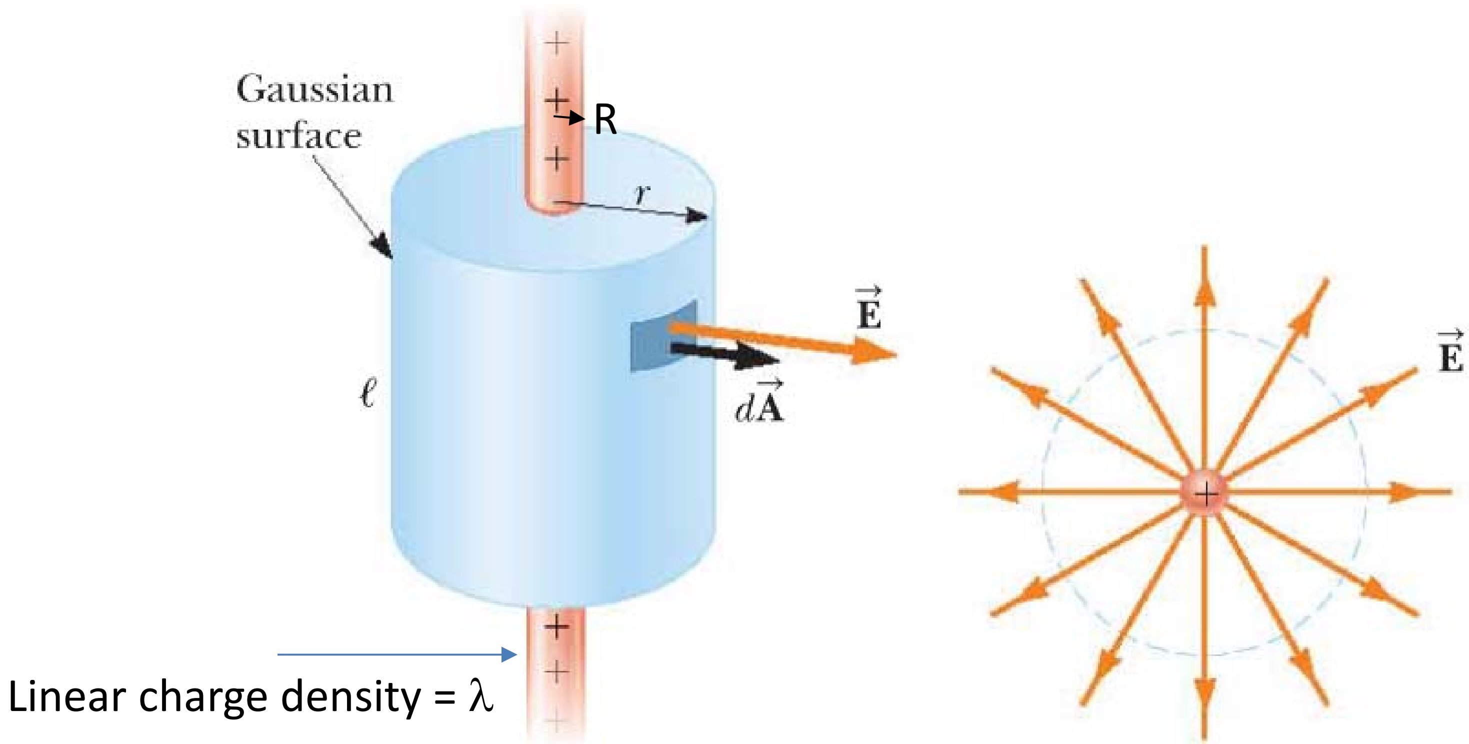
Test Next Wednesday (Sept 20)

1. Chapter 5 and 6.
2. 45 minutes sharp.
3. 4 multiple choices and 2 long problems.
4. Formula sheet provided.
5. Contact me before next Monday for prearrangement if you need special accommodation.

