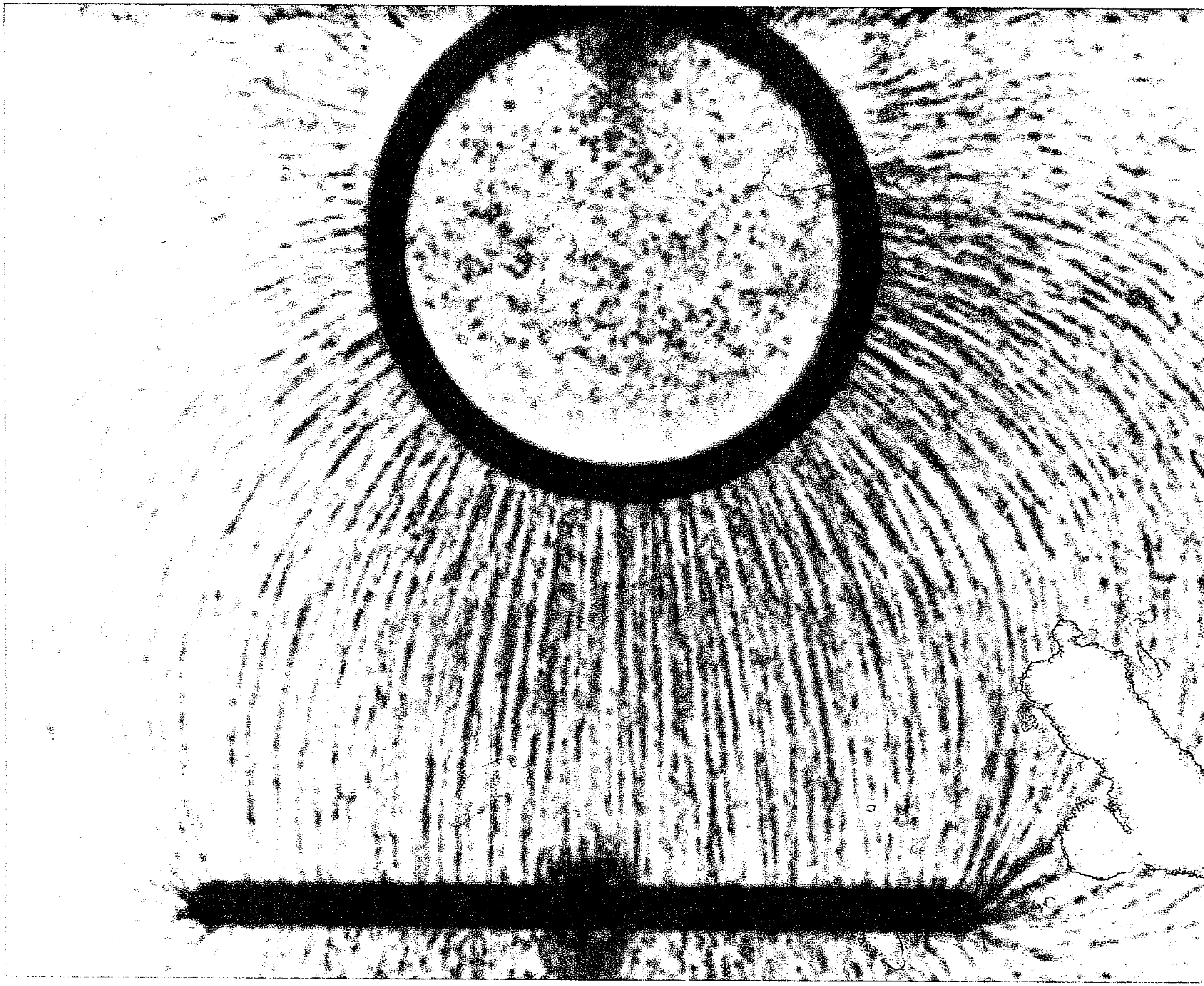
Phys 303 L

Lecture # 4



Chapter 24 Opener Physics for Engineers and Scientists 3/e
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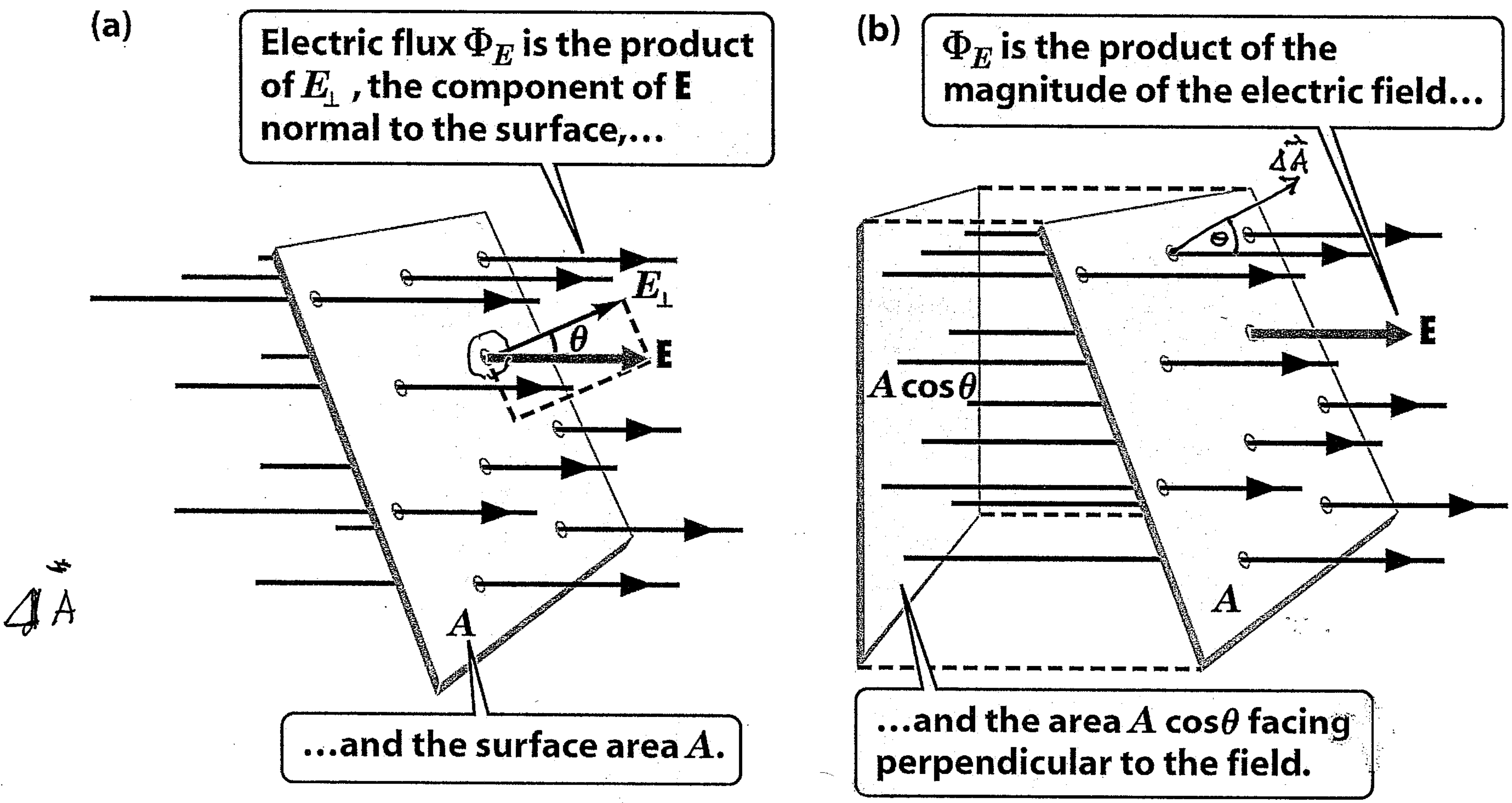
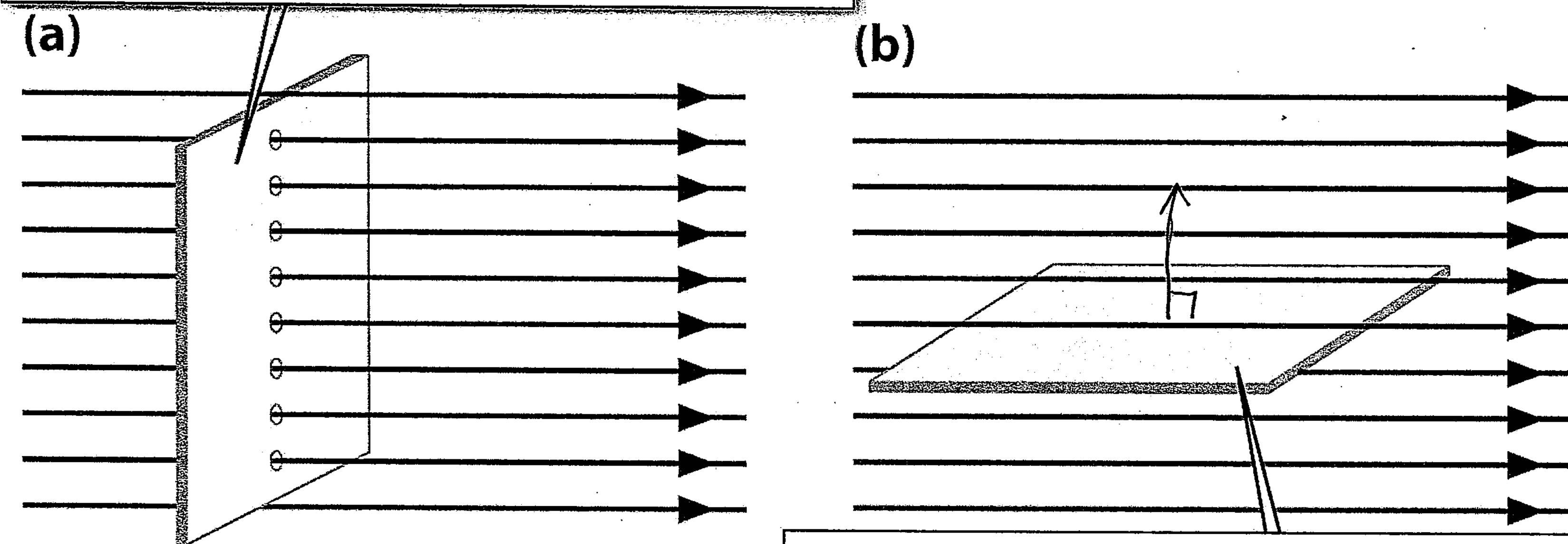


Figure 24-1 Physics for Engineers and Scientists 3/e

Area is a vector directed normal to the surface

$$\Delta\Phi_E = \vec{E}\cdot\Delta\vec{A} = E\,\Delta A\cos\theta$$

The plate area is A and the electric field is E. What is the electric flux through areas in fig. (a) and fig. (b)?



1. EA and 0 in (a) and (b) respectively.
2. 0 and EA in (a) and (b) respectively.
3. EA and EA in (a) and (b) respectively.
4. 0 and 0 in (a) and (b) respectively,

Figure 24-2 Physics for Engineers and Scientists 3/e

What is the electric flux through (a) and (b) in and electric field E?

