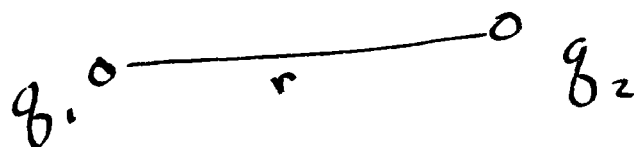


Last class

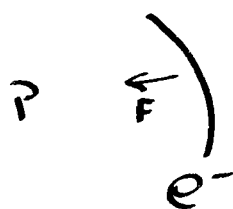


Coulombs
Law

$$\vec{F} = k \frac{q_1 q_2}{r^2} \hat{r}$$

- sign \rightarrow attractive
+ sign \rightarrow repulsive

Example



Hydrogen Atom

$$m_e = 9.11 \times 10^{-31} \text{ kg}$$

$$r_{\text{radius}} \sim 5.3 \times 10^{-11} \text{ m}$$

$$q_e = q_p = 1.6 \times 10^{-19} \text{ coul}$$

(a) velocity of e^- ?

$$F_{\text{centripetal}} = \frac{m v^2}{r}$$

Electrostatics

$$\frac{k q_1 q_2}{r^2} = \frac{m v^2}{r} \quad \rightarrow \quad v = 2.2 \times 10^6 \text{ m/s}$$

(b) How much energy is required to ionize Hydrogen ?

just about the most fundamental question you can
ask abt the element
lots of chemistry in this

Whoa! back to our course

Coulomb's Law

$$k \equiv \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \frac{\text{N}\cdot\text{m}^2}{\text{C}^2}$$

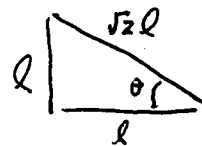
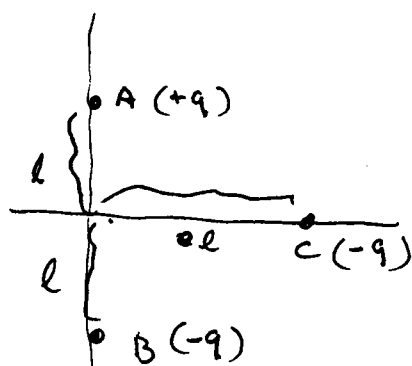
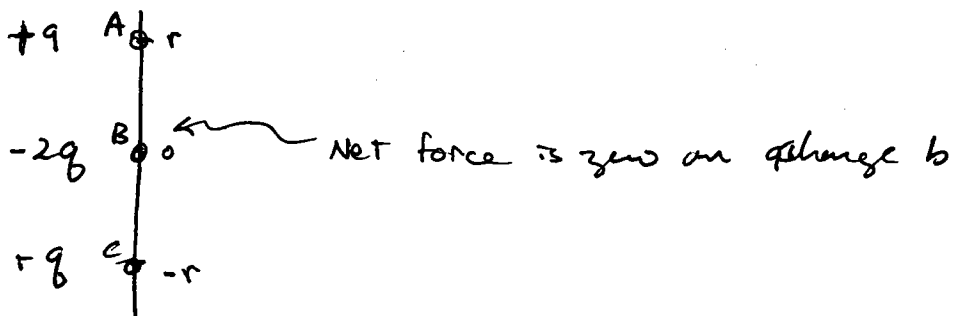
$\epsilon_0 \equiv$ Permittivity of free space

$$\epsilon_0 = 8.85 \times 10^{-12} \frac{\text{C}^2}{\text{N}\cdot\text{m}^2}$$

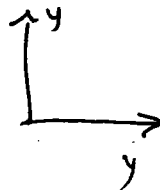
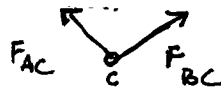
Fundamental
Remember
This !!

