v

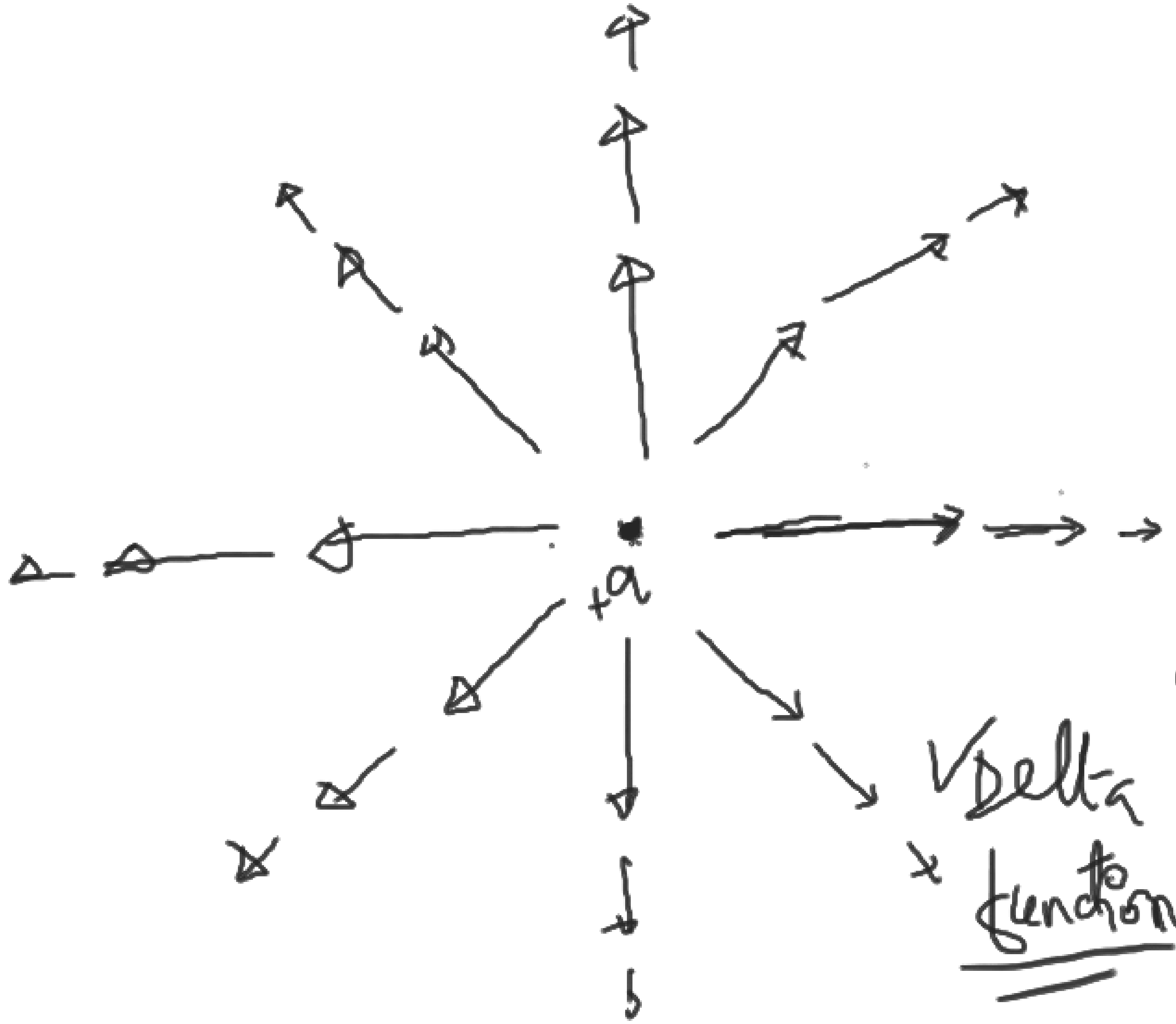
BPT-401

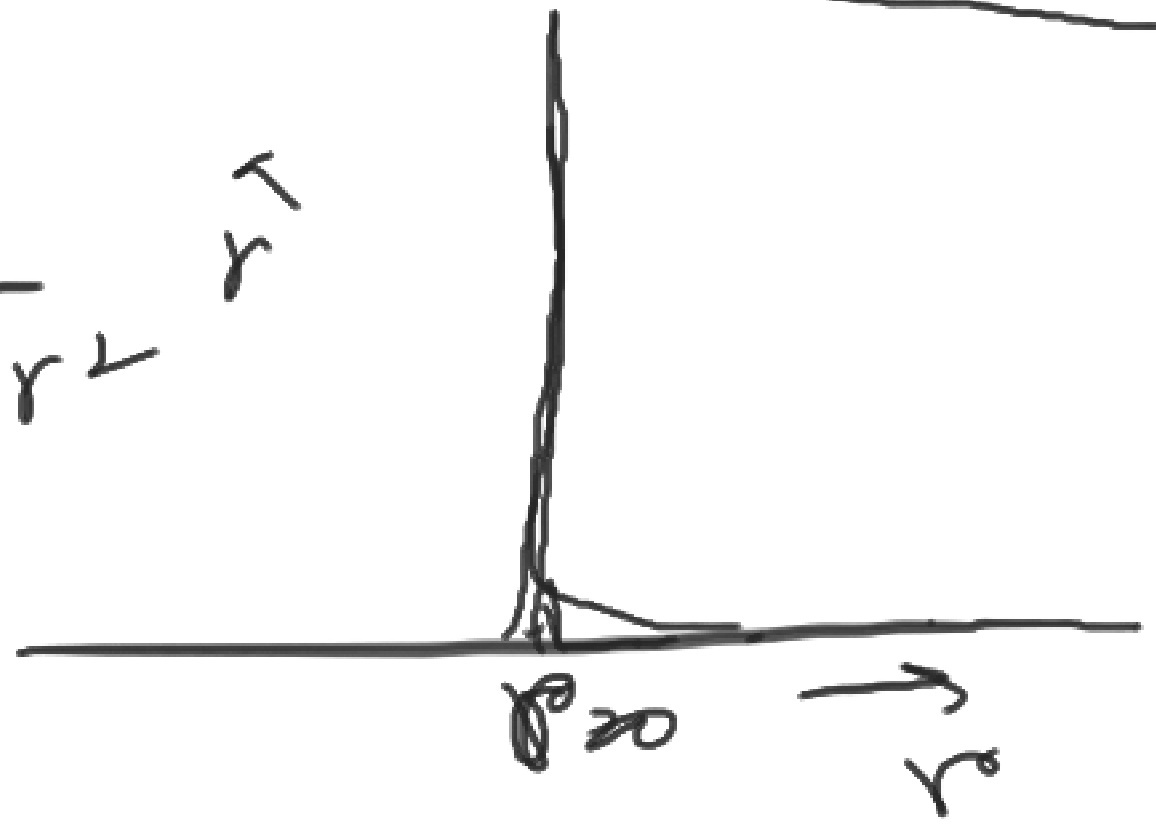
Date - 15/03/2021

sketch

$$\vec{v} = \frac{\hat{r}}{r^2}$$

$$\vec{E} = \frac{q}{4\pi\varepsilon_0 r^2}\hat{r}$$





