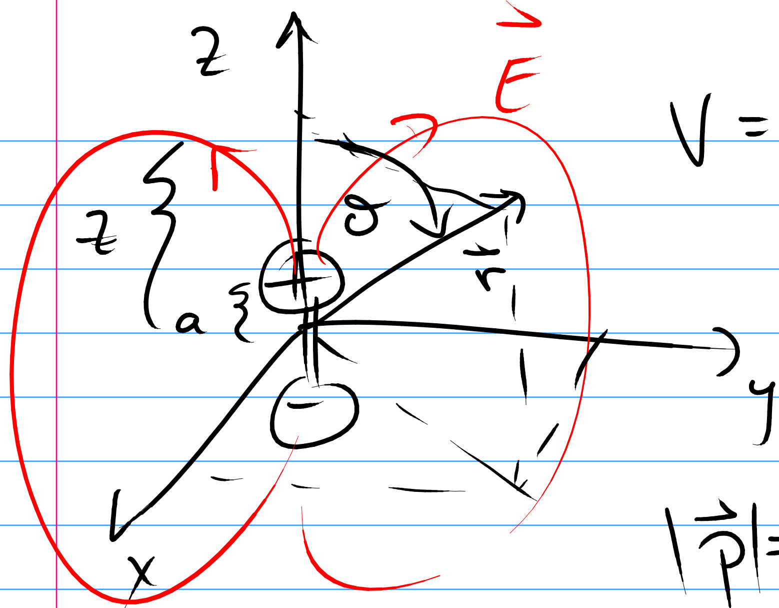


$$V = \frac{\vec{p}\cdot\hat{r}}{4\pi\epsilon_0 r^2} = \frac{|\vec{p}||\hat{r}|\cos\theta}{4\pi\epsilon_0 r^2}$$

$$\vec{r} = x\hat{x} + y\hat{y} + z\hat{z}$$

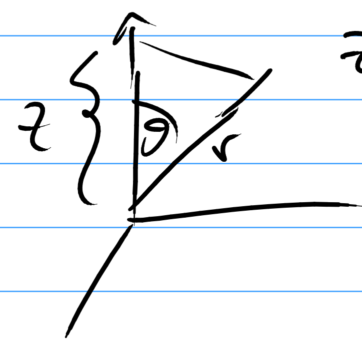
$$|\vec{p}| = 2qa$$

$$\vec{E} = -\vec{\nabla}V = -\left(\hat{x}\frac{\partial}{\partial x}V + \hat{y}\frac{\partial}{\partial y}V + \hat{z}\frac{\partial}{\partial z}V\right)$$

$$r = \sqrt{x^2+y^2+z^2}$$

$$\cos\theta = \frac{z}{r} = \frac{z}{\sqrt{}}$$

$$z = r\cos\theta$$

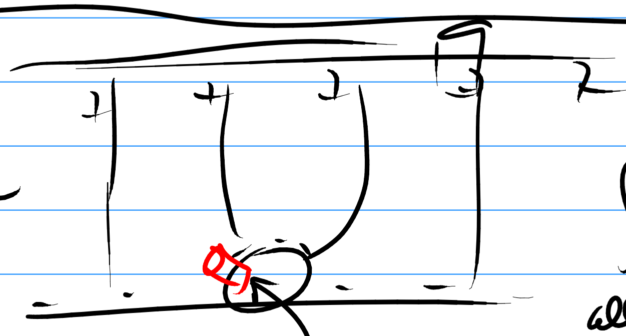


$$V = \frac{P}{4\pi\epsilon_0}\frac{z}{\sqrt{}\left(\sqrt{}\right)^2}$$

$x^2+y^2+z^2$

Capplet

How to determine motion?



