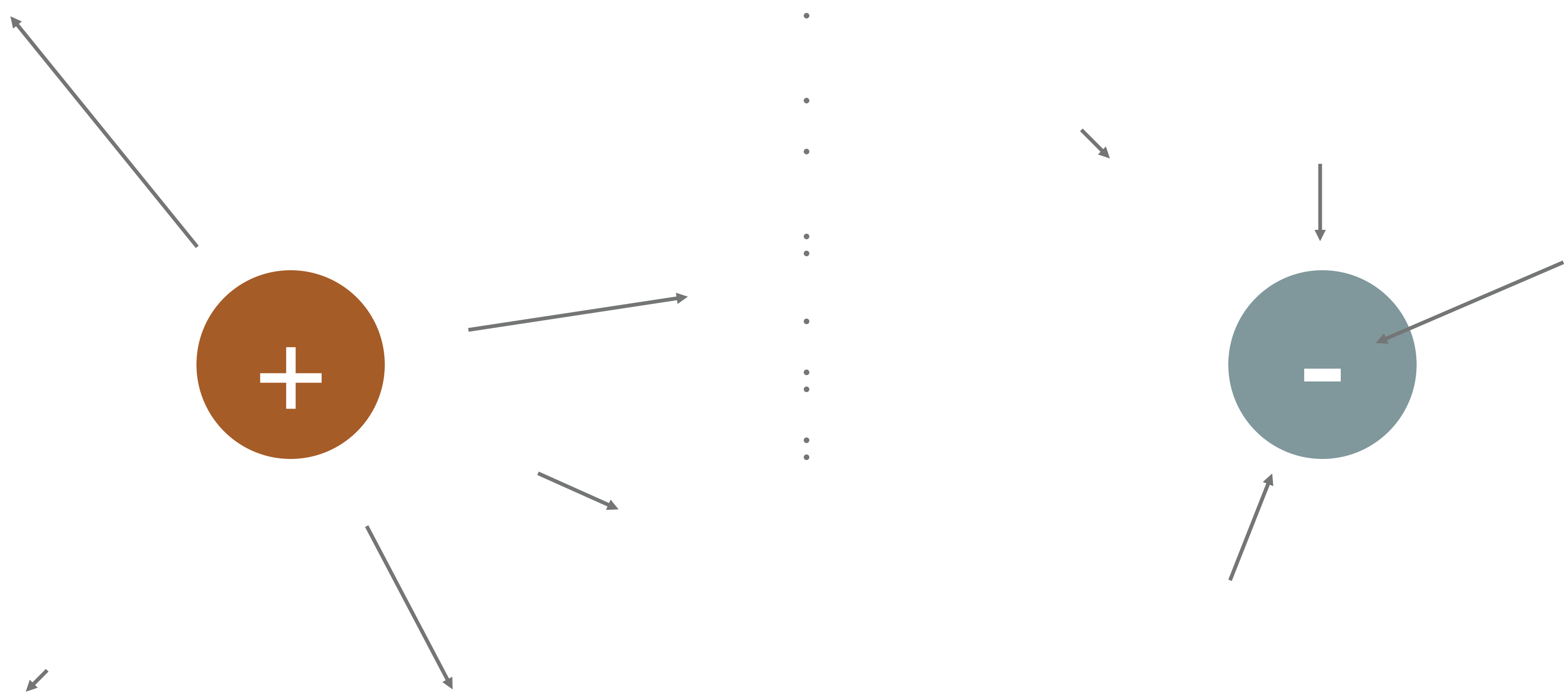
CHAPTER 22 – ELECTRIC FIELDS

PONDERABLE *How is this interaction transmitted between charged matter?*

THE ELECTRIC FIELD



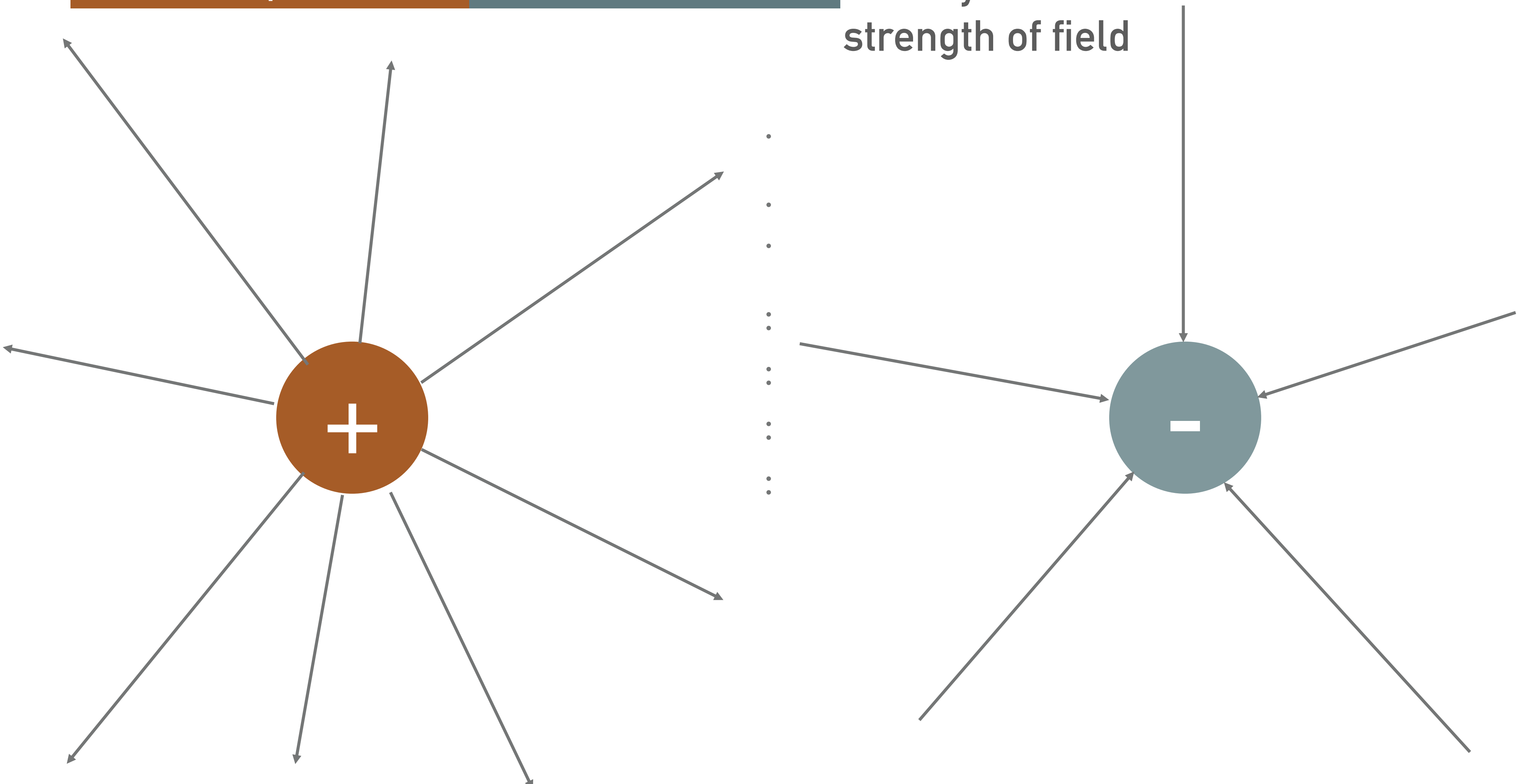
Away from positive charged objects

Towards negative charged objects

CHAPTER 22 – ELECTRIC FIELDS