$$\vec{\nabla} \cdot \vec{v} = 0 \ ?$$

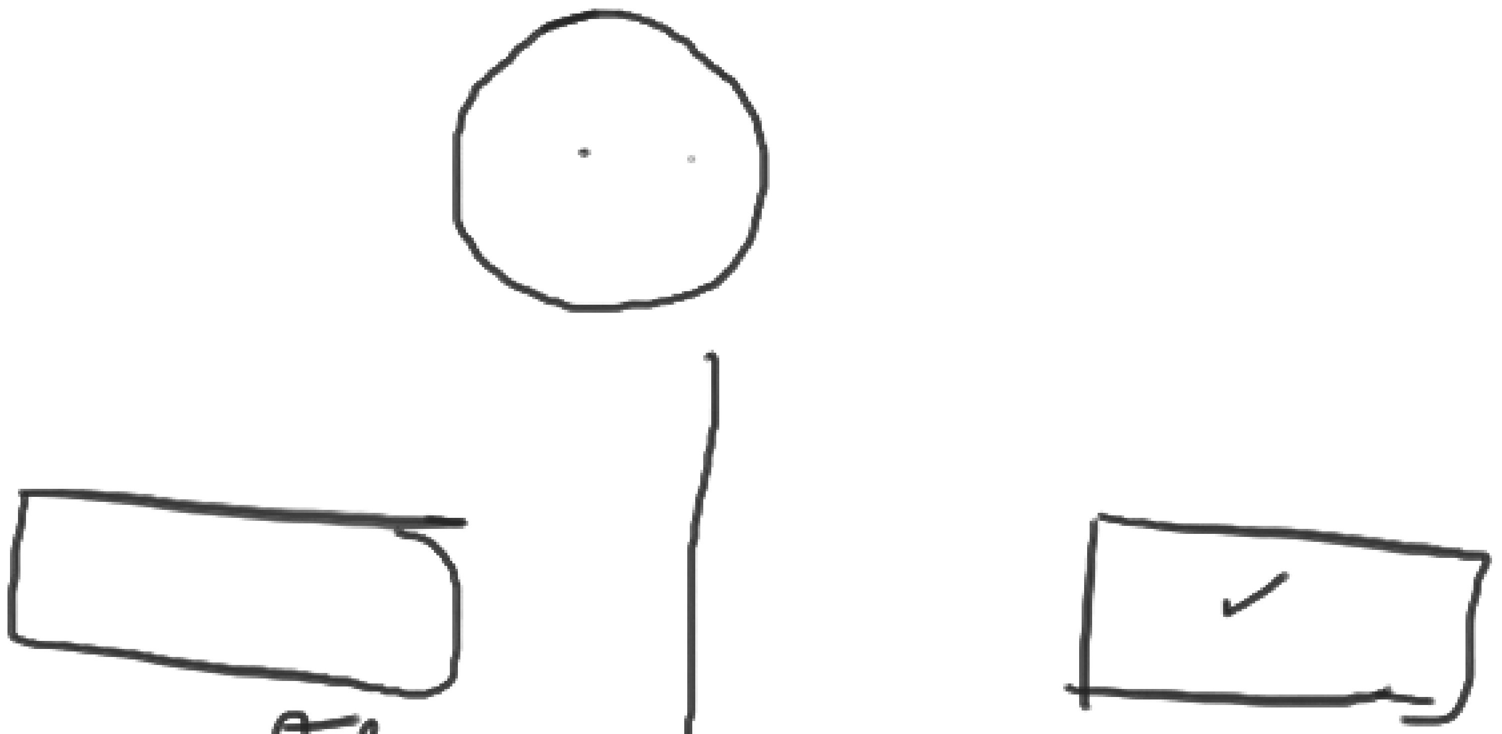
at $r = 0$, $E \to \infty$

Delta function

$$\delta = \begin{cases} \infty & \text{at } r = 0 \\ 0 & \text{at } r \neq 0 \end{cases}$$

Electric field interaction with matter

E



metal

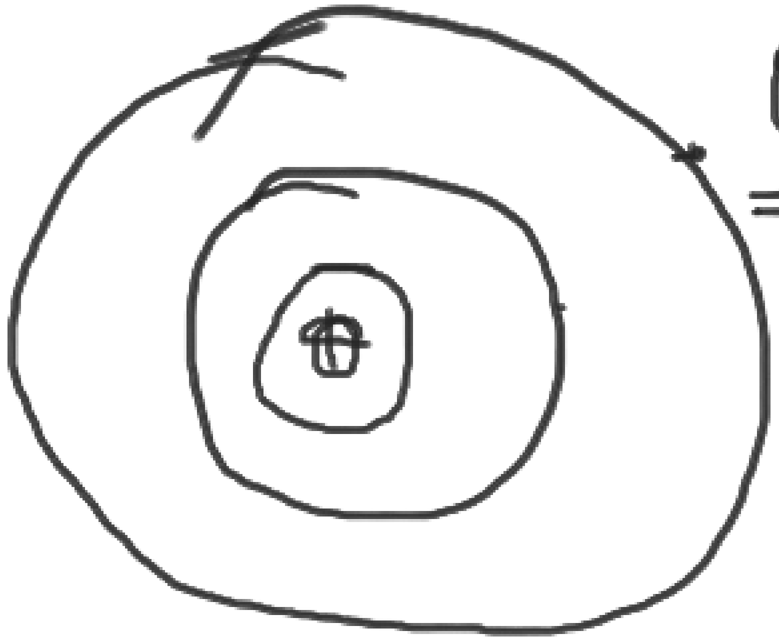
wood

Conductors

Free electrons

Insulators (Dielectrics)