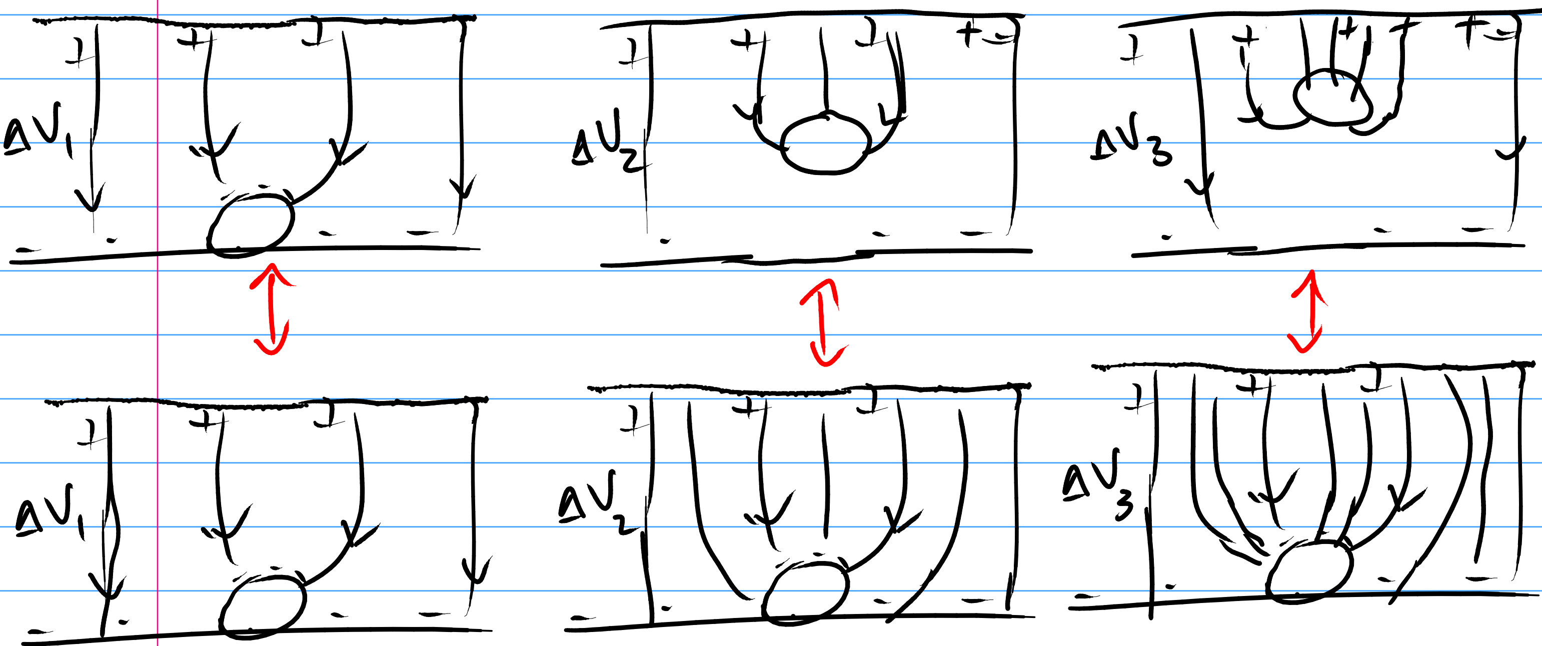
$$\int_{\text{all space}} \frac{1}{2}\epsilon_0 E^2 d\tau$$

