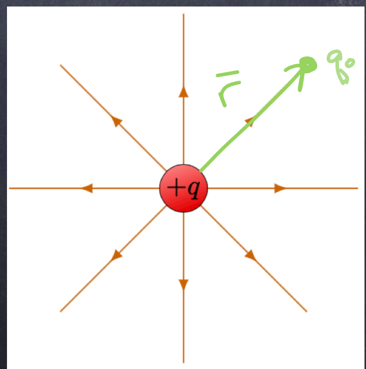
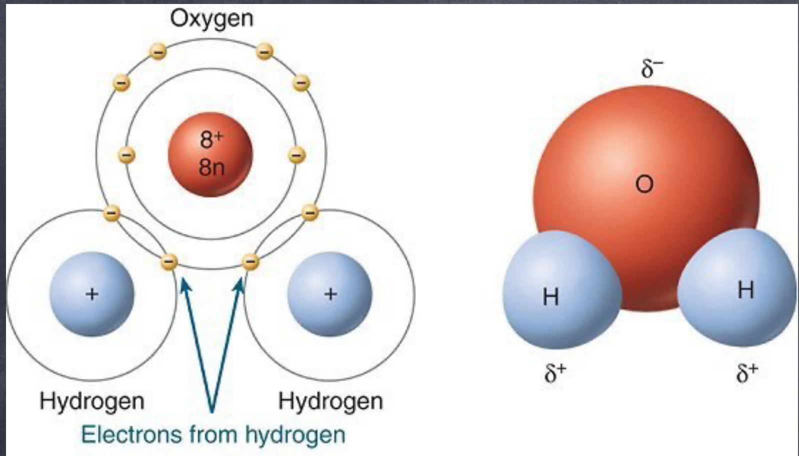
PHY 117 HS2023

Week 8, Lecture 2
Nov. 8th, 2023
Prof. Ben Kilminster

yesterday:

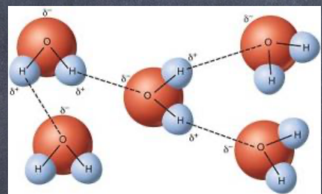


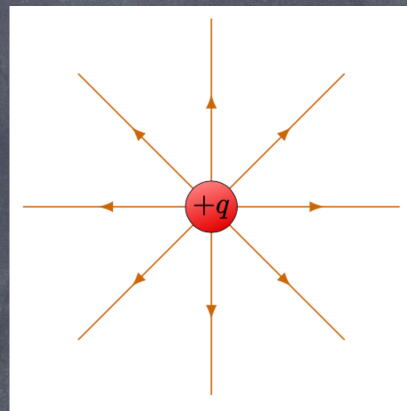
$$\bar{E} = \frac{k q q_0}{r^2} \hat{r}$$