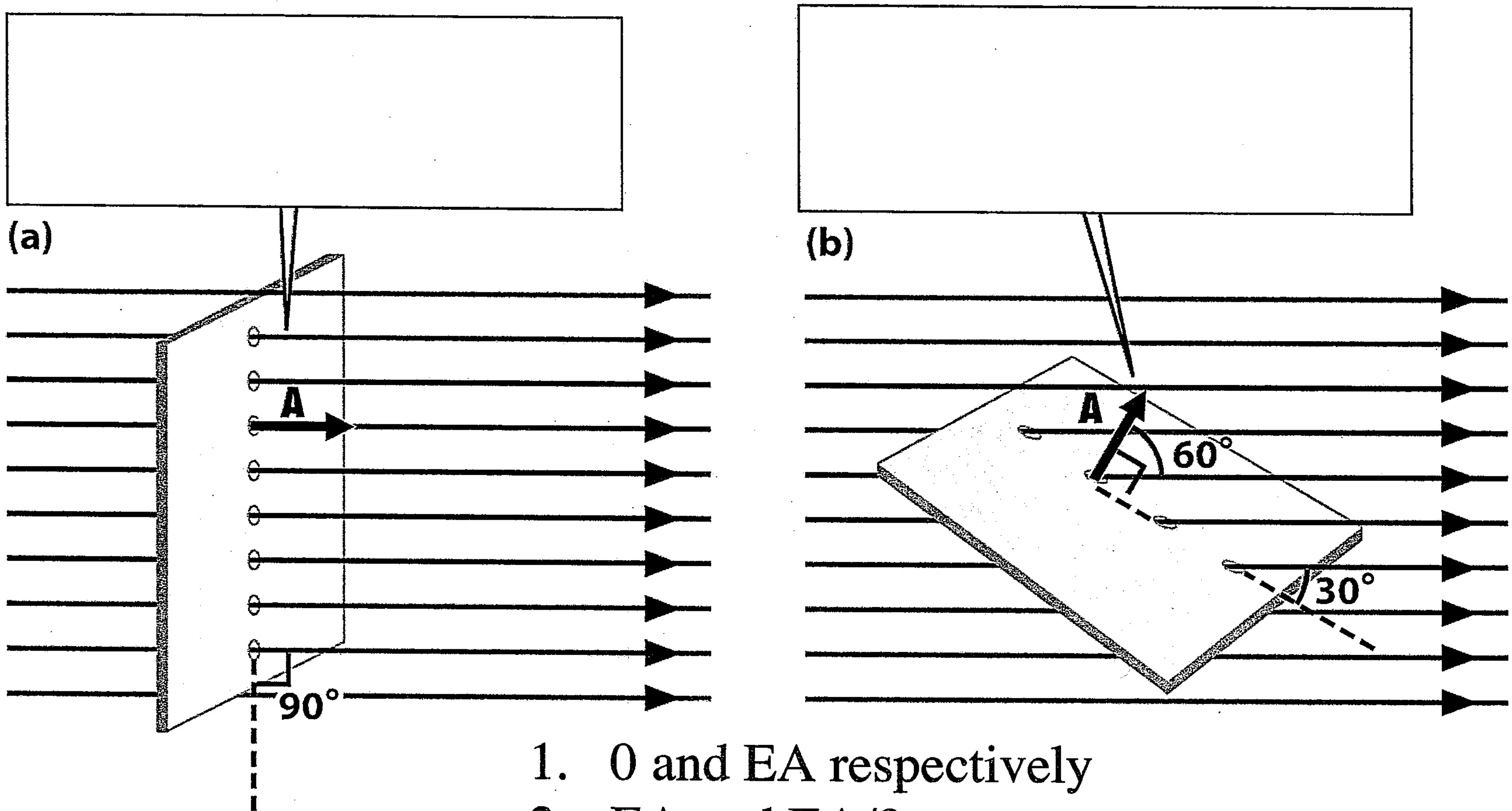


Figure 24-5 Physics for Engineers and Scientists 3/e

1. 0 and EA respectively
2. EA and EA/2
3. EA and $\sqrt{3}$EA/2
4. 0 and EA/2
5. 0 and $\sqrt{3}$EA/2

