes, no, maybe

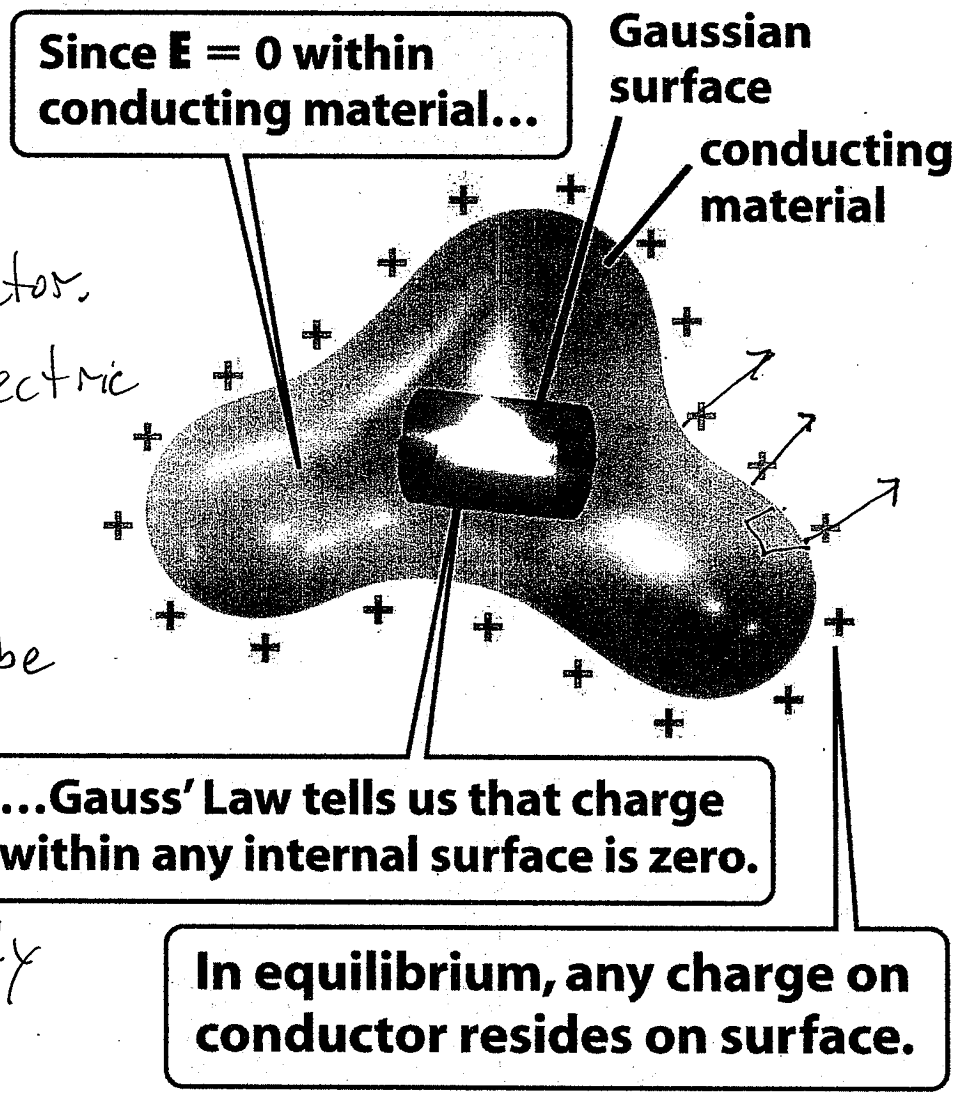


Figure 24-21 Physics for Engineers and Scientists 3/e

Is the charge uniformly distributed on surface of conductor for the material shape shown? no!