Alternate Representation ELECTRIC FIELD LINES

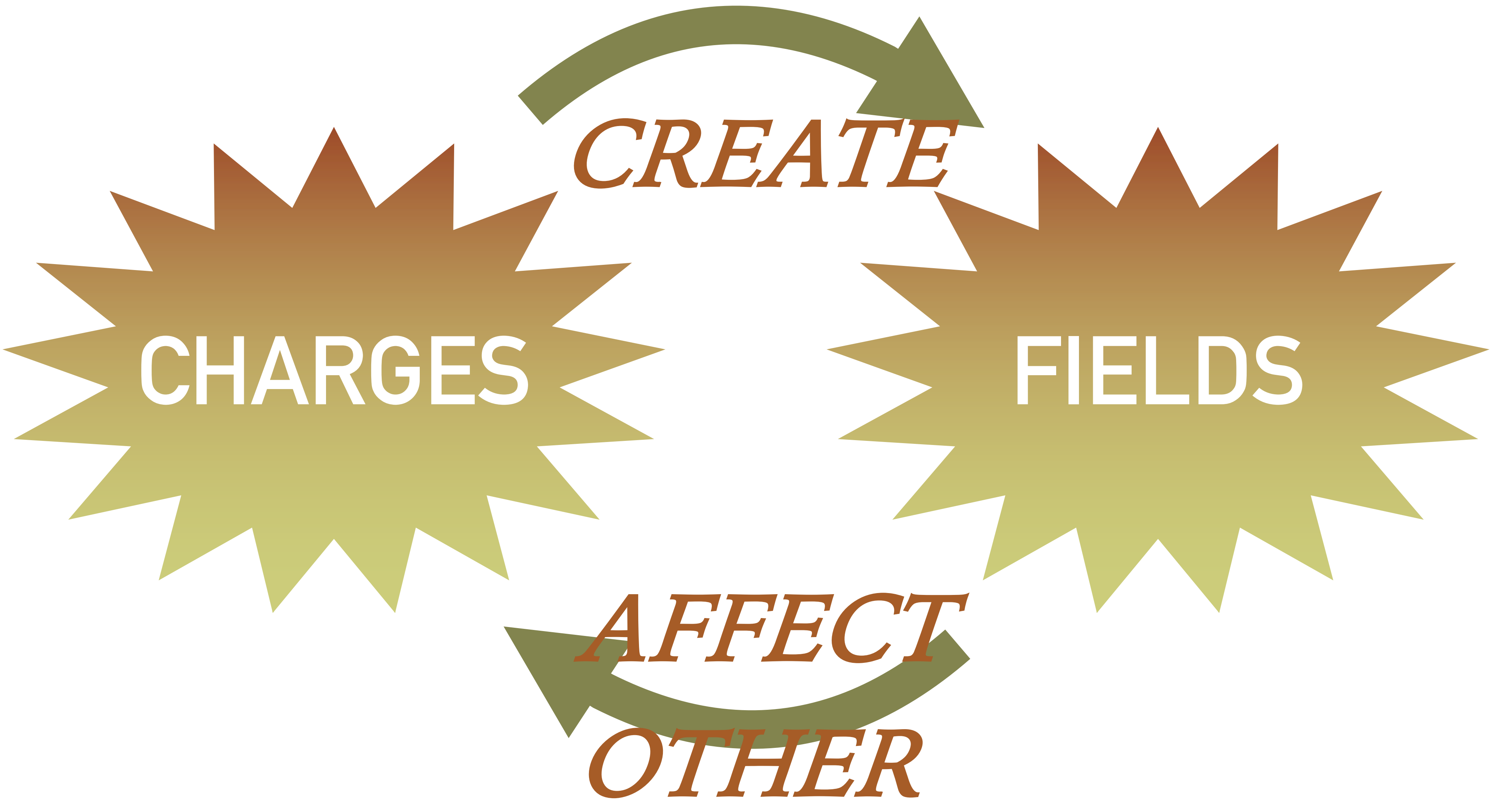
Density of field lines indicates strength of field



Away from positive charged objects

Towards negative charged objects

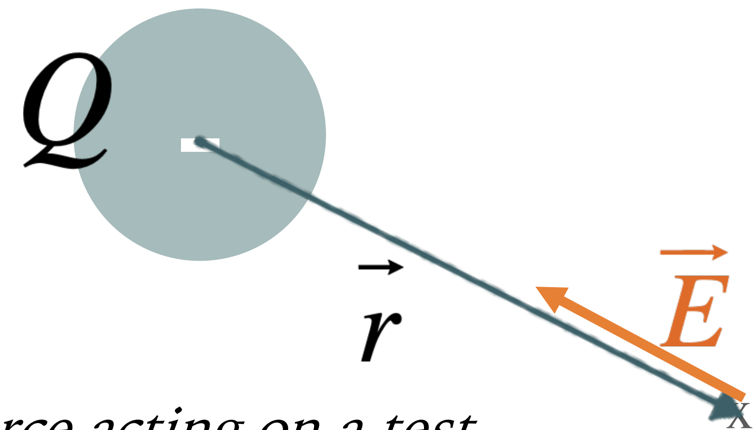
CHAPTER 22 - ELECTRIC FIELDS



CHAPTER 22 – ELECTRIC FIELDS DUE TO A SINGLE CHARGE

MAGNITUDE OF ELECTRIC FIELD

$$\vec{E}_{net} = \frac{\vec{F}_{net}}{q}$$



NET *Electric field at point equals the force acting on a test charge at this observation location, divided by the amount of charge on the test charge.*

NET Electric field at an observation location due to the CHARGE(S) in the SURROUNDINGS.