Electric Flux through a closed surface

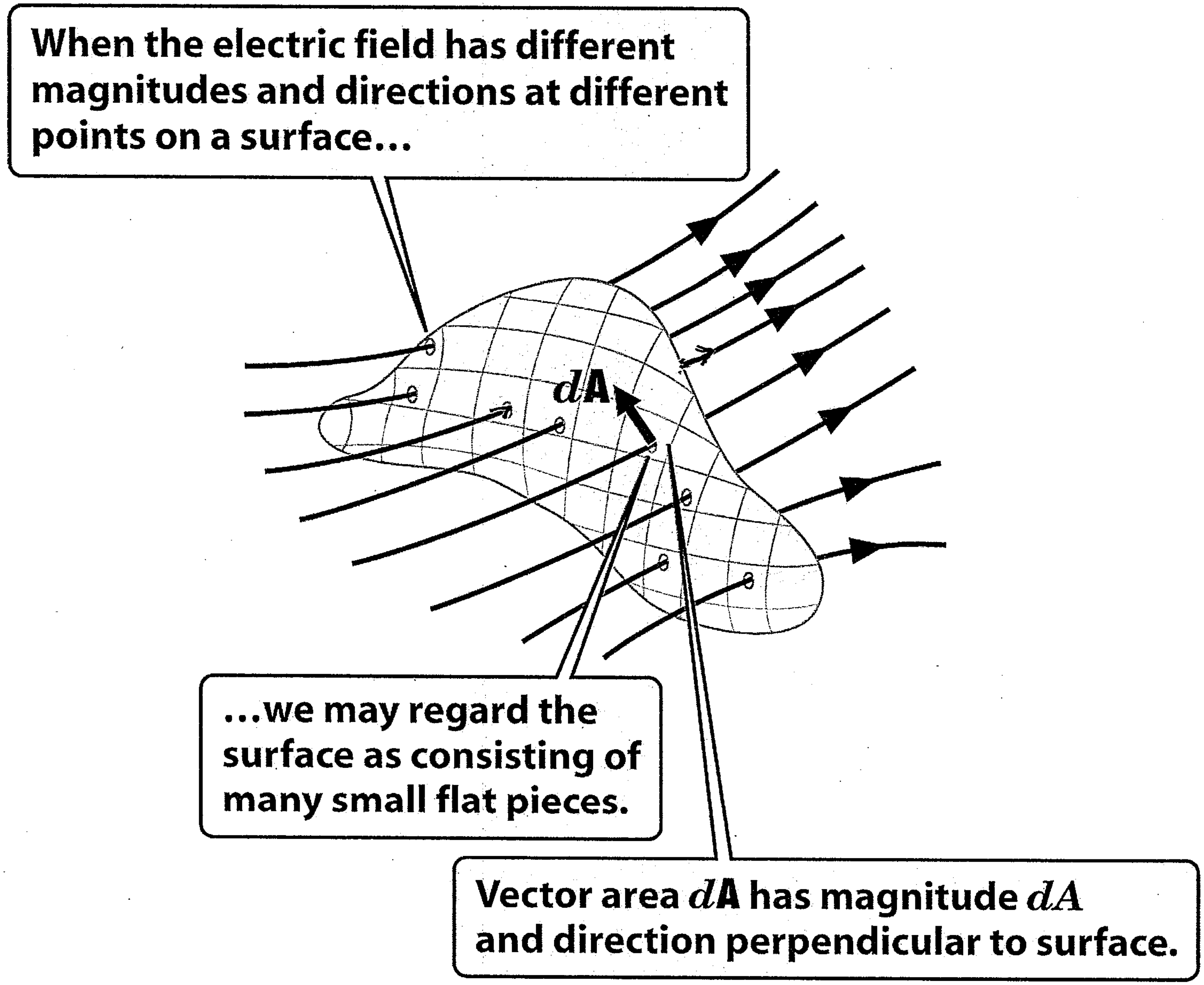


Figure 24-3 Physics for Engineers and Scientists 3/e

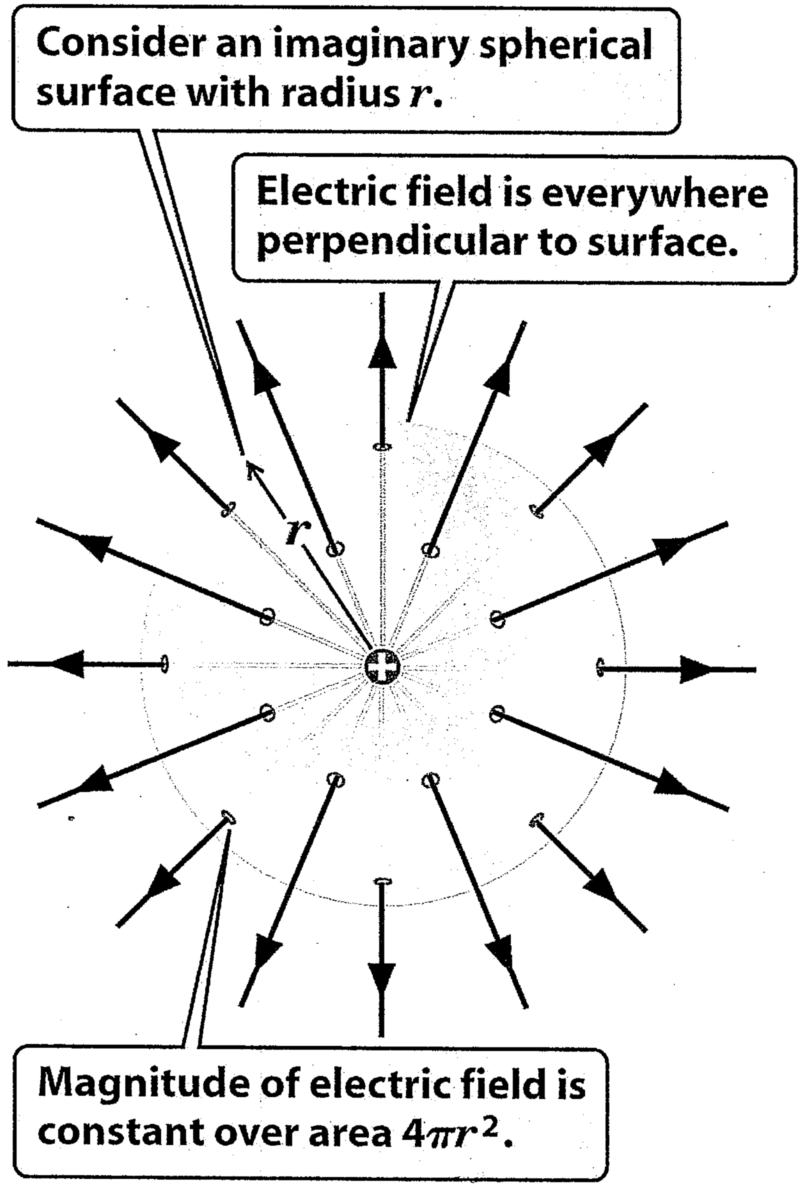
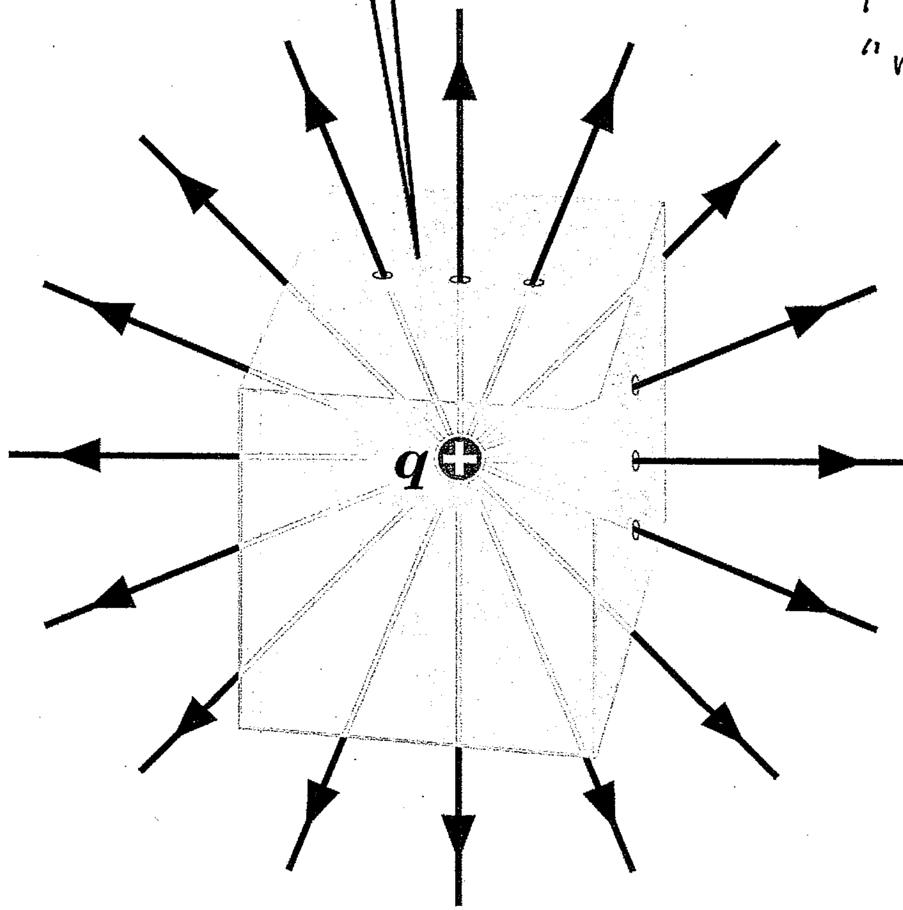


Figure 24-6 Physics for Engineers and Scientists 3/e

q

65

The sphere of Example 2 has been replaced by a cube. Does the flux change?



The same "number a lines" go through the rectangular prism as through the concentric sphere.