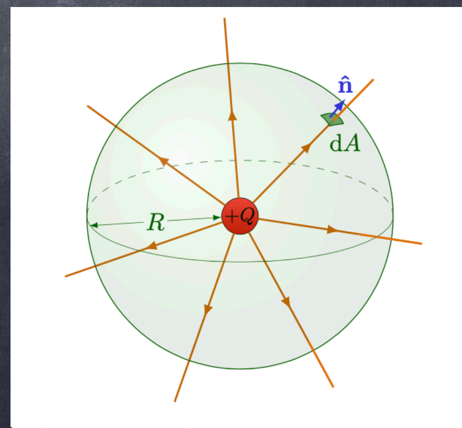


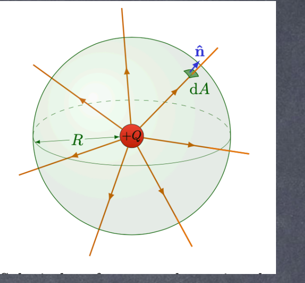
(a) Electron shells in a water molecule

(b) Distribution of partial charges in a water molecule

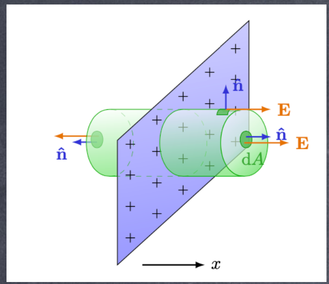



+q

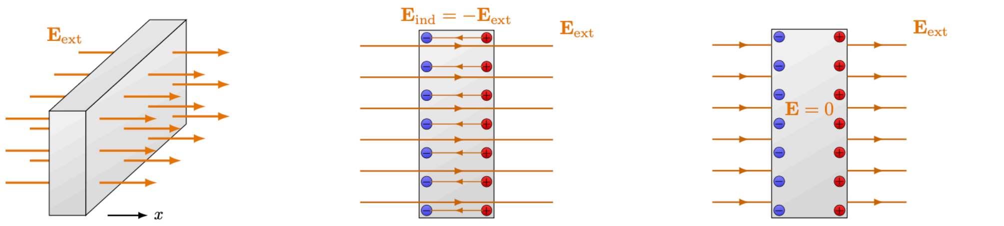

n̂
dA
R
+Q



n̂
dA
R
+Q



n̂
E
n̂
E
n̂
dA
x

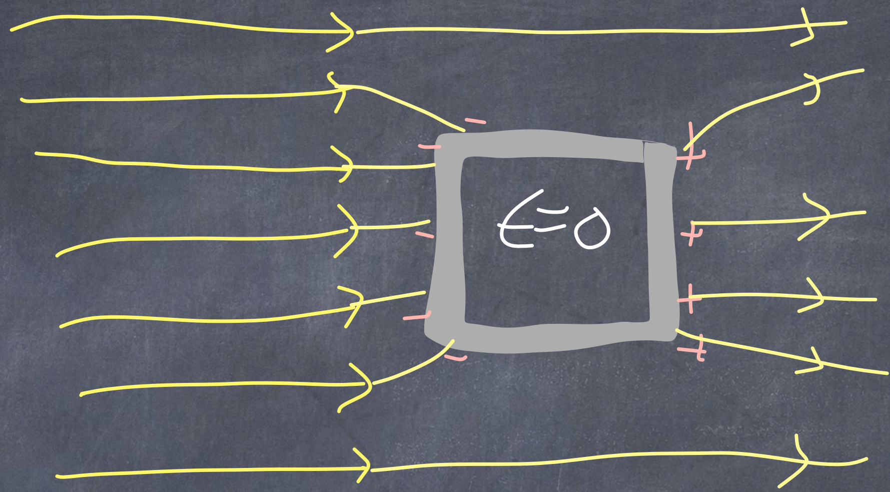


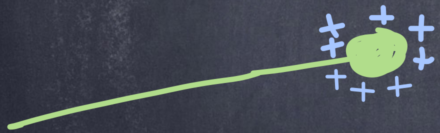
(a) An external field $\mathbf{E}_{\text{ext}}$ is applied to a slab of conducting metal.

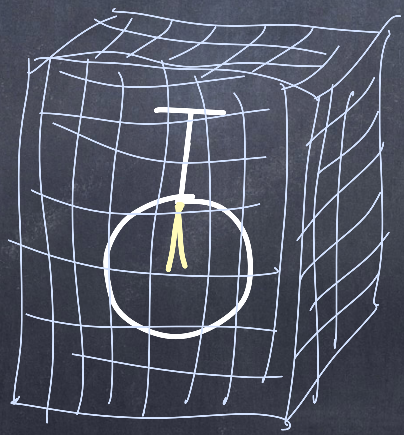
(b) The free charges redistribute and create an internal field $\mathbf{E}_{\text{ind}}$.

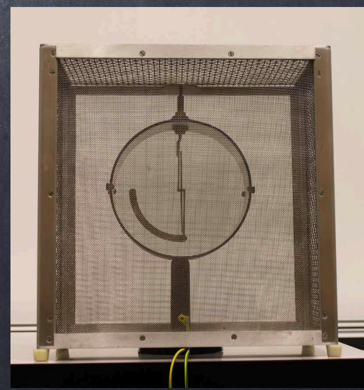
(c) Once the charge has settled, the internal and external fields cancel.

Faraday cage

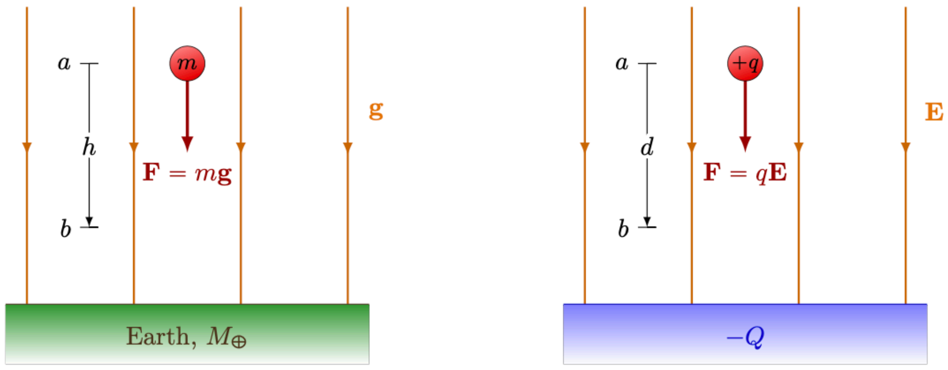








3.1 Electric potential energy



(a) Gravitational: $\Delta U = -mgh$.