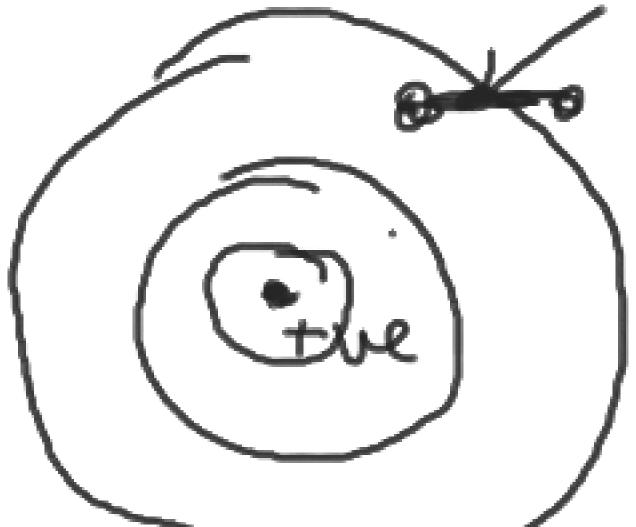
atom of conductors,



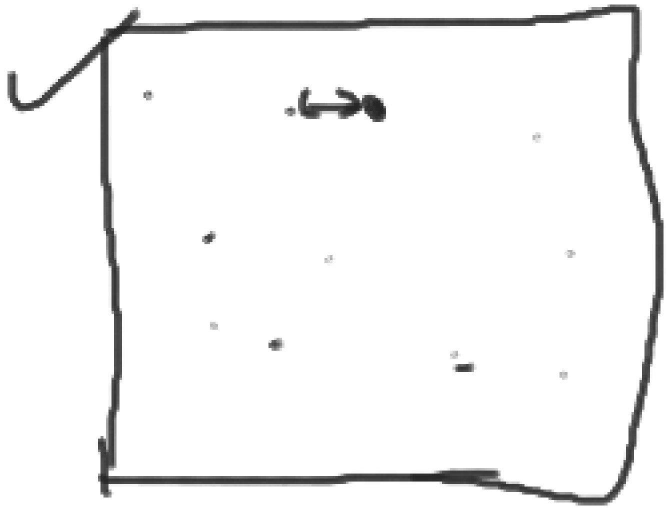
free electrons

$\vec{E}$ interaction with conductors

Insulators $\Rightarrow$ No Free electrons

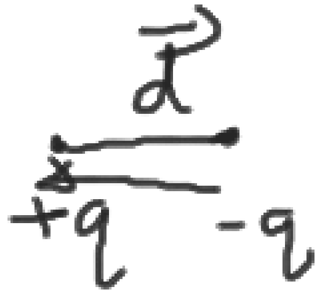


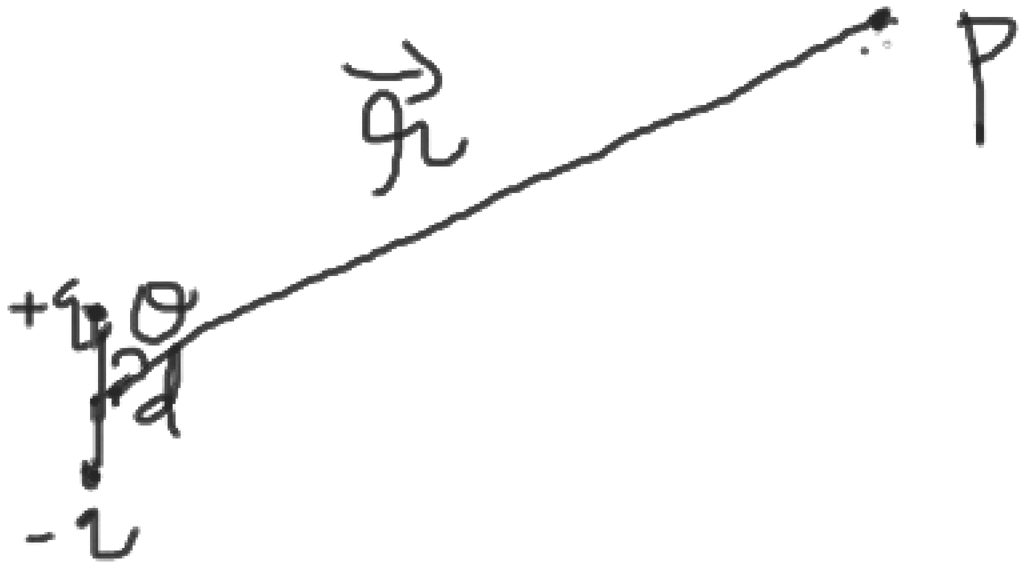
Neutral



10^{23}

Electric dipole:





$r \sim$

$$V(\vec{r}) \cong \frac{1}{4\pi\varepsilon_0} \frac{qd}{r^2} \cos\theta$$

$d \sim 1\,nm$

$10^{-9}\ m$

10^3

$$= \frac{1}{4\pi\varepsilon_0} \frac{\vec{p} \cdot \hat{r}}{r^2}$$

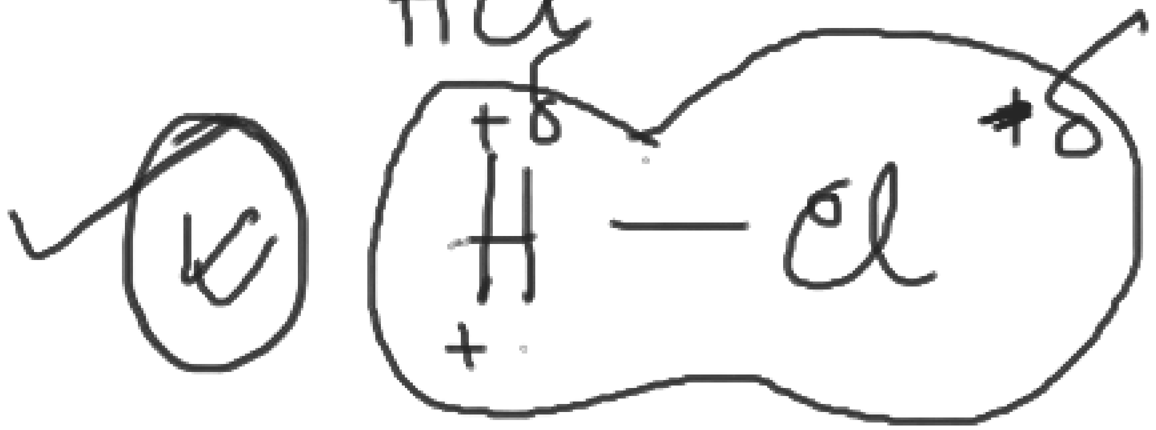
$\vec{p} = q\vec{d}$ dipole moment

$$E_{dip}(r,\theta) = \frac{p}{4\pi\varepsilon_0 r^3}\left(2\cos\theta\,\hat{r} + \sin\theta\,\hat{\theta}\right)$$

$$= \frac{1}{4\pi\varepsilon_0 r^3}\left[3(\vec{p}\cdot\hat{r})\hat{r} - \vec{p}\right]$$