Application of Gauss's Law II

Uniform cylindrical (infinite long) distribution



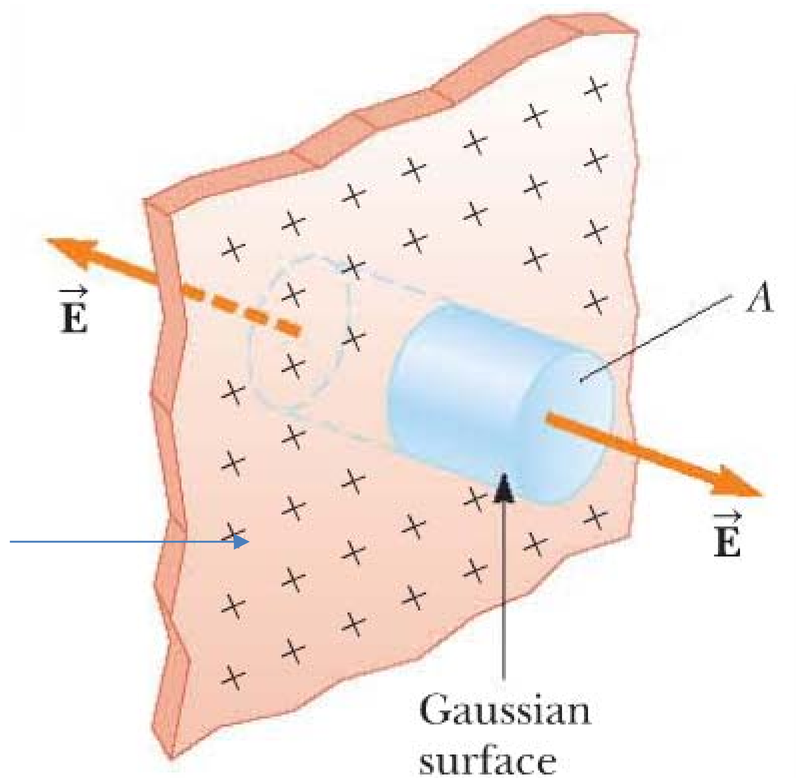
For r>R $\varepsilon_0 \Phi_E = q_{in} \Rightarrow \varepsilon_0 \cdot E \cdot 2\pi r \ell = \lambda \ell$

$$\Rightarrow E = \frac{\lambda}{2\pi\varepsilon_0 r}$$

Note that a line point charge belongs to this case.

For r<R Depends on the actual charge distribution.

Uniform distribution in an infinite plane



Surface charge density = σ

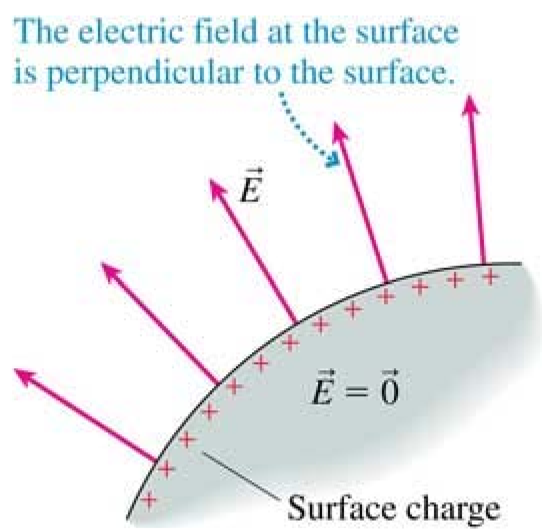
$$\varepsilon_0 \Phi_E = q_{in} \Rightarrow \varepsilon_0 \cdot 2 \cdot E \cdot A = \sigma A$$

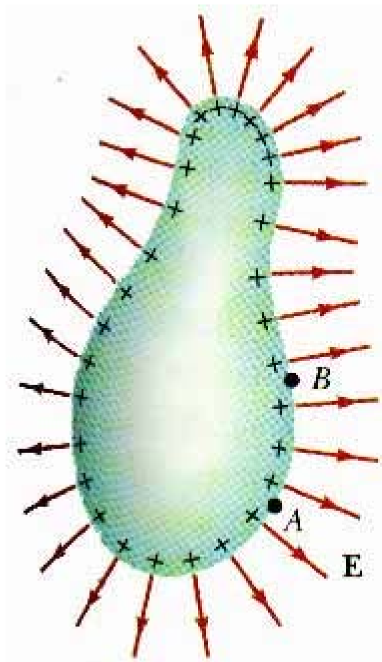
$$\Rightarrow E = \frac{\sigma}{2\varepsilon_0}$$ Note field is constant

More on Conductors

The following are true for any shape of a conductor, including the ones with cavities inside it (but assume there is no charge inside the cavities).

1. If the conductor has a net charge, all charges will stay only on the surfaces of the conductor.
2. There is no electric field inside the conductor.
3. The electric field outside the outer surface always perpendicular to the surface in the proximity of the conductor.