$$E_\perp = \frac{\sigma_0}{\epsilon_0}$$

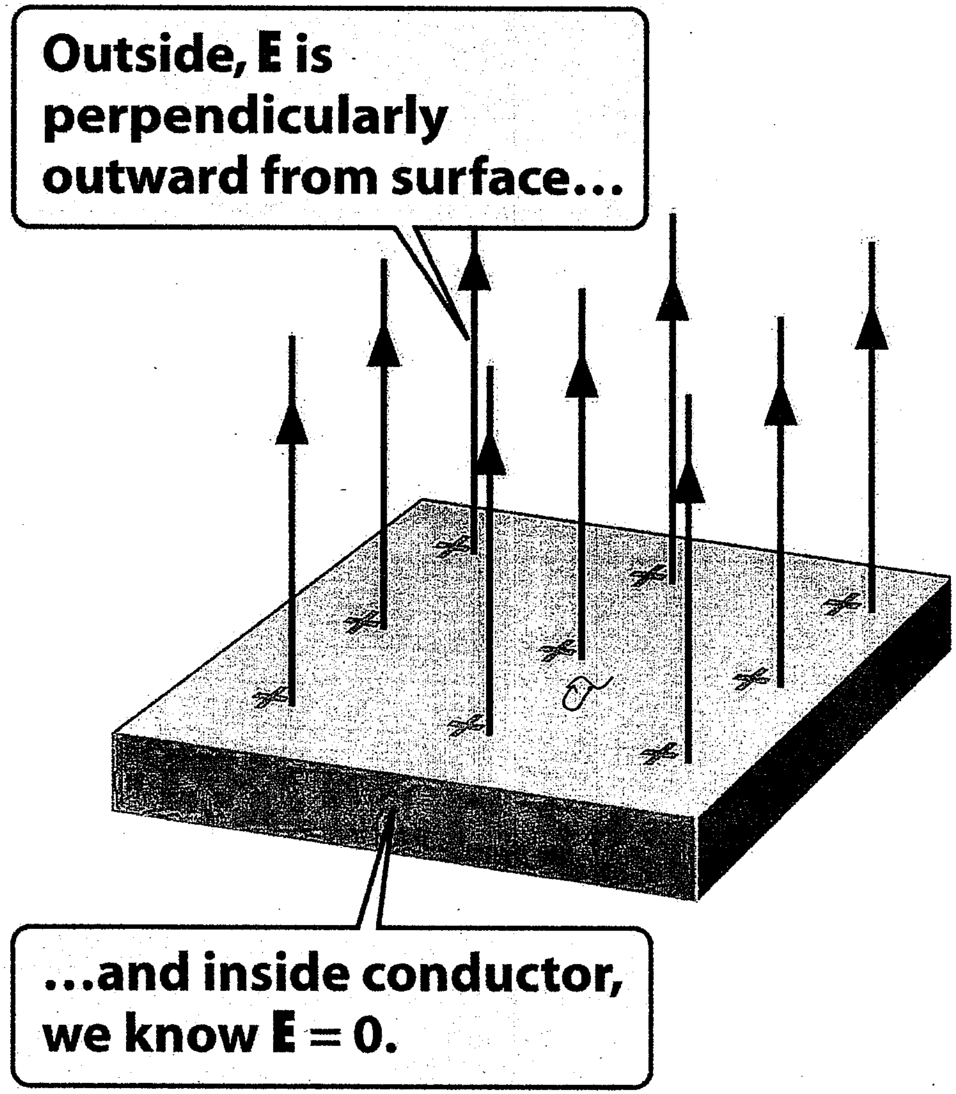


Figure 24-23a Physics for Engineers and Scientists 3/e

$Q_2' = Q_2 + Q_1$

$\sigma_2' = \frac{Q_2 + Q_1}{4\pi R_2^2}$

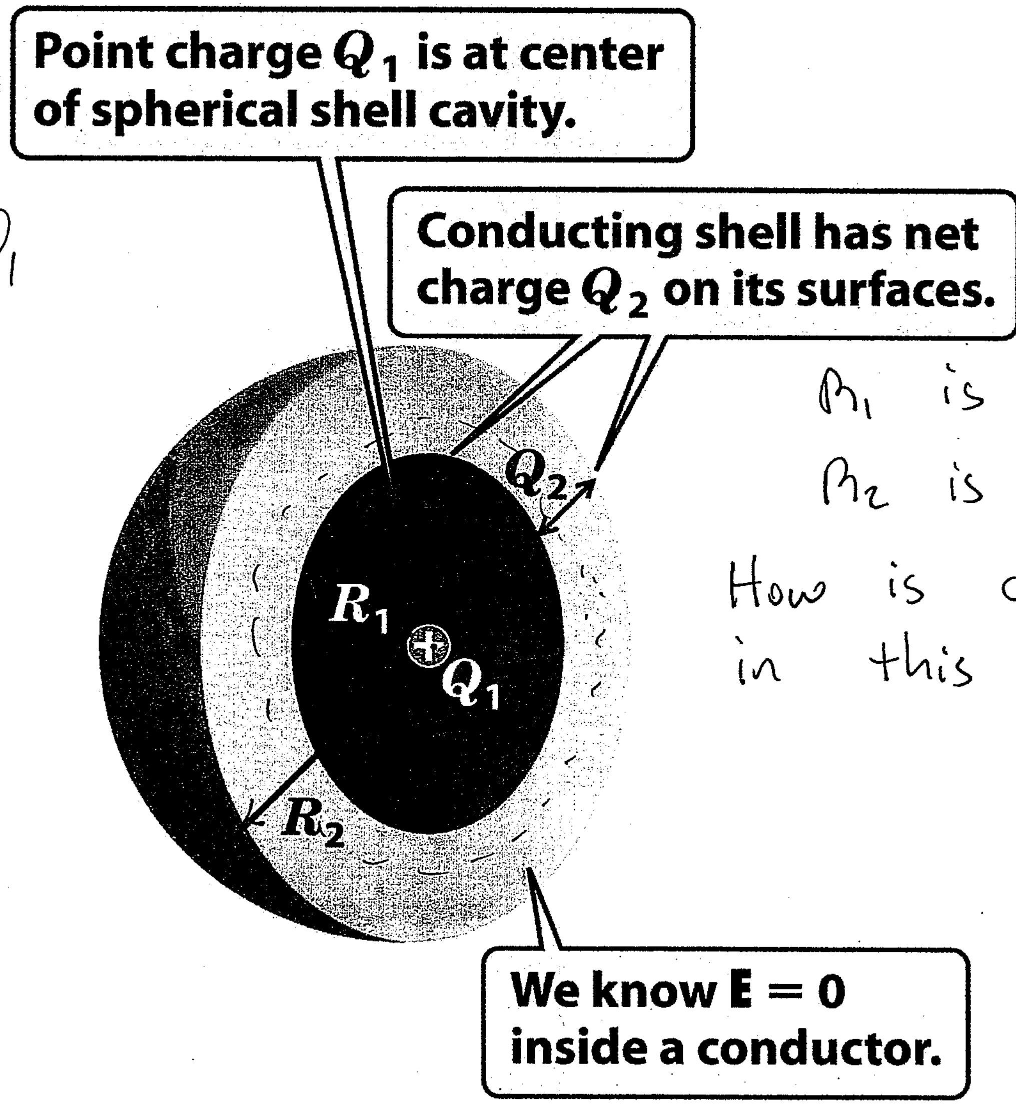


Figure 24-24 Physics for Engineers and Scientists 3/e

R_1 is inner radius } of
R_2 is outer radius } shell

How is charge distributed in this conductor?

Charge on inside surface? $-Q_1$, $\sigma_1 = \frac{-Q}{4\pi R_1^2}$

How are electric field and local surface charge density related at the surface of a conductor?