Water $\Rightarrow$

HCl



$+\delta \quad -\delta$

$\bullet\!\longrightarrow\!\bullet$

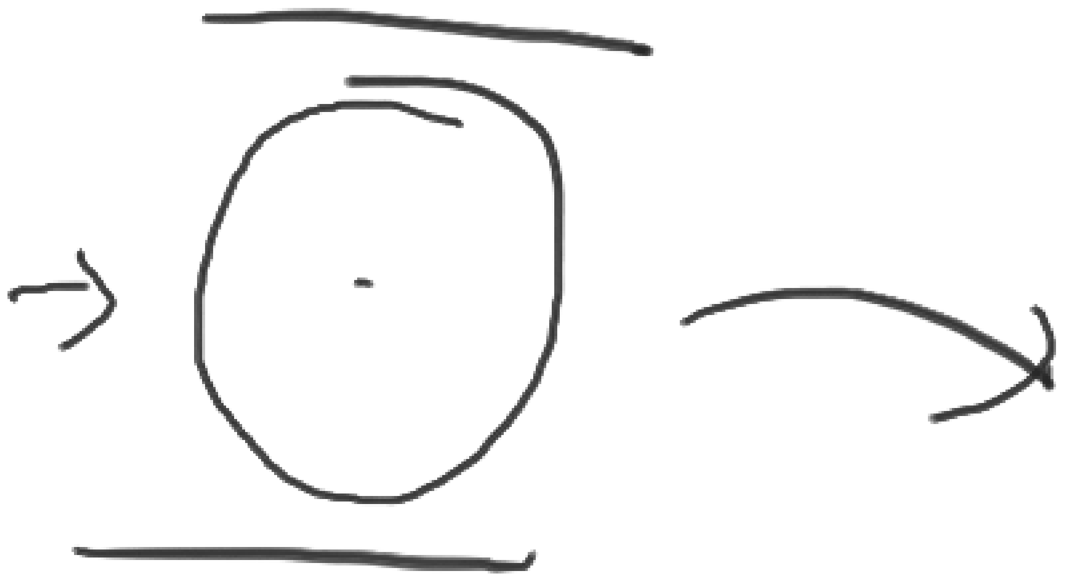
dipole

Cl - electronegative species

Permanent dipole moment – water, Hcl,

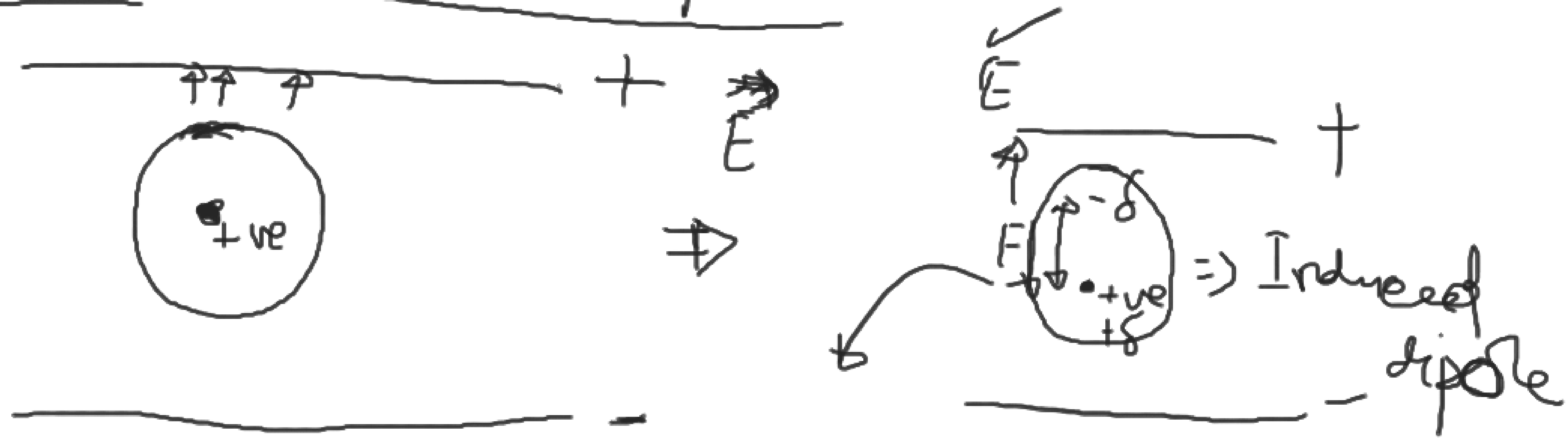
Dielectric which non

Polar dieletrics



non- polar dielectrics

non-polar dielectrics   Induced dipole



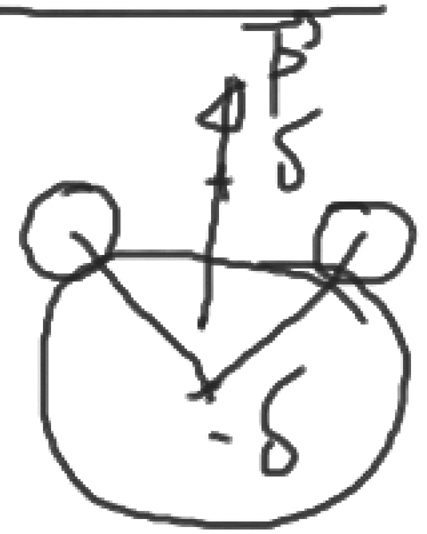
Polarized

Dipole moment ($\vec{p}$) $\propto \vec{E}$