$$\vec{F}_{12} = k \frac{q_1 q_2}{r_{12}^2} \hat{r}$$

Vector equation : superposition holds



$$\sin \theta = \frac{l}{\sqrt{2}l} = \frac{1}{\sqrt{2}}$$



$$\sum F_x : (F_{Ac})_x + (F_{Bc})_x = 0$$

$$\sum F_y : |F_{Ac}| \sin \theta + |F_{Bc}| \sin \theta$$

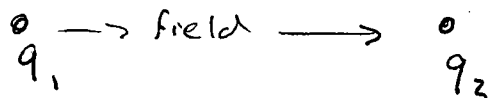
$$= |F_{Ac}| \frac{1}{\sqrt{2}} + |F_{Bc}| \frac{1}{\sqrt{2}}$$

$$= \frac{2}{\sqrt{2}} \frac{k(9)(9)}{(\sqrt{2}l)^2} \hat{y} \text{ up in } y$$

Symmetry

↑
↓
Do this
example





Field vs. action at a distance

↳ if q_1 moves ... change in field propagates at c
field disturbance

Electric field

electric field strength \vec{E} defined as

Fundamental
⇒ Remember
this

$$\vec{E} = \vec{F} / q_0$$

where q_0 is some ^{positive} test charge.

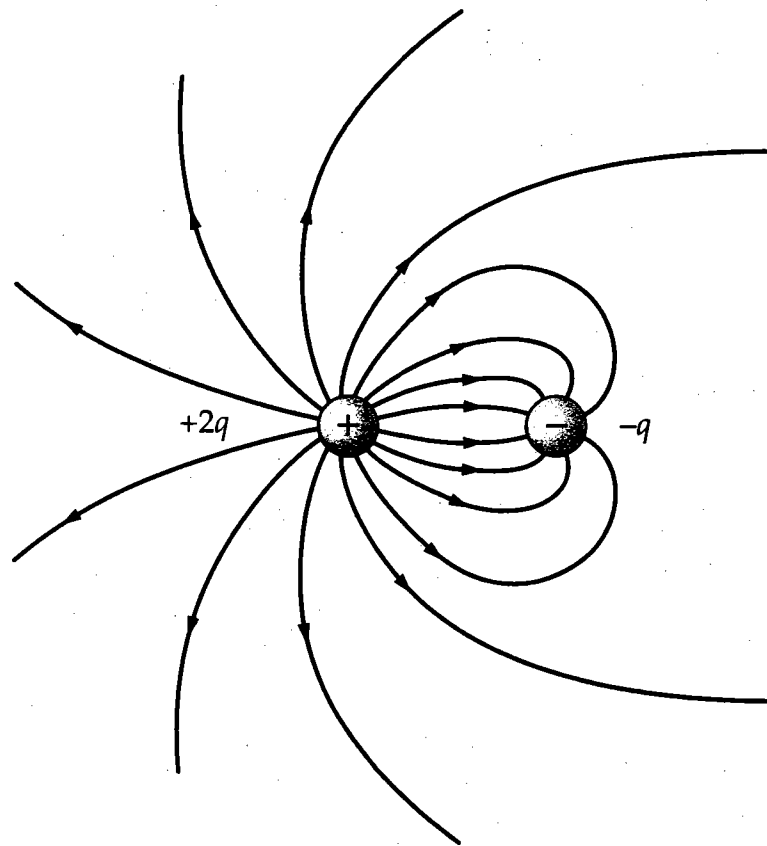
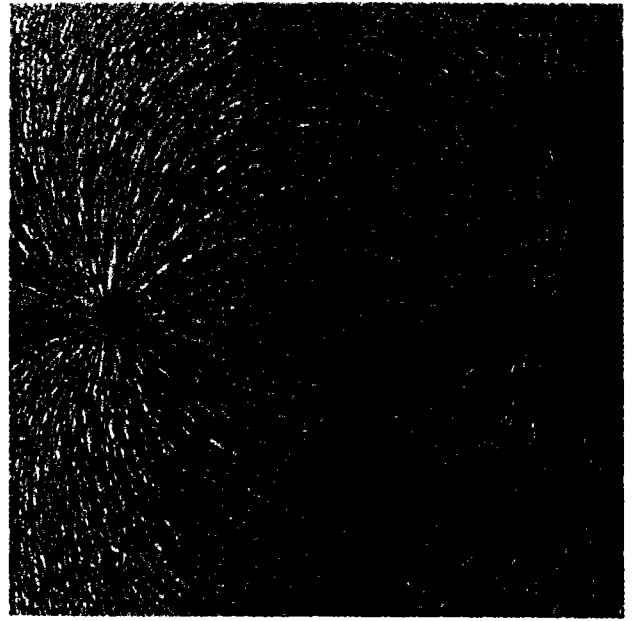
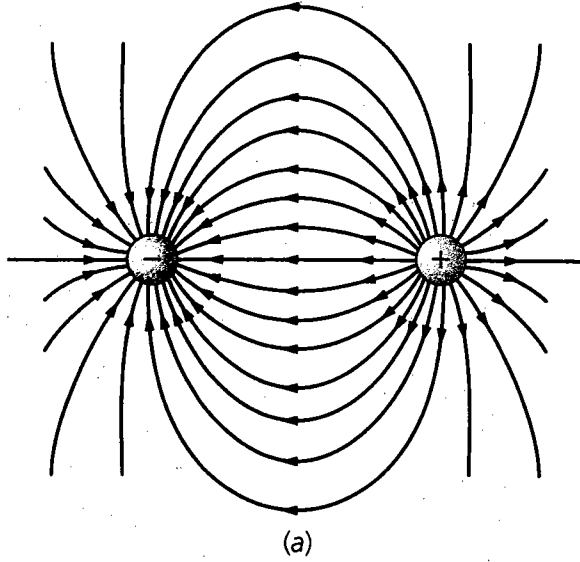
\vec{F} is \vec{F} due to electrostatic force on q_0