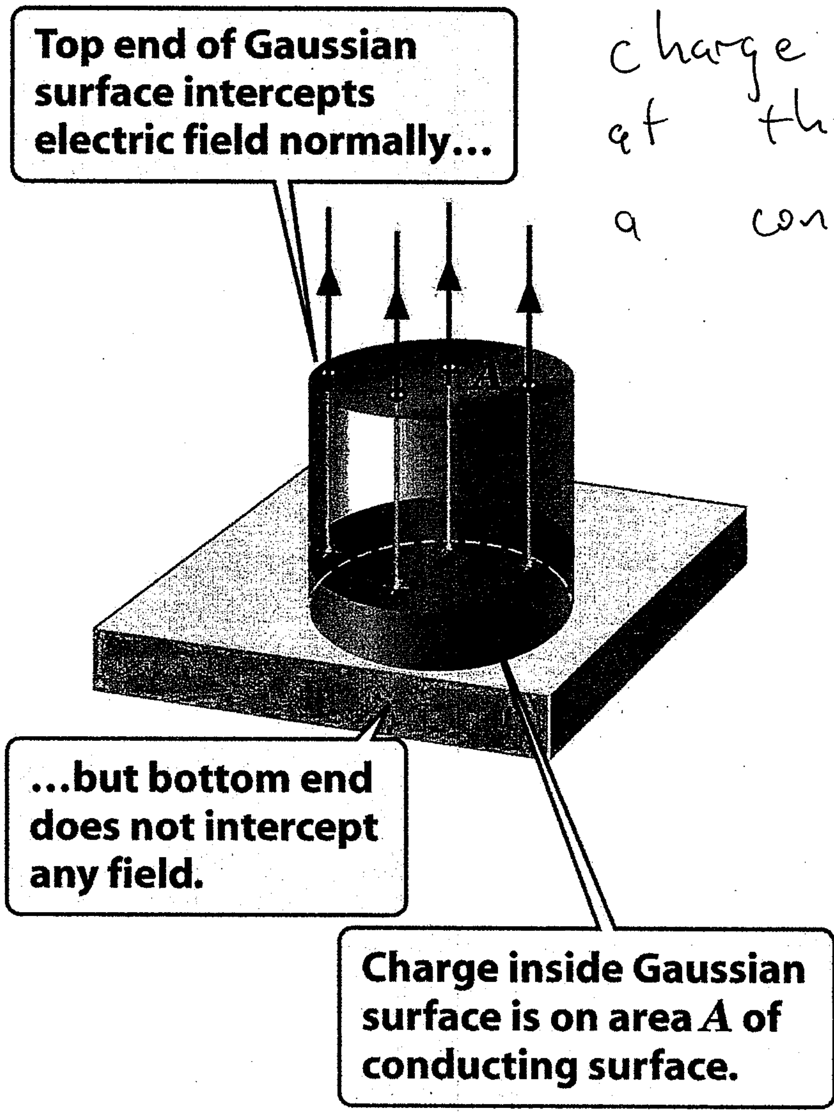


Figure 24-23b Physics for Engineers and Scientists 3/e

GAUSS' LAW

$$\Phi_E = \oint E_\perp \, dA = \frac{Q_{\text{inside}}}{\epsilon_0}$$

$$\oint E_\perp \, dA = \begin{cases} E \times 4\pi r^2 & \text{(spherical)} \\ E \times 2\pi r L & \text{(cylindrical)} \\ 2EA & \text{(planar, both ends in field)} \\ EA & \text{(planar, one end in field)} \end{cases}$$