Figure 24-8 Physics for Engineers and Scientists 3/e

a. 0
b. q/ε_0
c. Indeterminate

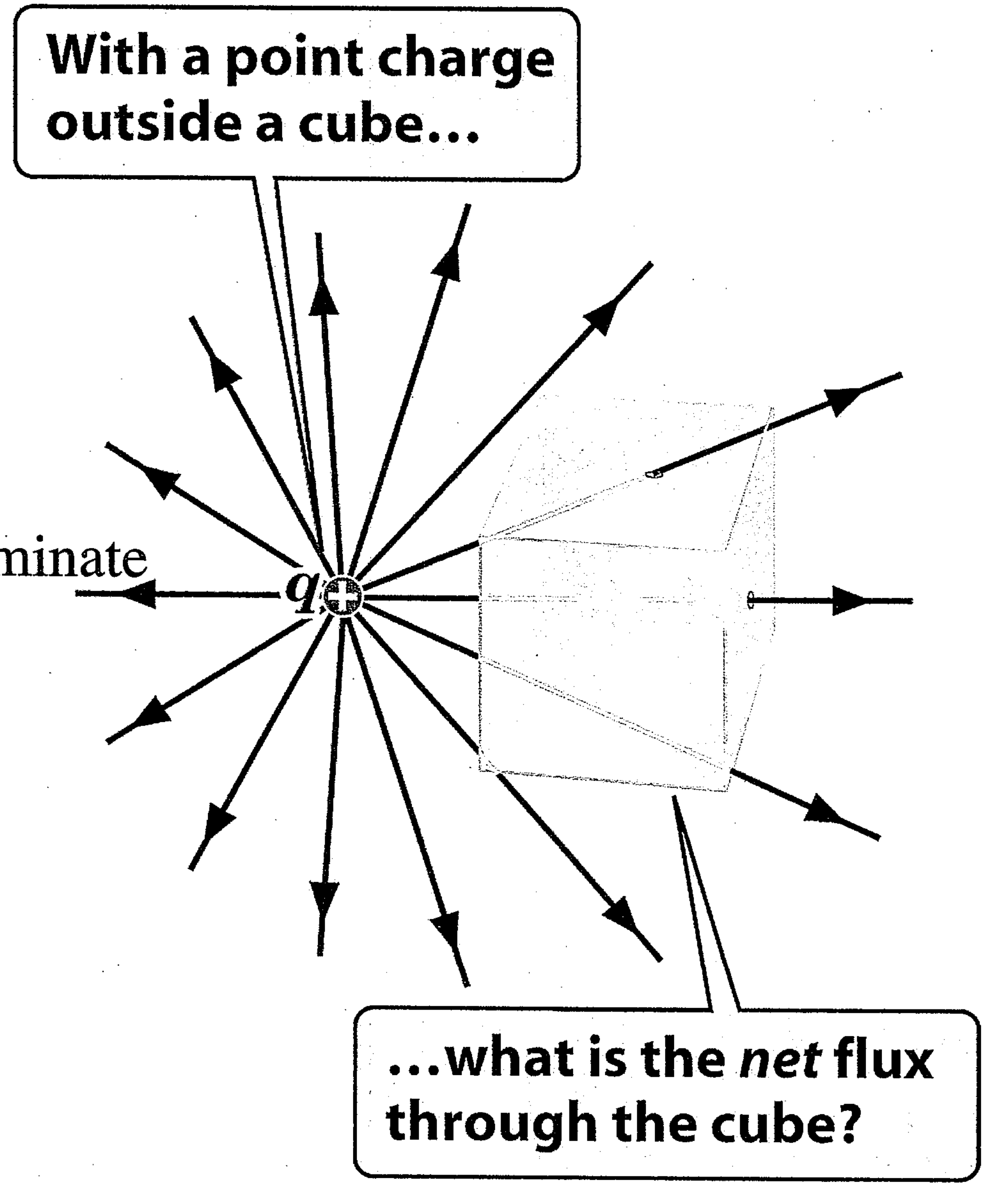
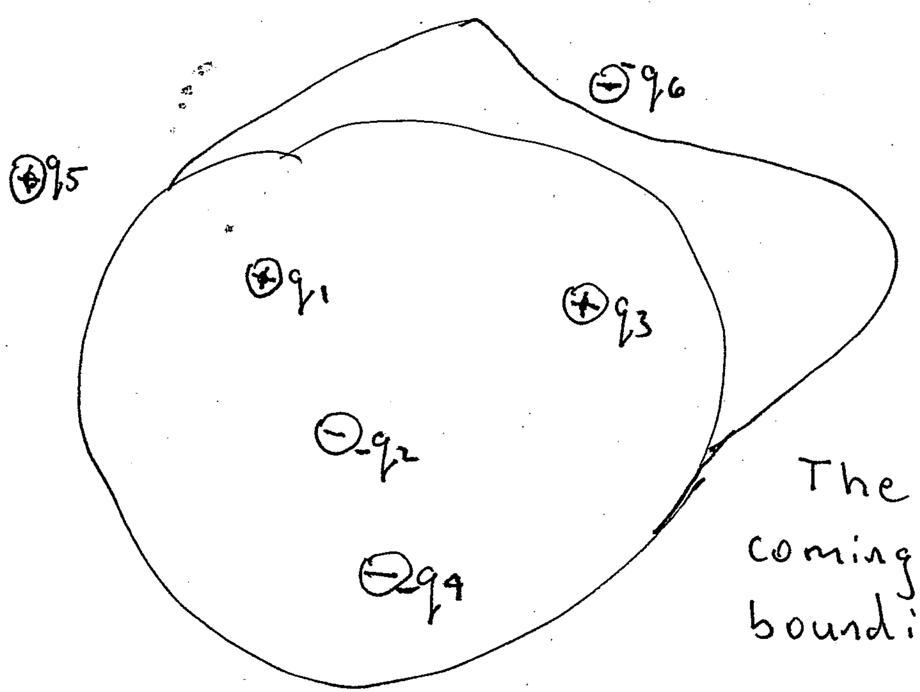


Figure 24-9 Physics for Engineers and Scientists 3/e

Gauss' Law



$q_1 - q_4$ inside volume

q_5 and q_6 outside the volume

The total electric flux, Φ_E, coming out of a surface bounding an enclosed volume is $\sum_i q_i/\epsilon_0$ (inside charges)

For our example

$$\Phi_E = \frac{q_1}{\epsilon_0} - \frac{q_2}{\epsilon_0} + \frac{q_3}{\epsilon_0} - q_4/\epsilon_0$$