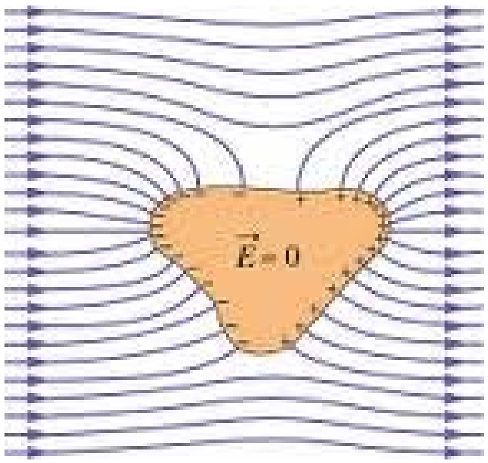


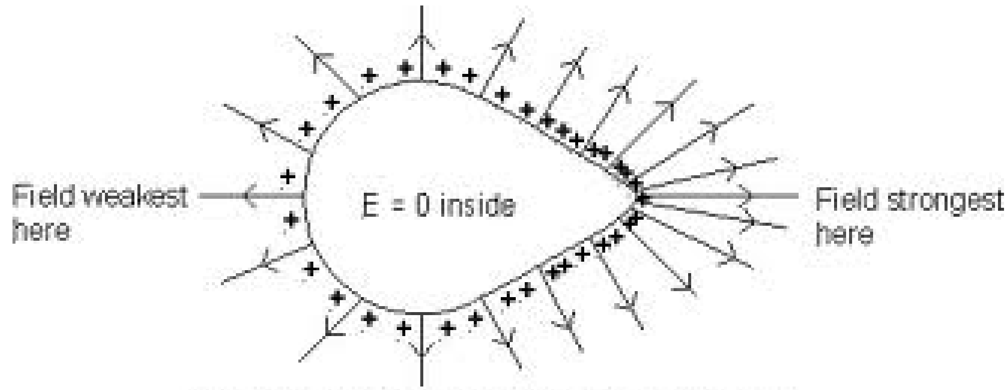


All on Conductors (as a Source of Electric Field)

(Con't)

4. Electric field is stronger at the sharper part (smaller radius of curvature) of the outer surface.





(d) Electric field & charge distribution around a pear-shaped conductor

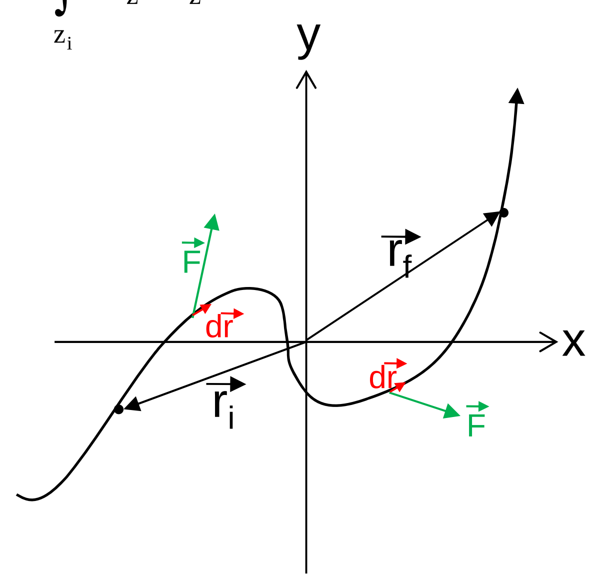
Class 11. Electric Potential Energy and Electric Potential

Work

Work done W by a force $\vec{F} = \int_{x_i}^{x_f} F_x\, dx + \int_{y_i}^{y_f} F_y\, dy + \int_{z_i}^{z_f} F_z\, dz$

$$\vec{F} = \int_{x_i}^{x_f} F_x\, dx + \int_{y_i}^{y_f} F_y\, dy + \int_{z_i}^{z_f} F_z\, dz$$
$$= \int_{x_i}^{x_f} F_x\, dr_x + \int_{y_i}^{y_f} F_y\, dr_y + \int_{z_i}^{z_f} F_z\, dr_z$$

Work done W by a force $\vec{F} = \int_{\vec{r}_i}^{\vec{r}_f} \vec{F} \cdot d\vec{r}$



Potential energy

$$\Delta K = K_f - K_i \quad = \quad \text{Work done by electric force } \vec{F}_E$$

$$+ \ \text{Work done by other forces } \vec{F}_i$$

Static electric is conservative, so we can define electric potential energy U_E as:

$$\Delta U_E = -\text{Work done by electric force } \vec{F}_E$$

$$\therefore \ \Delta K \quad = \ -\Delta U_E + \text{Work done by other forces } \vec{F}_i$$

$$\Rightarrow \boxed{\Delta K \ + \ \Delta U \ = \ \text{Work done by other forces } \vec{F}_i}$$