EQUIPOTENTIAL SURFACES

Similar to contour lines for gravity/height

- closer lines = more steep
- same potential along line

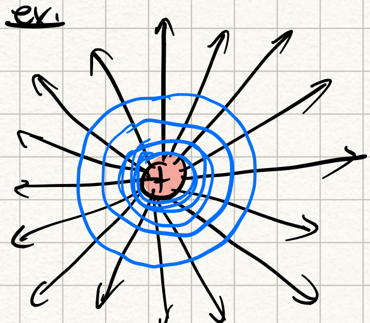
- Equipotential surface for electrostatics is 3D-surface on which V remains constant.
  ↳ EPE does not change

- Because PE doesn't change, $\vec{E}$ does no work. Thus $\vec{E}$ must be $\perp$ to every point in that surface.

✲ Field lines and equipotential surfaces are always mutually perpendicular
→ field lines are curves
→ equipotential surfaces are curved surfaces

✲ in a uniform field, equipotentials are parallel planes $\perp$ to field lines.

ex.

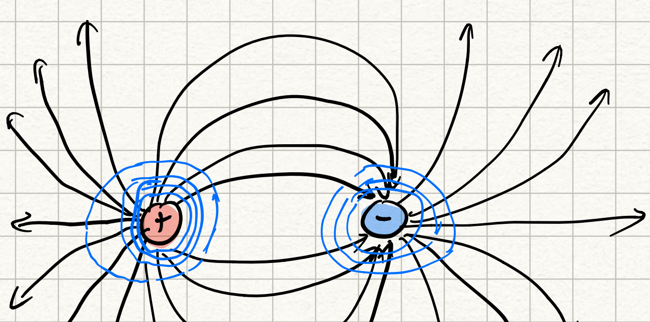


Single point charge

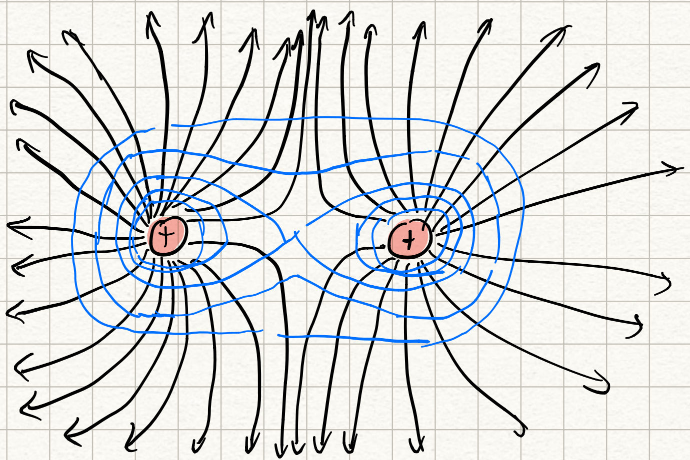
✲ actual equipotential surfaces are 3-D.

These are cross-sections.

- when close to charges, equipotentials are more condensed



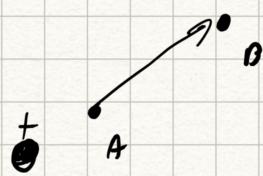
dipole



two equal positive charges

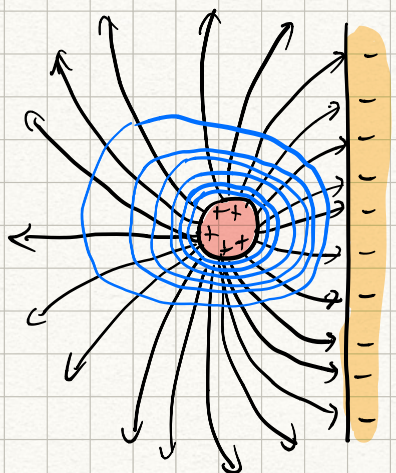
☆ E doesn't have to be constant over an equipotential surface.

like how topographical map, different points on the same contour line can be at different slopes.

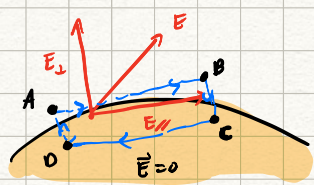


$$\int_a^b \vec{E}\cdot d\vec{l}$$

EQUIPOTENTIALS & CONDUCTORS



- surface of conductor is always equipotential when charges @ rest



if $\vec{E}$ had tangential component, charge would move in rectangular path, part-in, part-out.

imagine if we transported test charge in rectangular loop,
Work should be zero, since returning to start
however, work from CD is 0, and if $E_{/\!/} \neq 0$, work from AB $\neq 0$ ✱

- if no charge, cavity walls have no charge and $\vec{E} = 0$ inside cavity

- if charge q, inner walls have charge −q, and $\vec{E} \neq 0$ inside cavity

- Volume of conductor is also equipotential
  → $V_{ab} = V_a - V_b = \int_a^b \vec{E}\cdot d\vec{l}$. Since $\vec{E} = 0$, any ΔV inside for 2 arbitrary points is zero.
  → this doesn't mean $V_a = V_b = 0$; only that $V_a = V_b$

- $V_{surface} = V_{volume}$
  → otherwise charges would move