all space

use Gauss's law to get dq Then

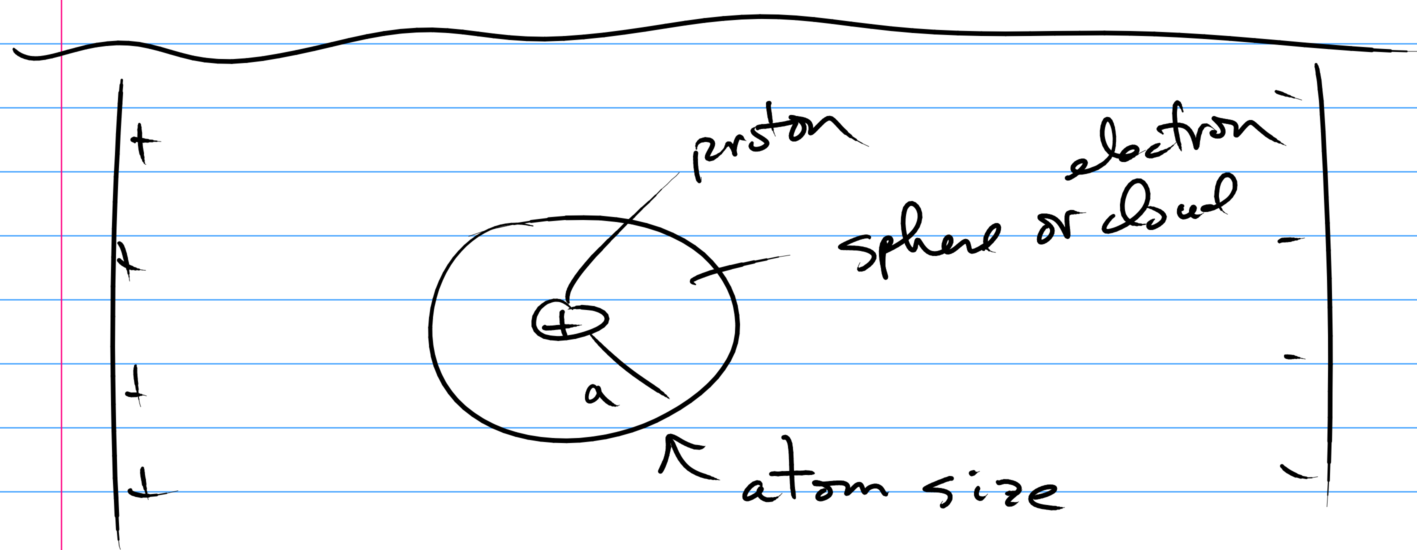
$$\vec{F} = \int d\vec{F} = \int \vec{E}(x,y,z)\, dq(x,y,z)$$

OR calculate the energy in the field for 2 cases

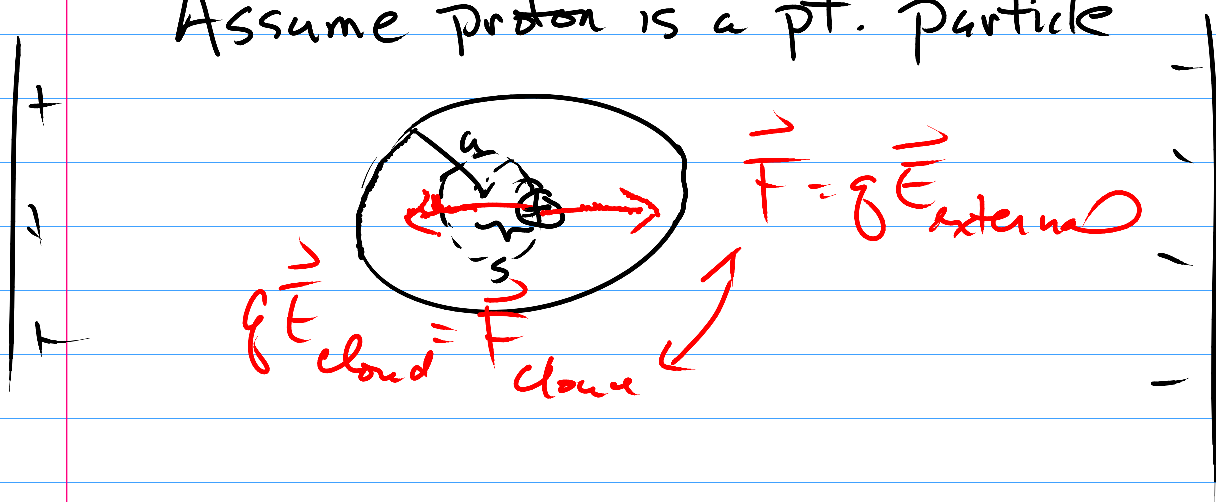


Calculate the energy in the field $\int \frac{1}{2}\epsilon_0 E^2 d\tau$ for each case. The difference in this energy is mgh of the conducting ball as it rises.

Atomic dipole induced by an external field



Assume proton is a pt. particle



$\vec{F} = q\vec{E}_{external}$

$q\vec{E}_{cloud} = \vec{F}_{cloud}$

$E_{cloud} = E_{external}$