Electricity and Magnetism

- Physics 259 – L02
- Lecture 26

UNIVERSITY OF CALGARY

Chapter 24.5 and 24.8:

Potential due to a continuous charge distribution
Potential of isolated conductors

Last time

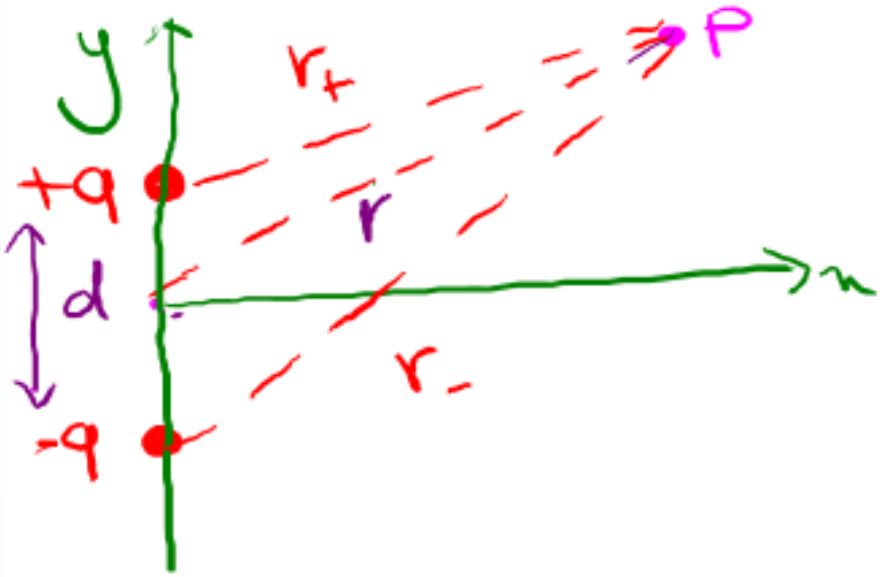
- Electric potential energy of a collection of charges
- Interpreting equipotential surfaces
- Equipotential surfaces: visualizing electric potential
- Potential due to an electric dipole

This time

- Potential due to an electric dipole
- Potential due to a continuous charge distribution

Electric potential of a dipole at arbitrary point p

Electric potential of a dipole ⇒ arbitrary P



$$V = V_+ + V_-$$

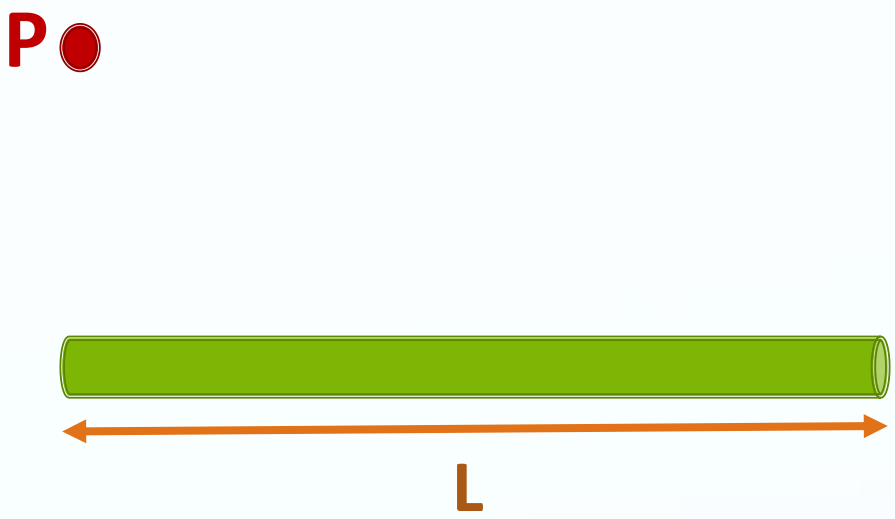
$$\begin{cases} V_+ = \frac{1}{4\pi\varepsilon_0}\frac{q}{r_+} \\ V_- = \frac{-1}{4\pi\varepsilon_0}\frac{q}{r_-} \end{cases}$$

$$\rightarrow V = V_+ + V_- = \frac{1}{4\pi\varepsilon_0}\frac{q}{r_+} + \frac{-1}{4\pi\varepsilon_0}\frac{q}{r_-}$$

$$\rightarrow V = \frac{q}{4\pi\varepsilon_0}\frac{d\cos\theta}{r^2} = \frac{1}{4\pi\varepsilon_0}\frac{p\cos\theta}{r^2}$$

- **Go through “Appendix 1-chapter 24” in D2L (different approach)**

Electric potential of a line of charge at point p



Thin nonconducting rod of length L with uniform positive charge with charge density λ.

Find electric potential V due to the rod at p, a perpendicular distance d from the left end of the rod.