(b) Electric: $\Delta U = -qEd$.

Figure 3.1: Comparison of potential energy difference $\Delta U = U_b - U_a$ in a force field.

When the movement is in the same direction as the force, there is a decrease in U.

We often refer to the electric potential, V. <u>or</u> electric potential different, ΔV

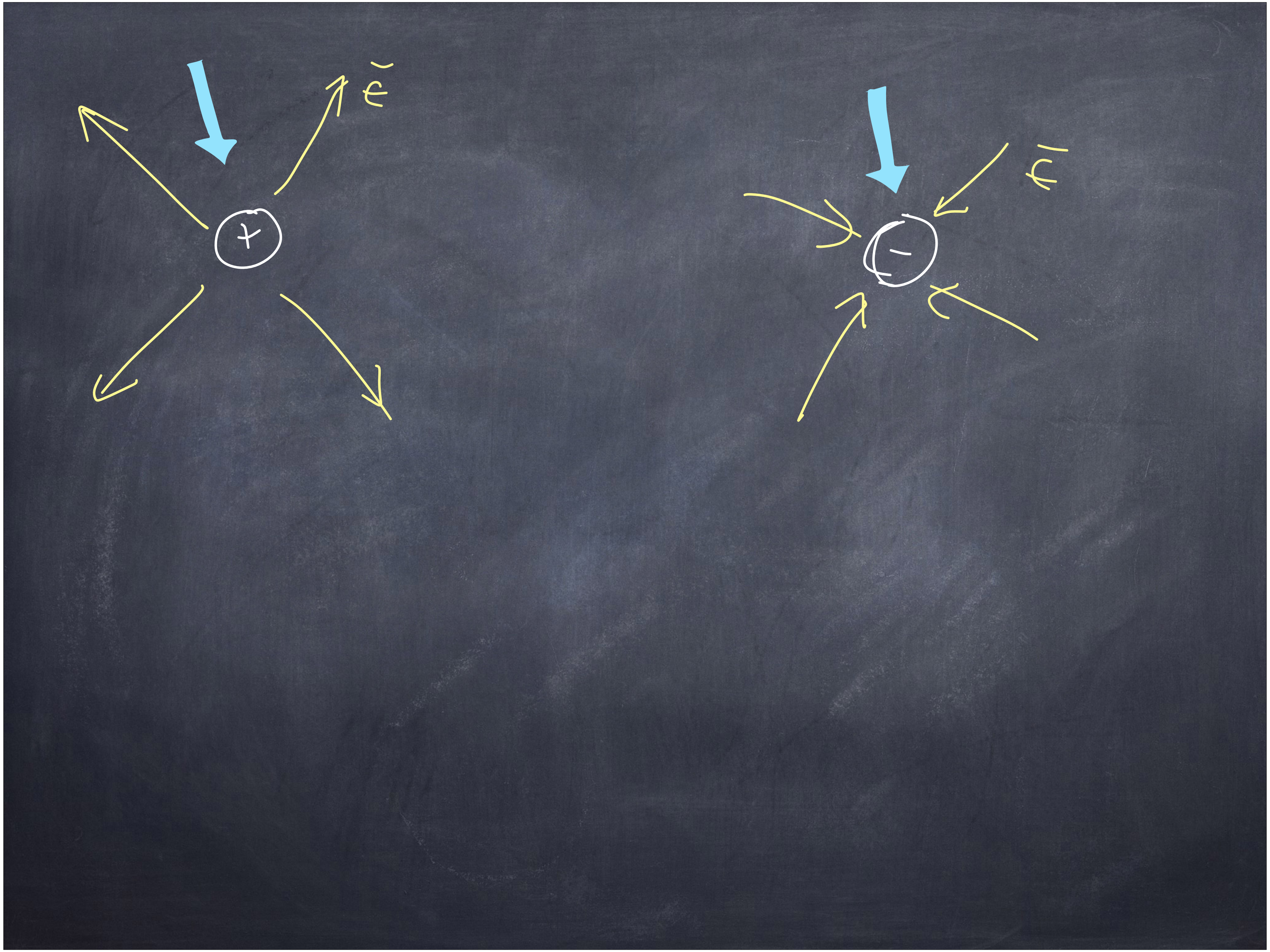
This is a scalar, <u>not</u> a vector.

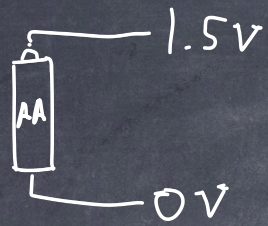
$$\Delta V = V_b - V_a = \frac{U_b - U_a}{q_0} = \frac{\Delta U}{q_0}$$

The potential is independent of the test charge, q_0

$$\Delta V = -\int_a^b \bar{E} \cdot d\bar{\ell}$$

The (−) sign means ΔV is (−) when movement is in same direction as $\bar{E}$-field.

