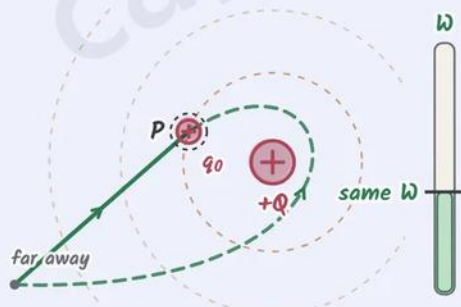


Electrostatic Potential and Capacitance

potential is a number, capacitance is geometry

Electrostatic potential

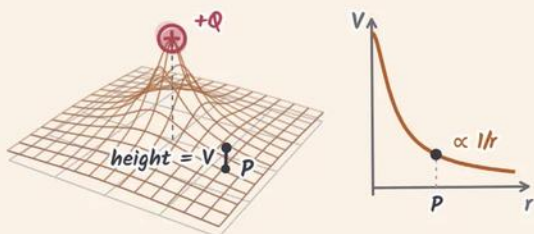
- work done by an external force bringing q from infinity to P , without accelerating it
- $V_P = \frac{W}{q}$: work per unit charge, unit volt = J/C
- the field is **conservative** : the work depends only on the ends, not the path
- only differences have meaning: $V_P - V_R = \frac{W_{RP}}{q}$, $V = 0$ at infinity by choice



q_0 brought in from far away along two paths: the same work, so V at P is fixed

Potential due to a point charge

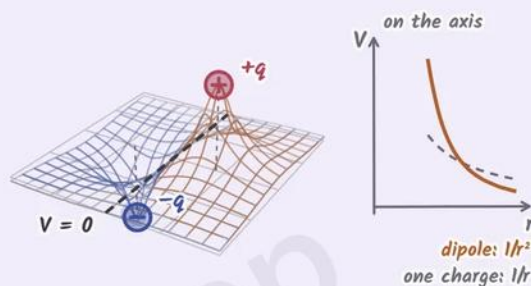
- $V = \frac{1}{4\pi\epsilon_0} \frac{q}{r}$, falls as $1/r$, gentler than E 's $1/r^2$
- $+q$: V positive all round it. $-q$: V negative, deepest near it
- the same at every point of a sphere round q



V as a height over the floor: a hill round $+Q$, falling as $1/r$

Potential due to a dipole *

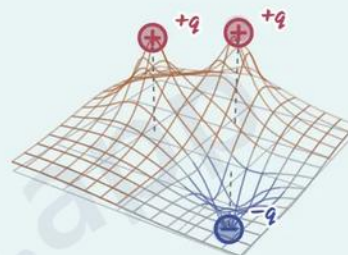
- $V = \frac{1}{4\pi\epsilon_0} \frac{p \cos \theta}{r^2}$, for $r \gg a$
- axis: $V = \pm \frac{1}{4\pi\epsilon_0} \frac{p}{r^2}$. equator: $V = 0$ everywhere
- falls as $1/r^2$, faster than a point charge; depends on the angle too



a hill beside a well: $V = 0$ all along the equator, $1/r^2$ on the axis

Potential due to a system of charges

- $V = \frac{1}{4\pi\epsilon_0} \sum \frac{q_i}{r_i}$: a plain sum with signs, no components
- charged shell, outside: as if all of q sat at the centre
- inside the shell: $V = \frac{q}{4\pi\epsilon_0 R}$ everywhere, constant, so $E = 0$



three charges: their hills and wells simply add