(for a finite thickness conductor, where one end of pillbox is in conductor

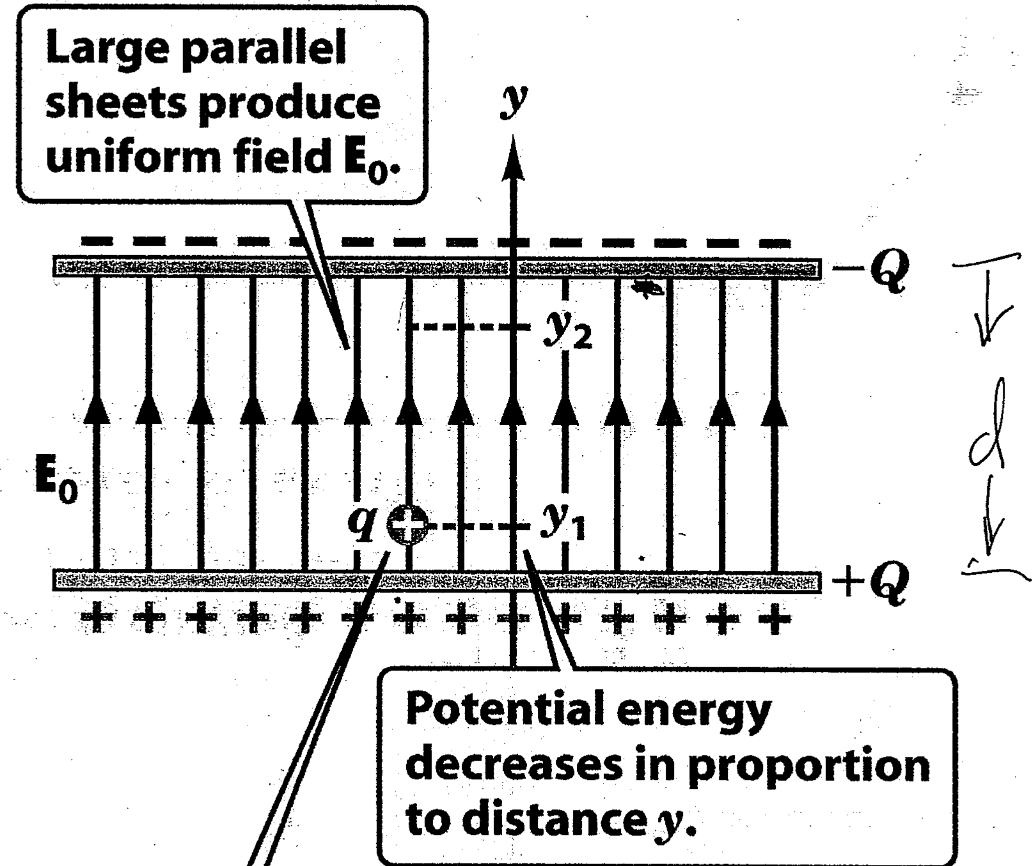
UNIFORM CHARGE DISTRIBUTIONS

$$q = \lambda L$$

$$q = \sigma A$$

$$q = \rho V$$

Equation 24-11 Physics for Engineers and Scientists 3/e



To slowly push positive charge q from negative to positive plate requires external work $W = qE_0d$

$PE = qE_0d = qV$

$\text{Potential} = \frac{PE}{q} = E_0 d = V$

$= \text{Voltage}$ "