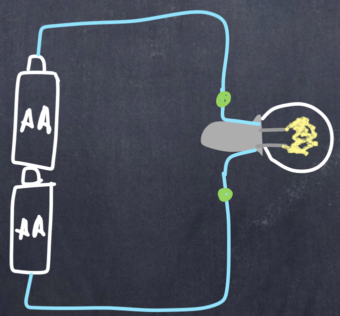


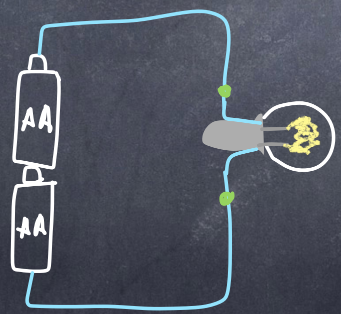


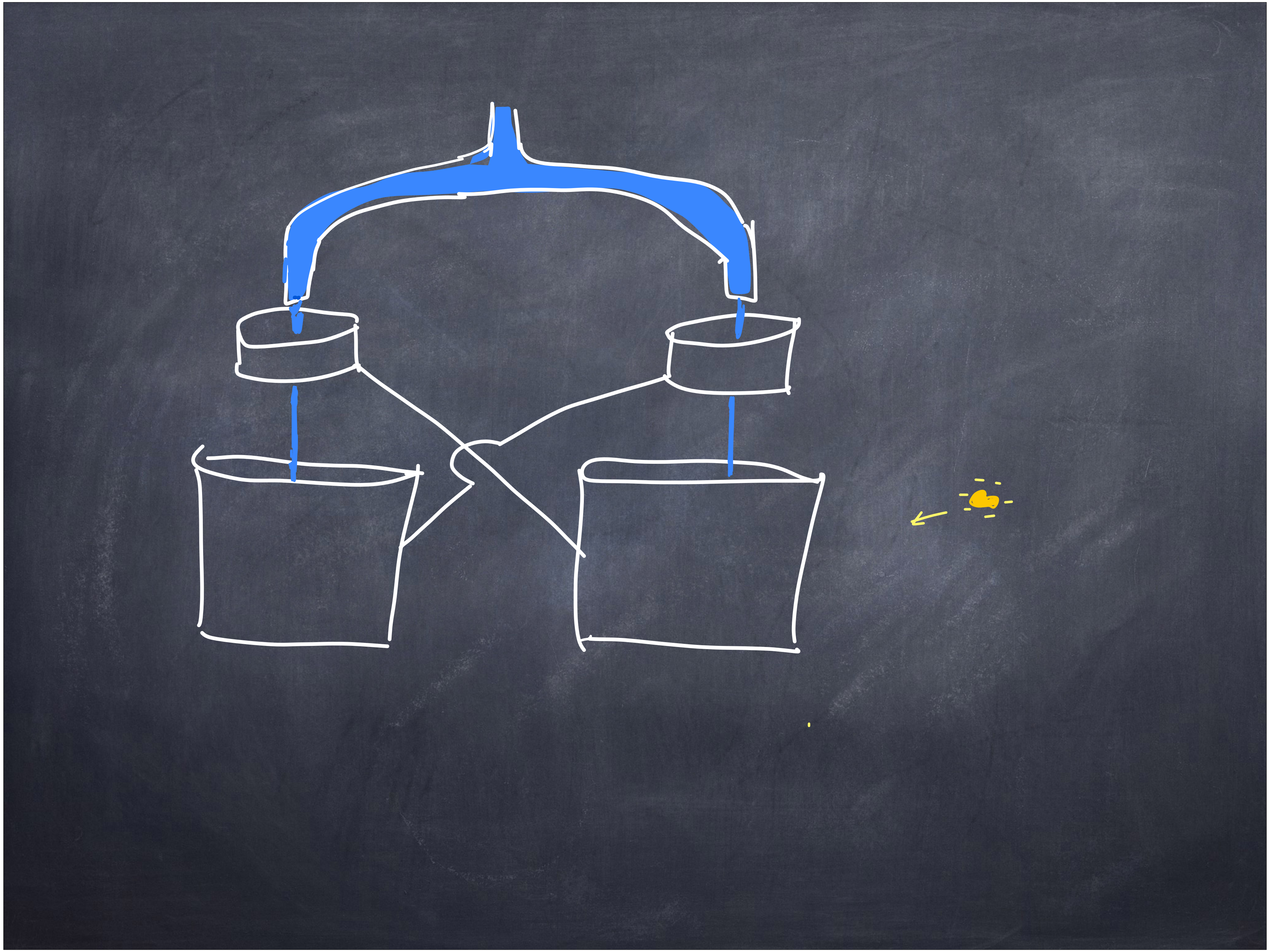
$\Delta V = 1.5V$

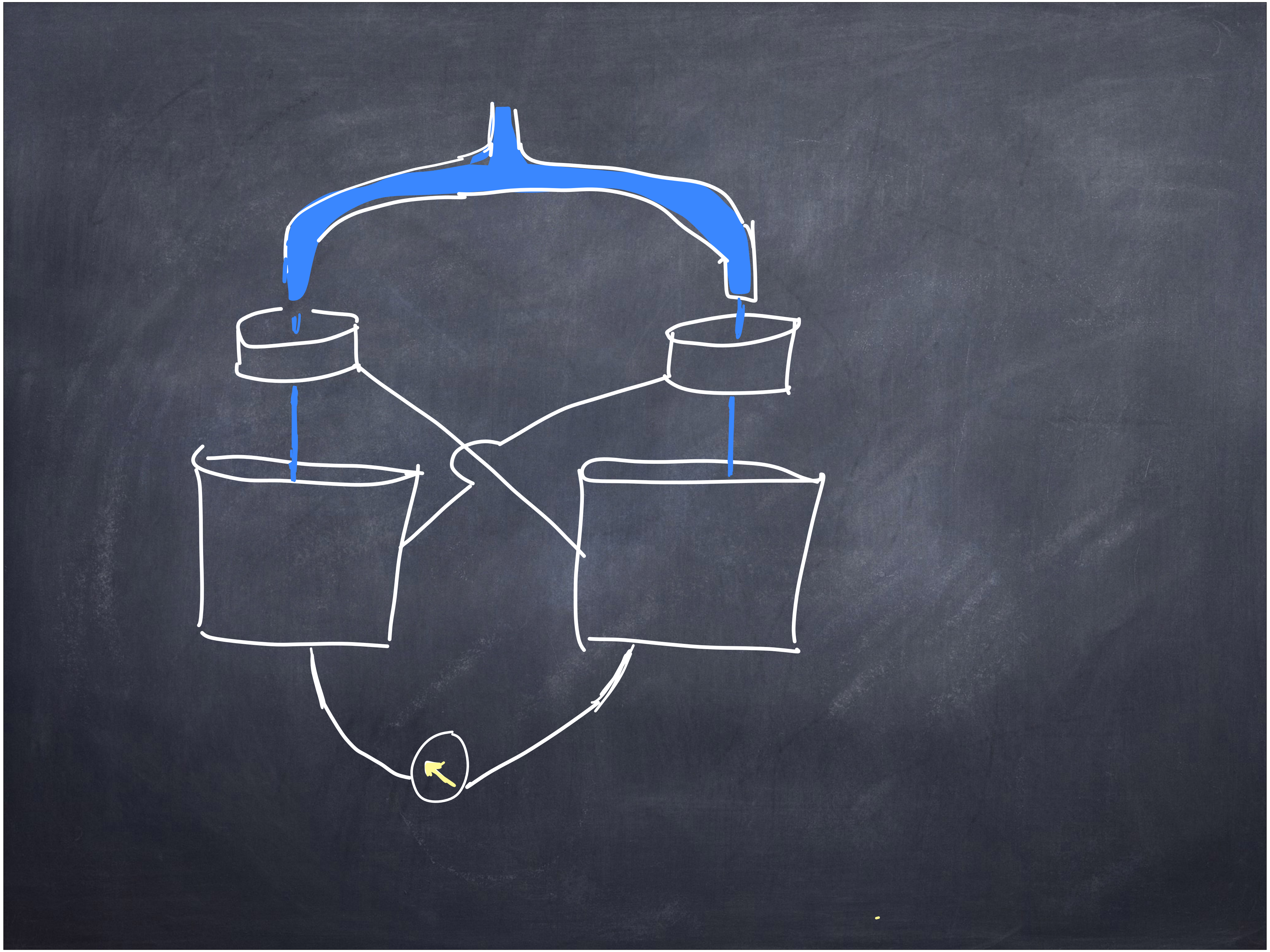
The difference in Voltage is important