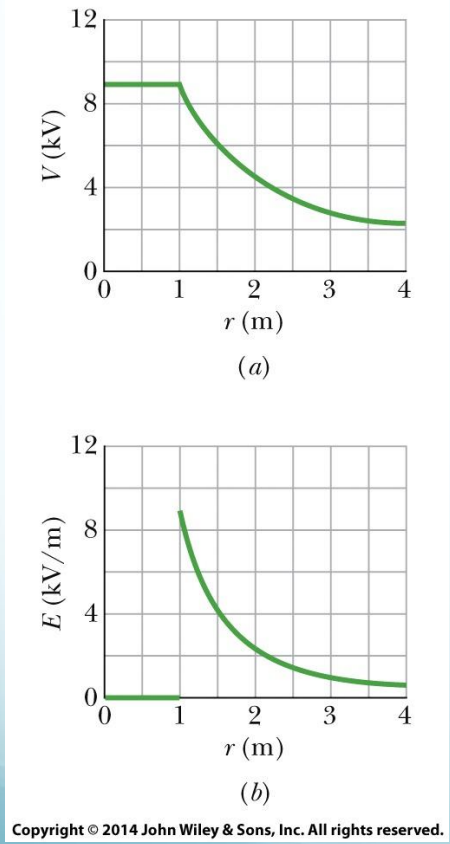
P

Electric potential of a line of charge at arbitrary point p

Potential of a charged isolated conductor

Courtesy Westinghouse Electric Corporation

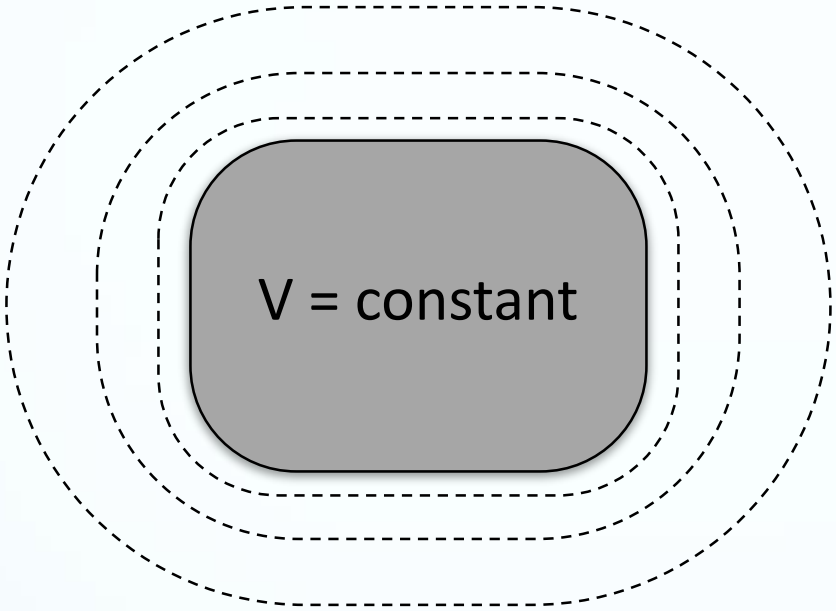
It is wise to enclose yourself in a cavity inside a conducting shell, where the electric field is guaranteed to be zero. A car (unless it is a convertible or made with a plastic body) is almost ideal.



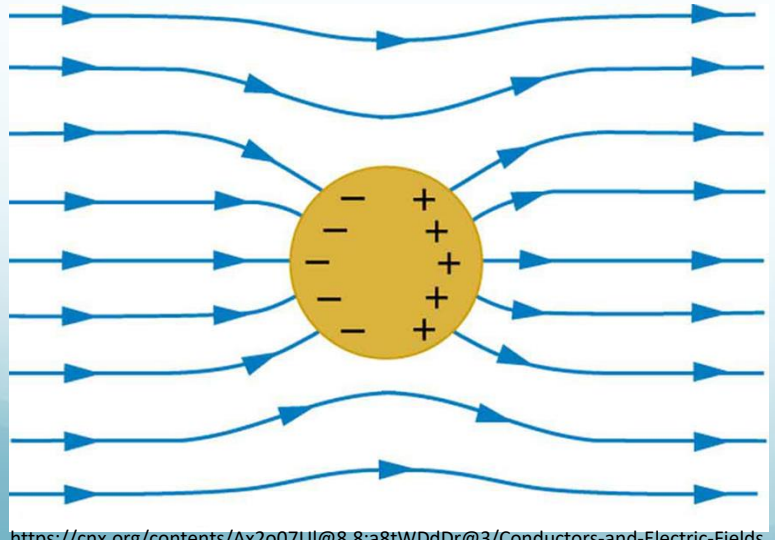
(a) A plot of *V(r)* both inside and outside a charged spherical shell of radius *1.0 m*.

(b) A plot of *E(r)* for the same shell.

Potential of a charged isolated conductor



The surface of a conductor is an equipotential. If there was a potential difference across the surface of a conductor, the freely moving charges would move around until the potential is constant.



https://cnx.org/contents/Ax2o07Ul@8.8:a8tWDdDr@3/Conductors-and-Electric-Fields

This means that electric field lines ALWAYS must meet a conducting surface at right angles (any tangential component would imply a tangential force on the free charges).

This section we talked about:

Chapter 24.5 and 24.8

See you on next Thursday