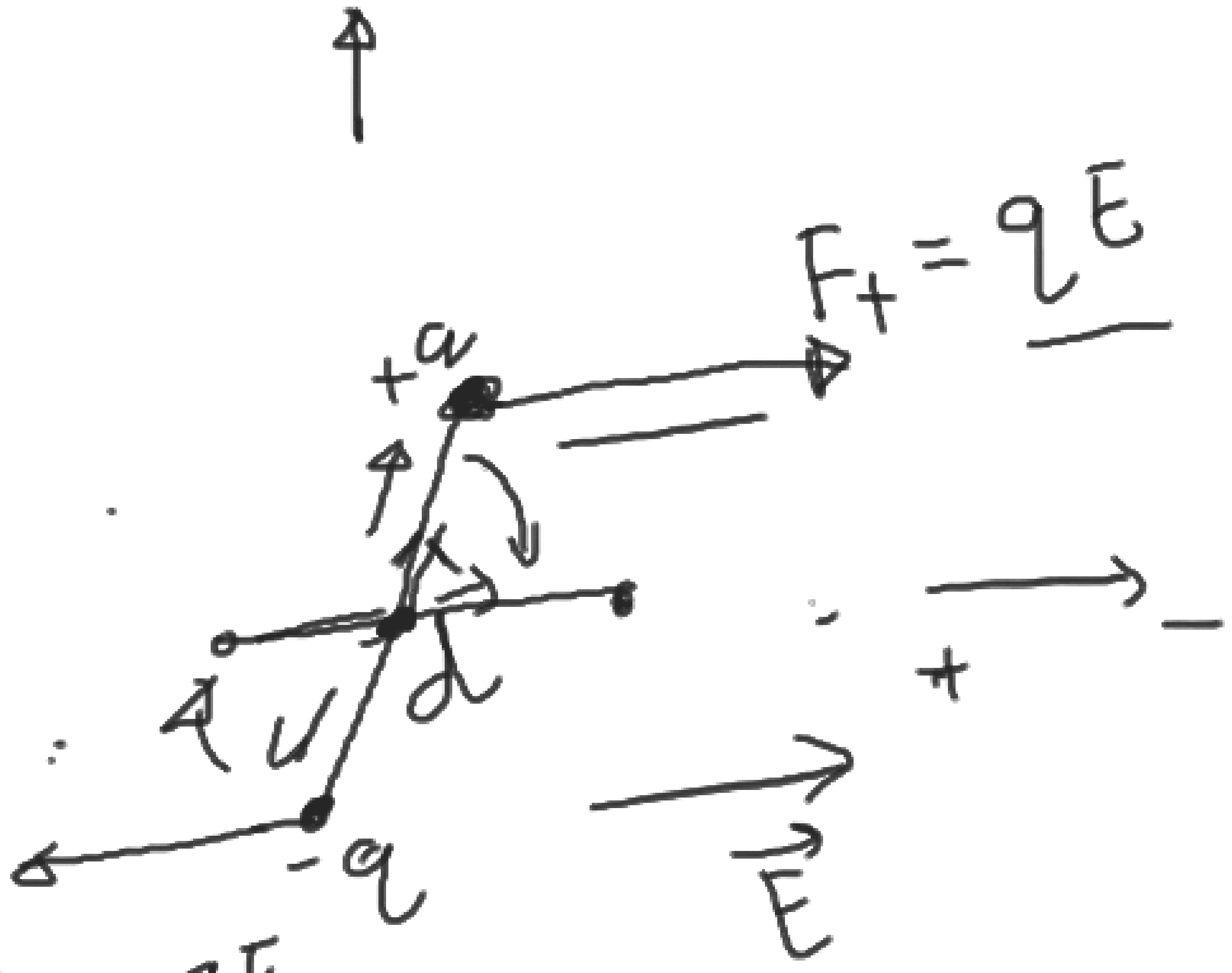
$$\vec{p} = \alpha \vec{E}$$

atomic polarizibility

Alignment of Polar molecules:



Uniform electric field



Torque

$$\vec N = \left(\vec r_+ \times \vec F_p\right) + \left(\vec r_- \times \vec F_-\right)$$

$F_- = -qE$

$$= \left[\frac{\vec d}{2} \times (q\vec E)\right] + \left[\left(-\frac{\vec d}{2}\right) \times (-q\vec E)\right]$$

$$= q\vec d \times \vec E = \vec p \times \vec E$$

✓