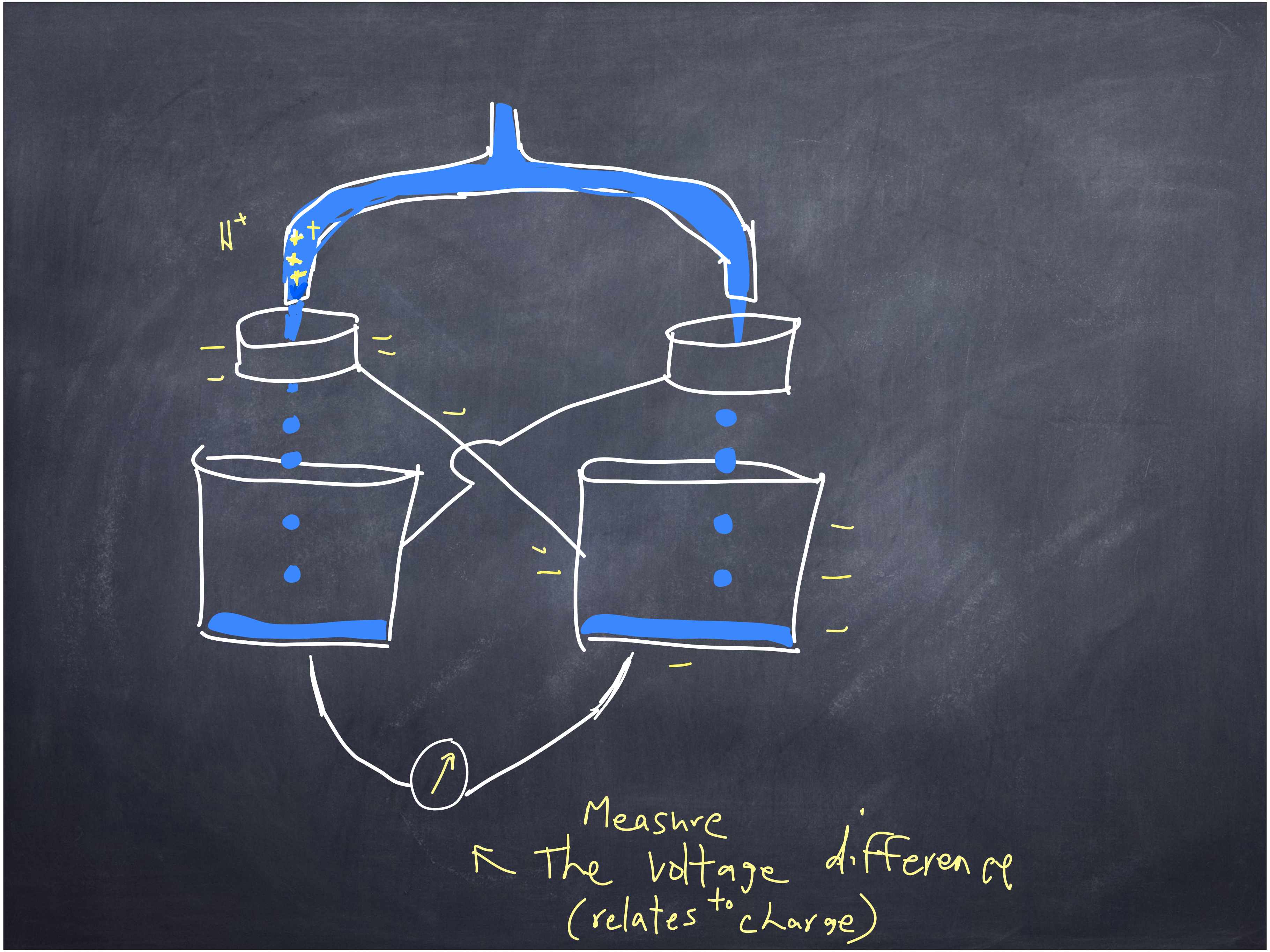
Potential is the same everywhere on a conductor

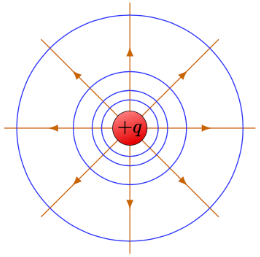




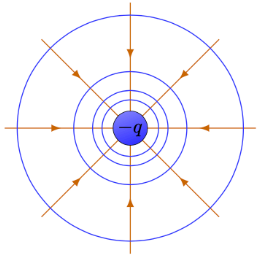




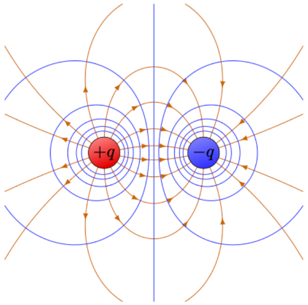

H+
Measure
The voltage difference
(relates to charge)



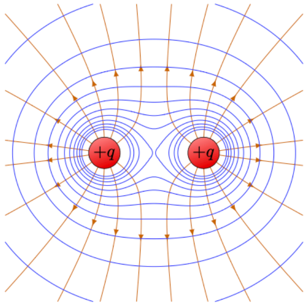
(a) Positive charge.



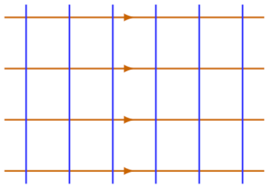
(b) Negative charge.