Electric Field lines - lines of force

useful for visualizing problems

- Tangent to line of force gives \vec{E} ^{direction only} at that point
- Start on \oplus charge or ∞
- End on \ominus charge or ∞
- density of lines \propto magnitude of \vec{E}
- lines never cross

Electric field lines for an electric dipole (top) and for two point charges $+2q$ and $-q$ (bottom)

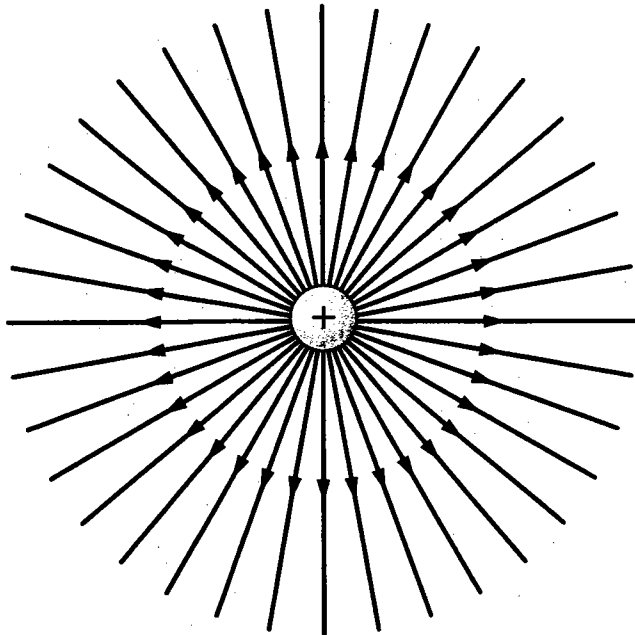


Transparency 1

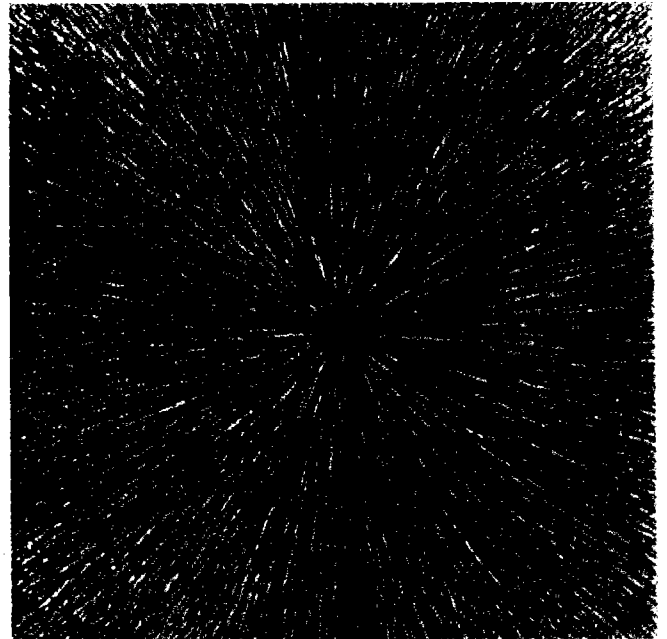
Figure 22-17, page 672; Figure 22-18, page 672

Electric field lines for one positive point charge (top)
and for two positive point charges (bottom)

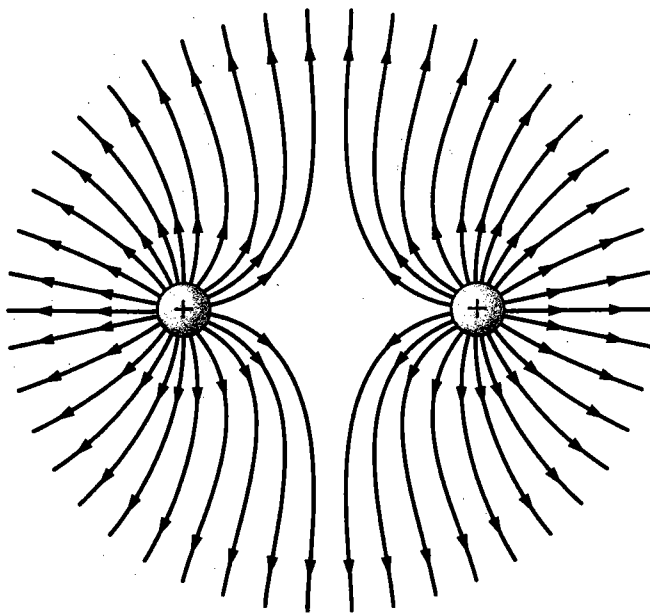
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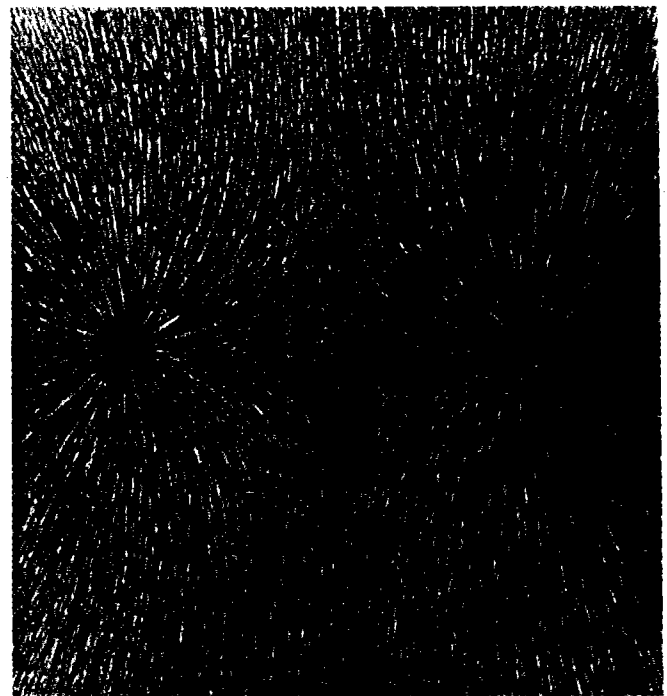
(a)



(b)



(a)



(b)