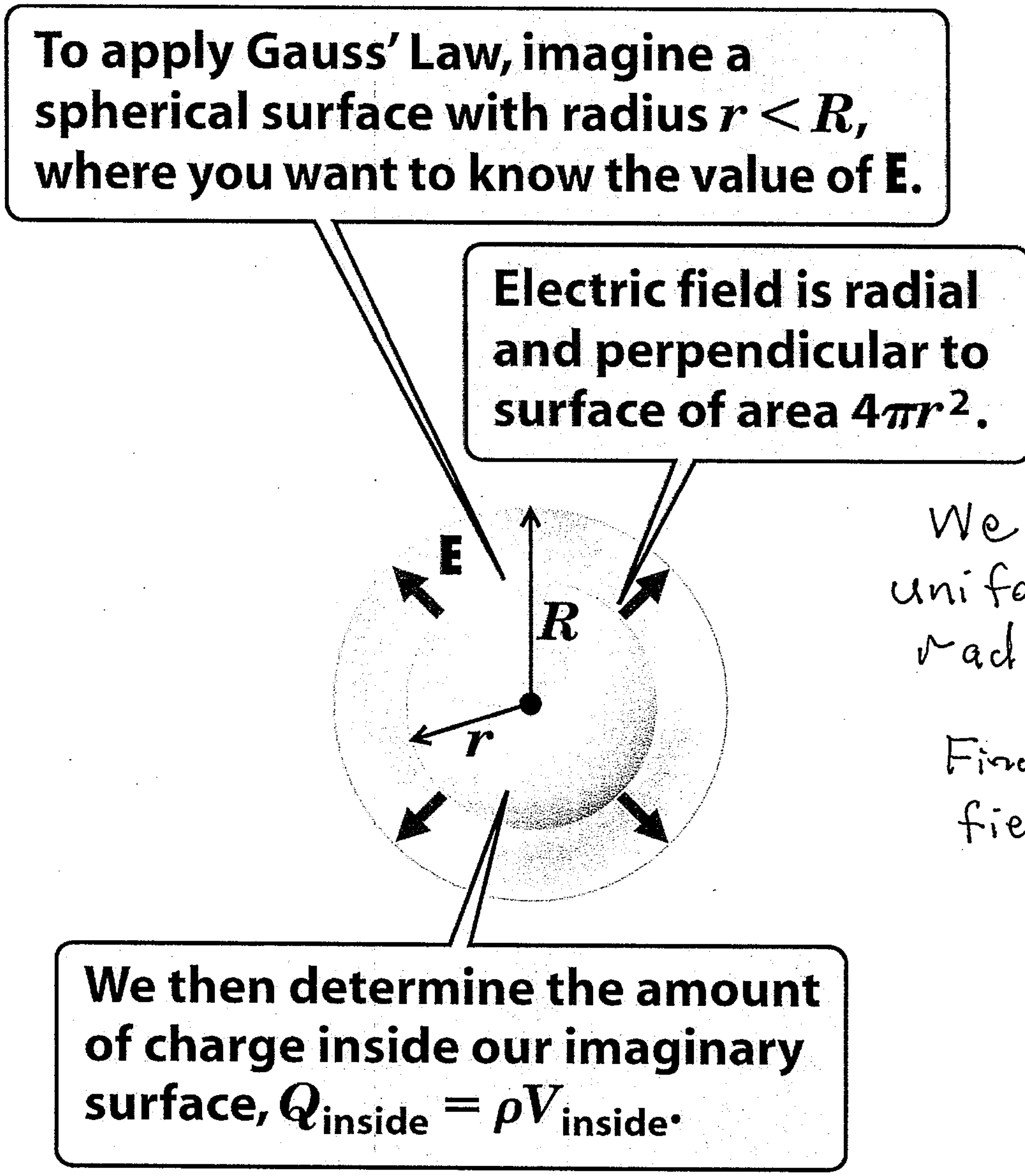


Figure 24-12a Physics for Engineers and Scientists 3/e

We have uniform charge of radius R

Find electrical field at radius r

We are given long axial rod of λ C/m.