(c) Opposite point charges.

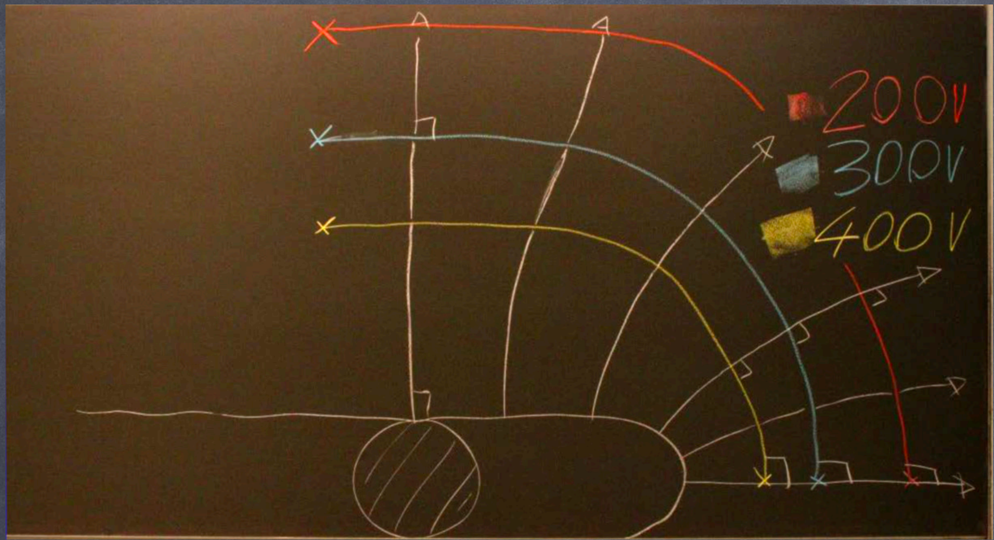


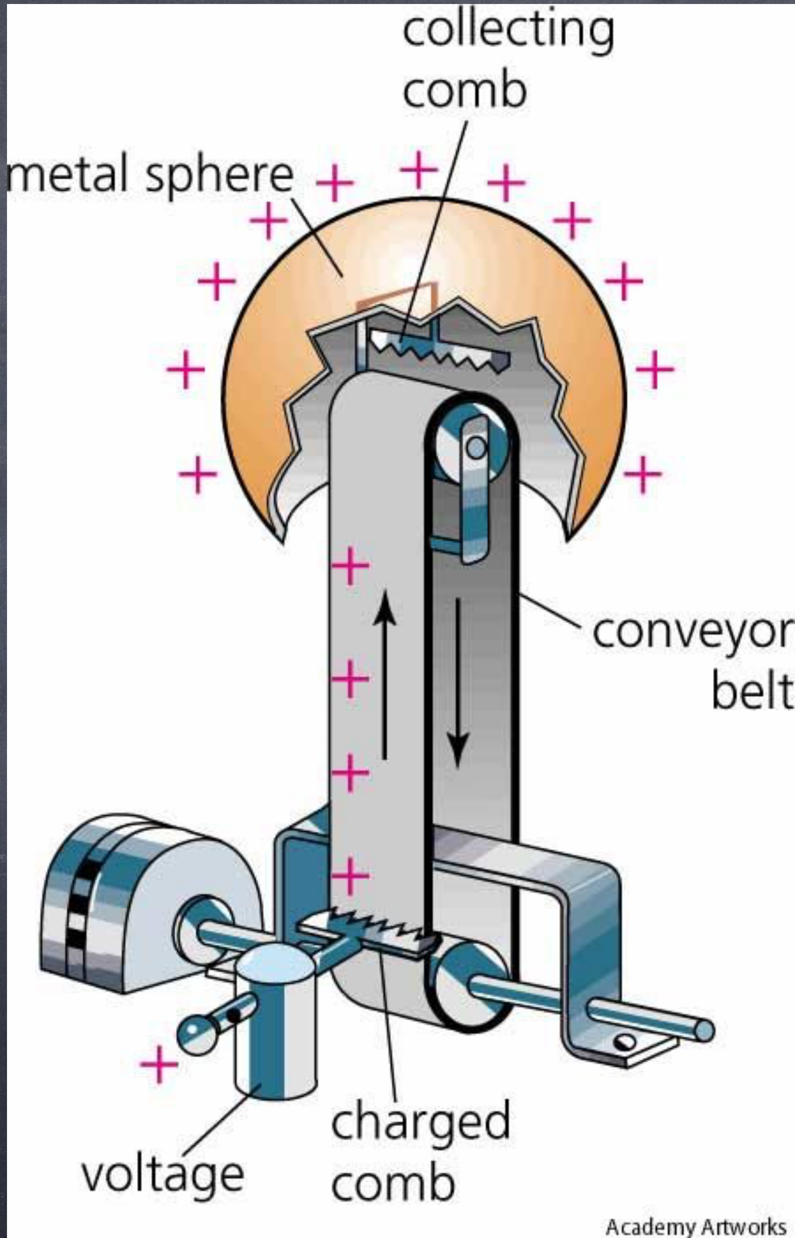
(d) Same-sign point charges.