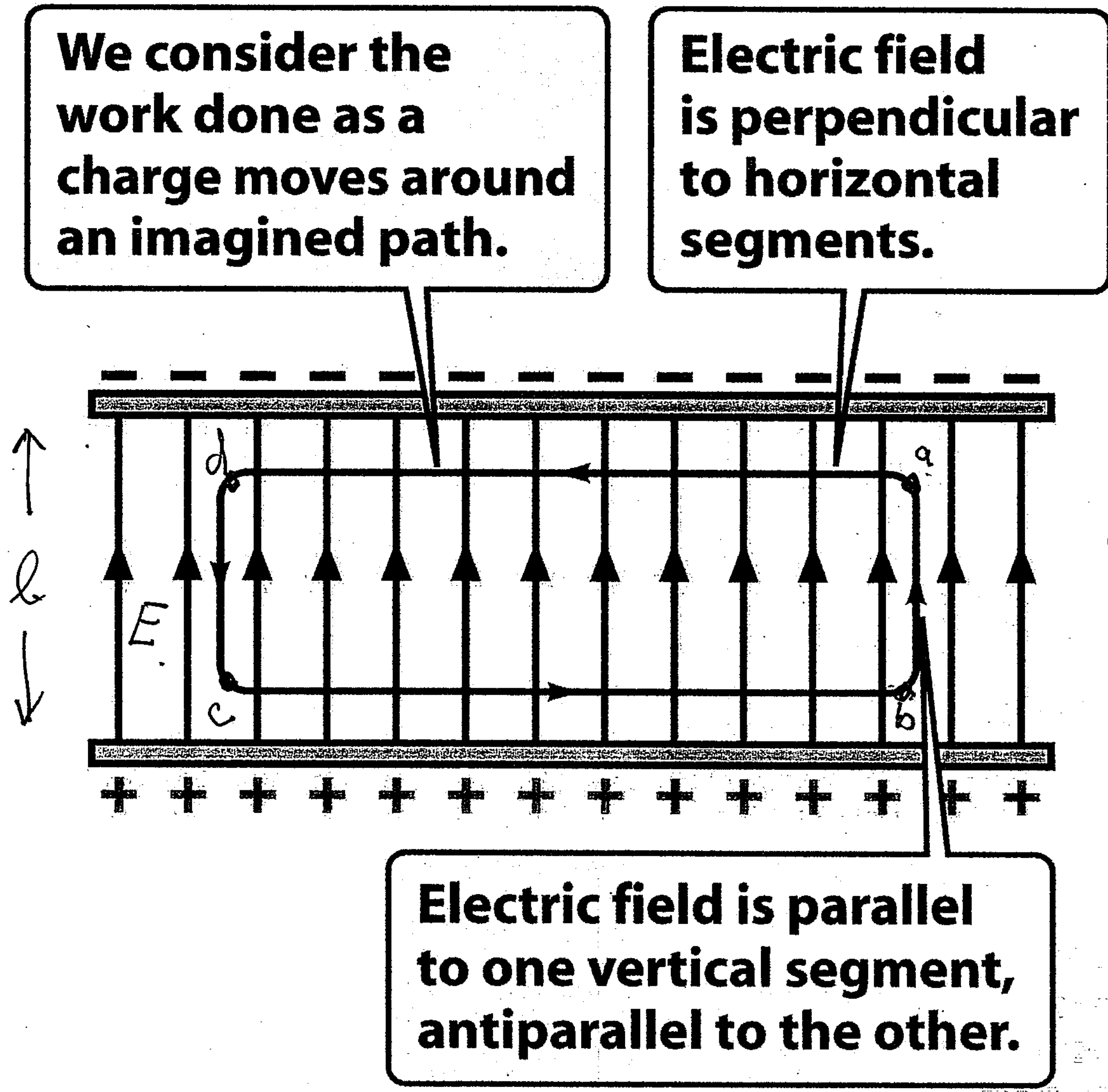


Figure 25-3a Physics for Engineers and Scientists 3/e

How much work does it take to move a positive charge, q from a to b? (qEl)

Is this work dependent on path?

How much work does it take to move along a-b-c-d-e? Does the answer change if we move a charge $-q$?

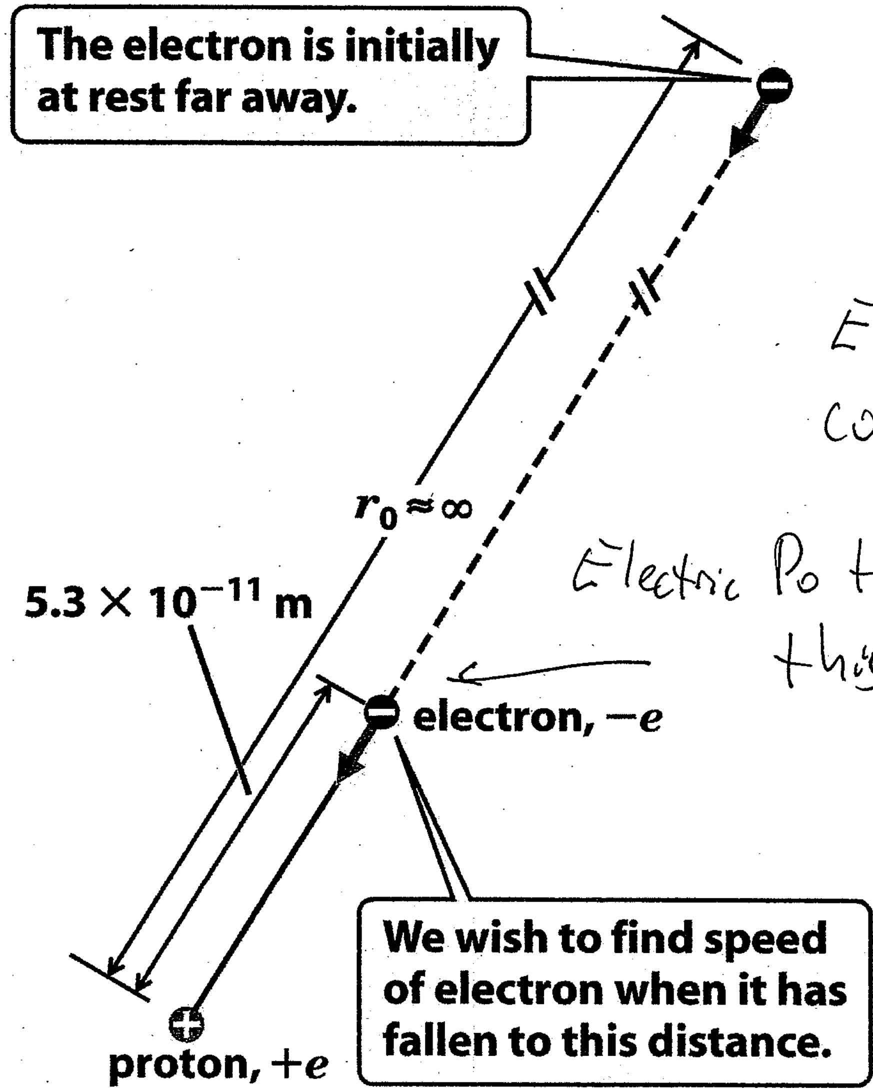


Figure 25-11 Physics for Engineers and Scientists 3/e

Energy is conserved

Electric Potential due to this electron

$$V = -\frac{|e|}{4\pi\epsilon_0}\frac{1}{r}$$