Find electrical field outside

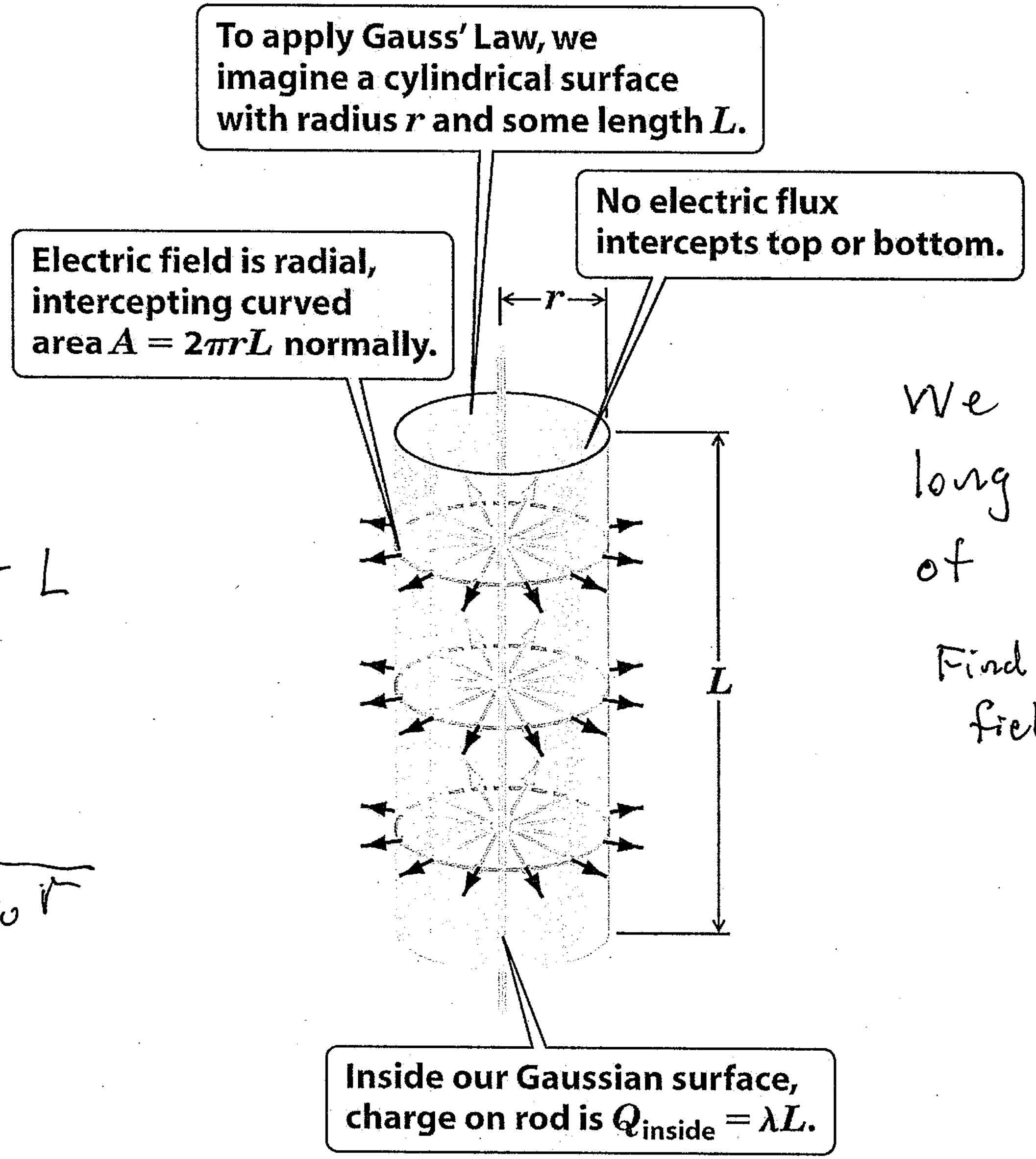


Figure 24-14 Physics for Engineers and Scientists 3/e

$$\Phi_E = E(r)\,A$$

$$= E(r)\, 2\pi r L$$

$$= \frac{\lambda L}{\epsilon_0}$$

$$E(r) = \frac{\lambda}{2\pi \epsilon_0 r}$$

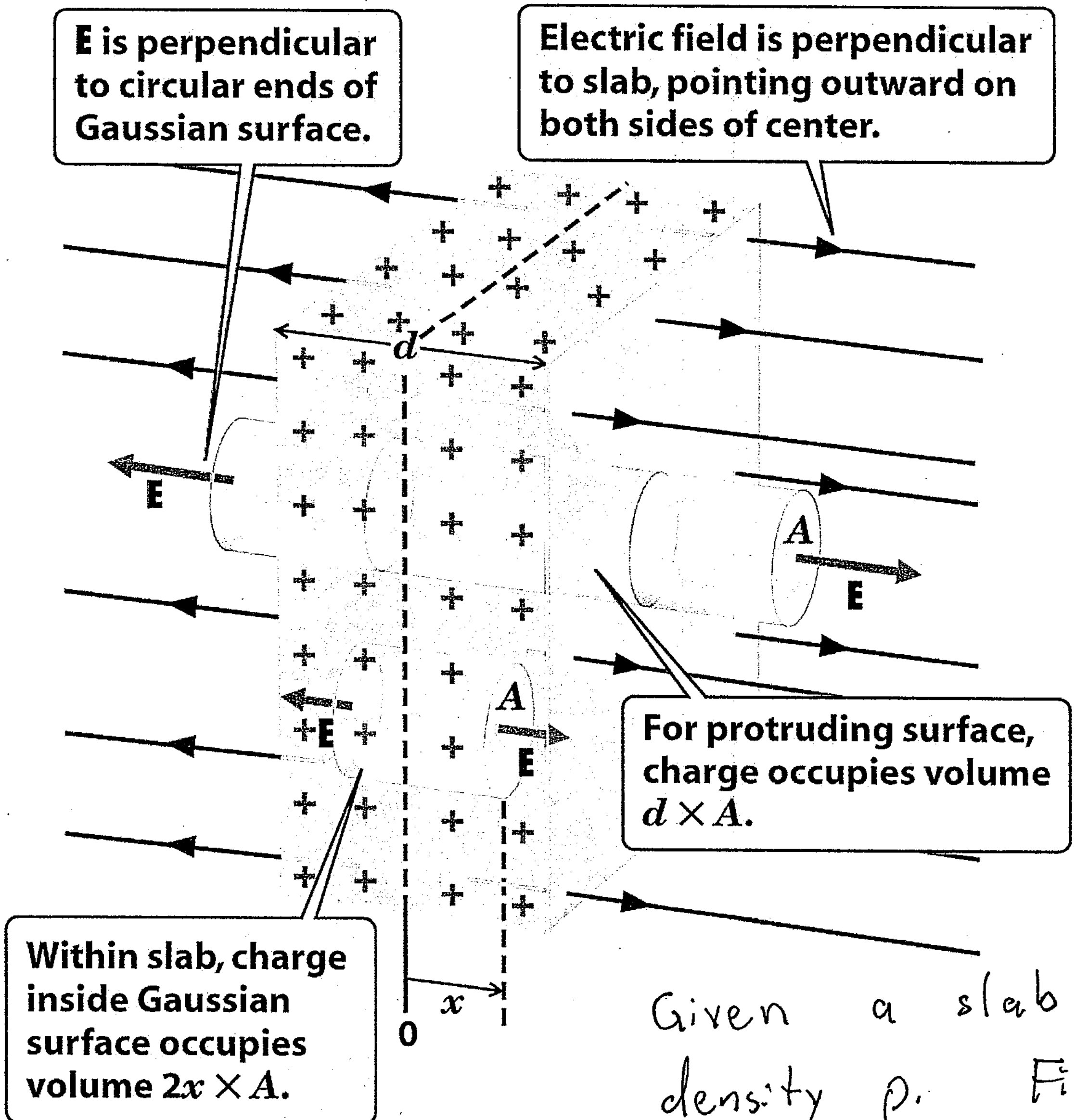


Figure 24-17 Physics for Engineers and Scientists 3/e

Given a slab, with charge density ρ. Find electric field inside and outside slab.

Given a large uniformly charged plate, of surface charge density σ.

What is electric field outside plate?