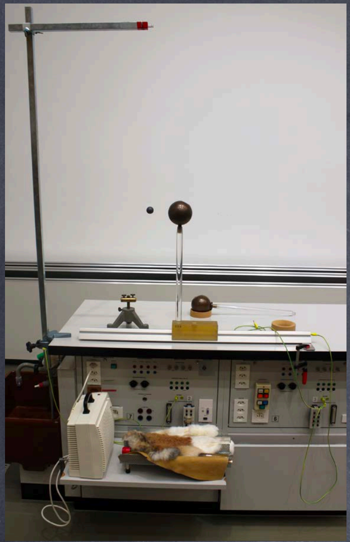


(e) Uniform field (like for a infinite sheet of charge).

Figure 3.6: Equipotential surfaces (blue) of electric field lines (orange) for different configurations of point charges. All the points on the same equipotential have the same electric potential. The equipotential are equidistant to each other: Two neighbouring equipotentials differ by a fixed voltage ΔV.

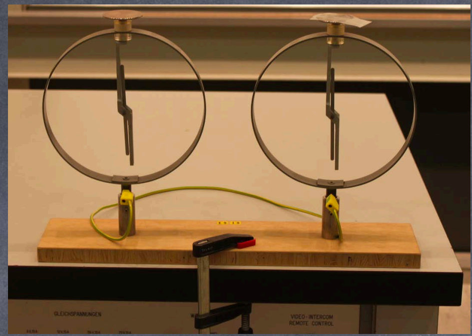

200V
300V
400V


collecting
comb
metal sphere
conveyor
belt
voltage
charged
comb
Academy Artworks



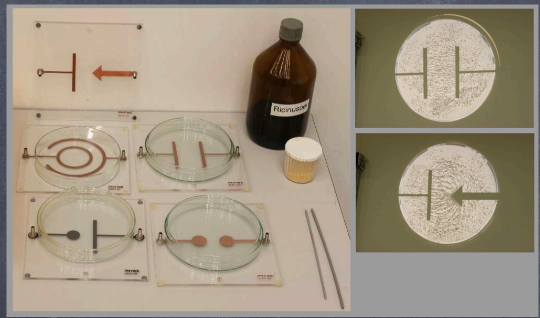
ES2

ES8

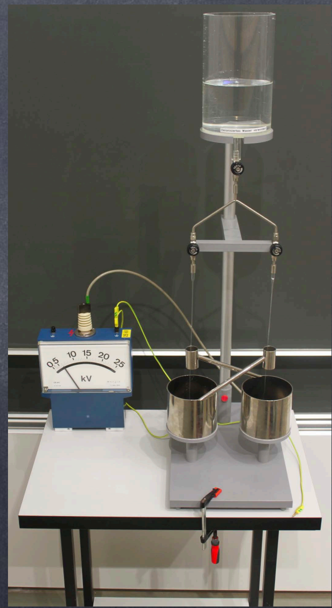


ES19

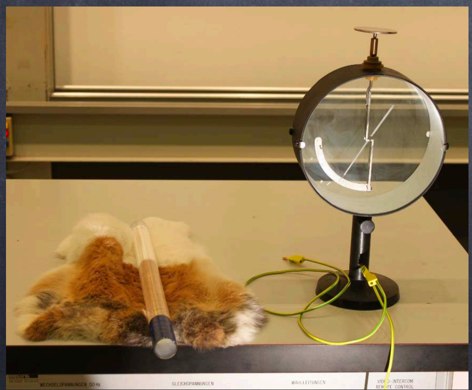
ES20



ES40



ES25



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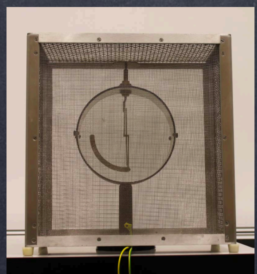
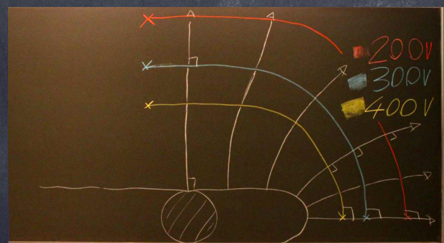


ES26



ES10