$\Phi_E = EA$

$= E(\pi r^2 + \pi r^2)$

$= \frac{\sigma}{\epsilon_0} A$

$= \frac{\sigma}{\epsilon_0} \pi r^2$

$2\pi r^2 E = \frac{\sigma}{\epsilon_0} \pi r^2$

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

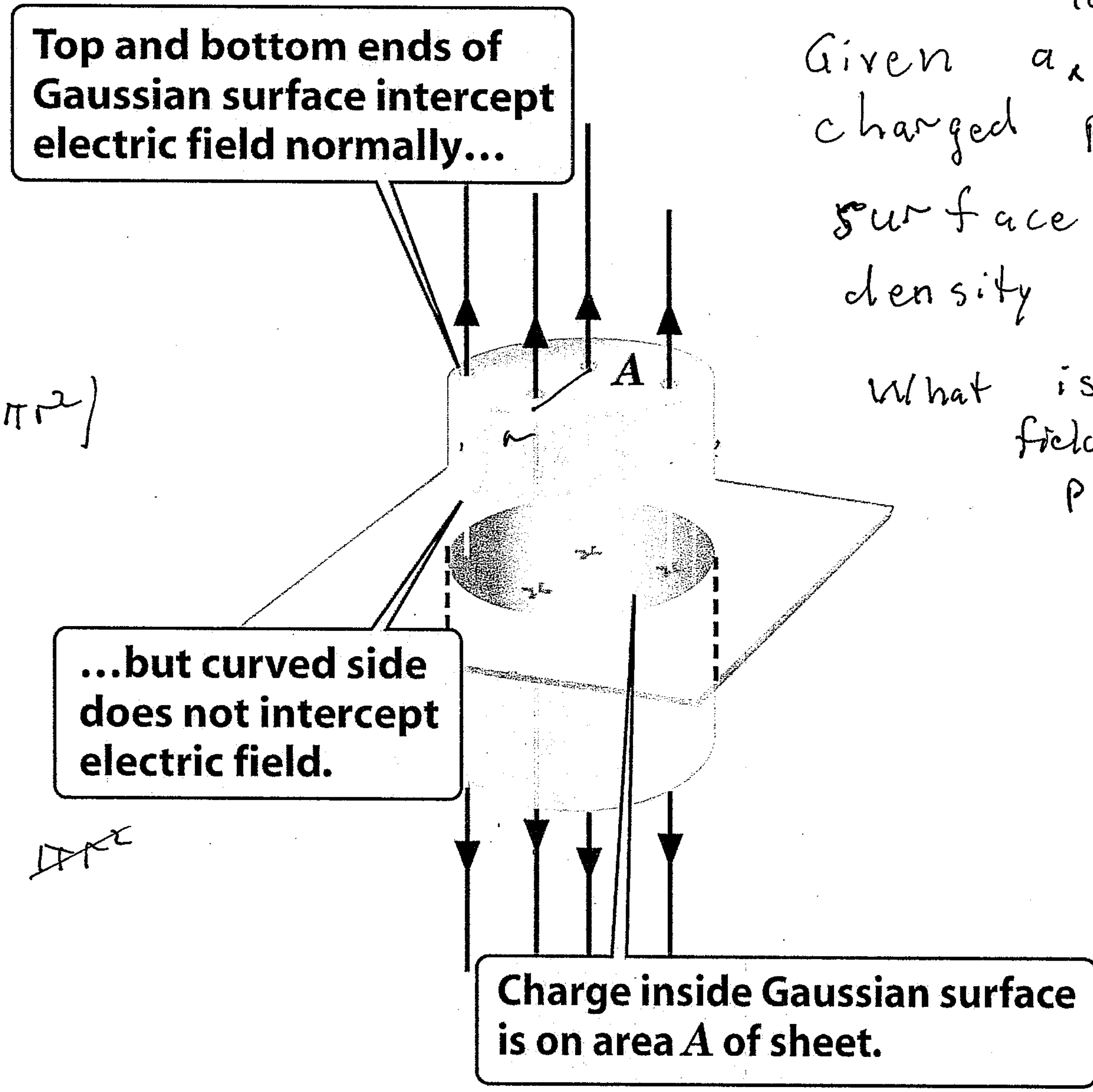
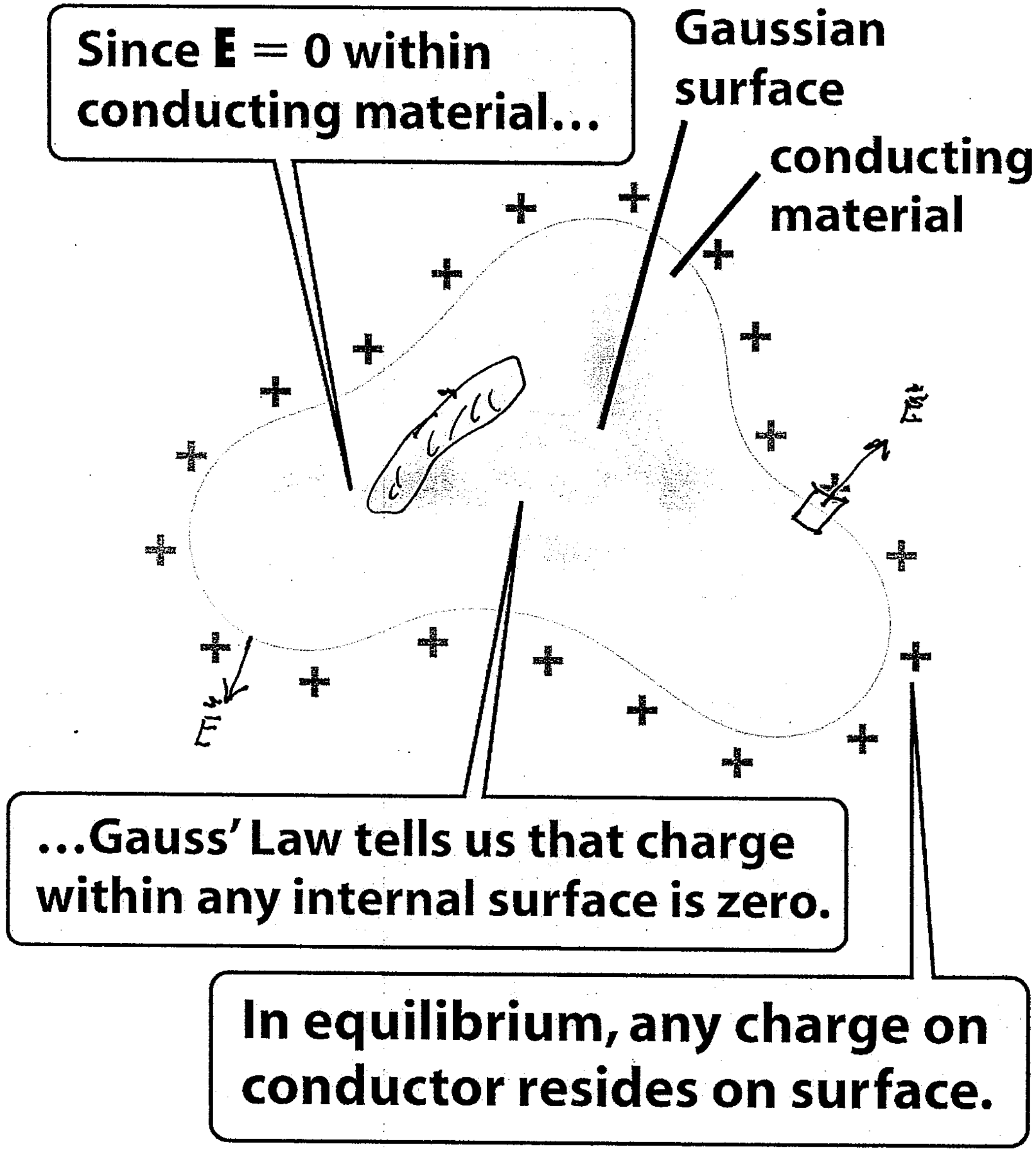


Figure 24-16b Physics for Engineers and Scientists 3/e



electric field at surface is perpendicur to surface (in direction of surface normal)

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

What is the electric at conducting surface in terms of surface charge σ at surface?

(a) 0 (b) $\sigma/2\epsilon_0$ (c) σ/ϵ_0 (d) indeterminate