The electric field due to one of these charges is

$$\vec{E}_{\text{charge}} = \frac{1}{4\pi\epsilon_0}\frac{Q}{|\vec{r}|^2}\hat{r}$$

CHAPTER 22 – ELECTRIC FIELDS AND FORCES

Electric Fields and Electric Forces

Charges experience a force due to the NET ELECTRIC FIELD at its locati

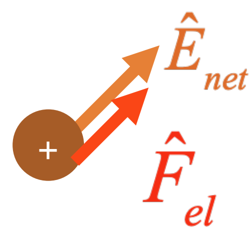
$$\vec{F}_{el} = q\vec{E}_{net}$$

q is the charge on the object at the location of E_{net}

Directions of Forces

$$\hat{F}_{el} = q\hat{E}_{net}$$

↗ $=(+)$ ↗

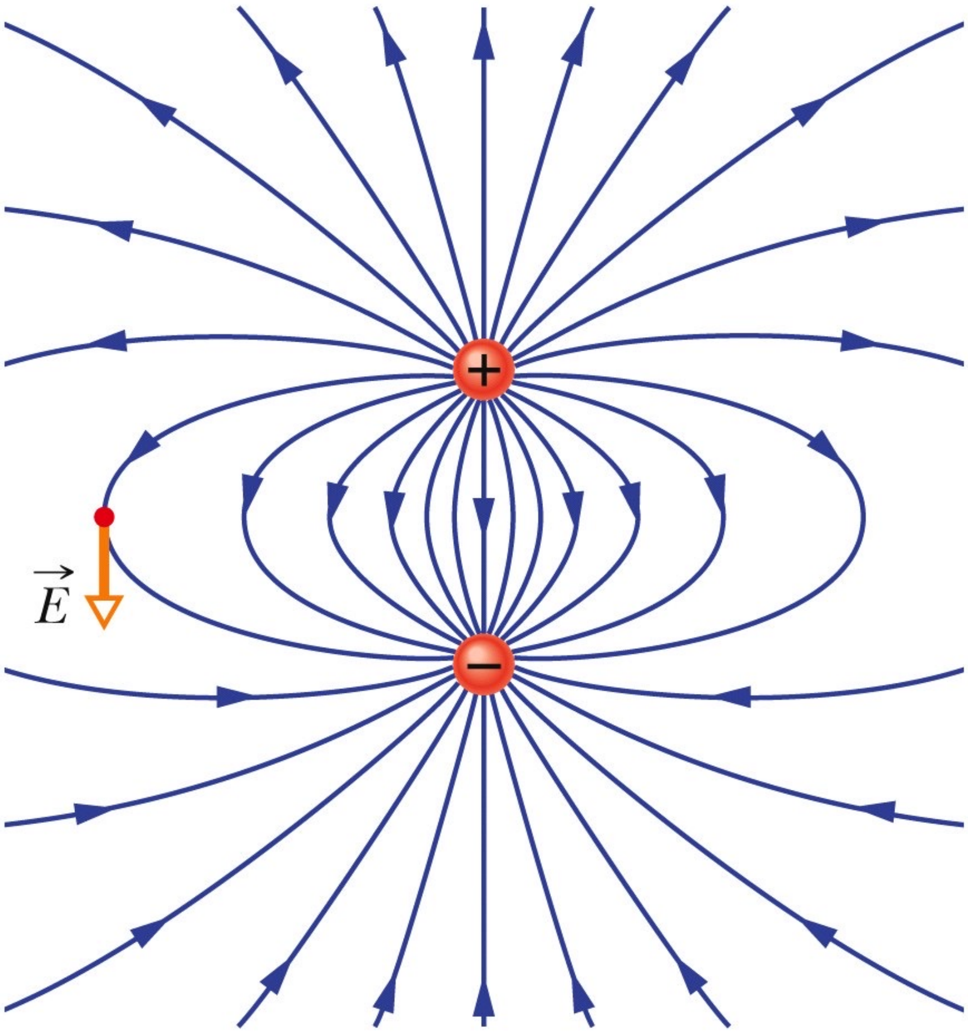


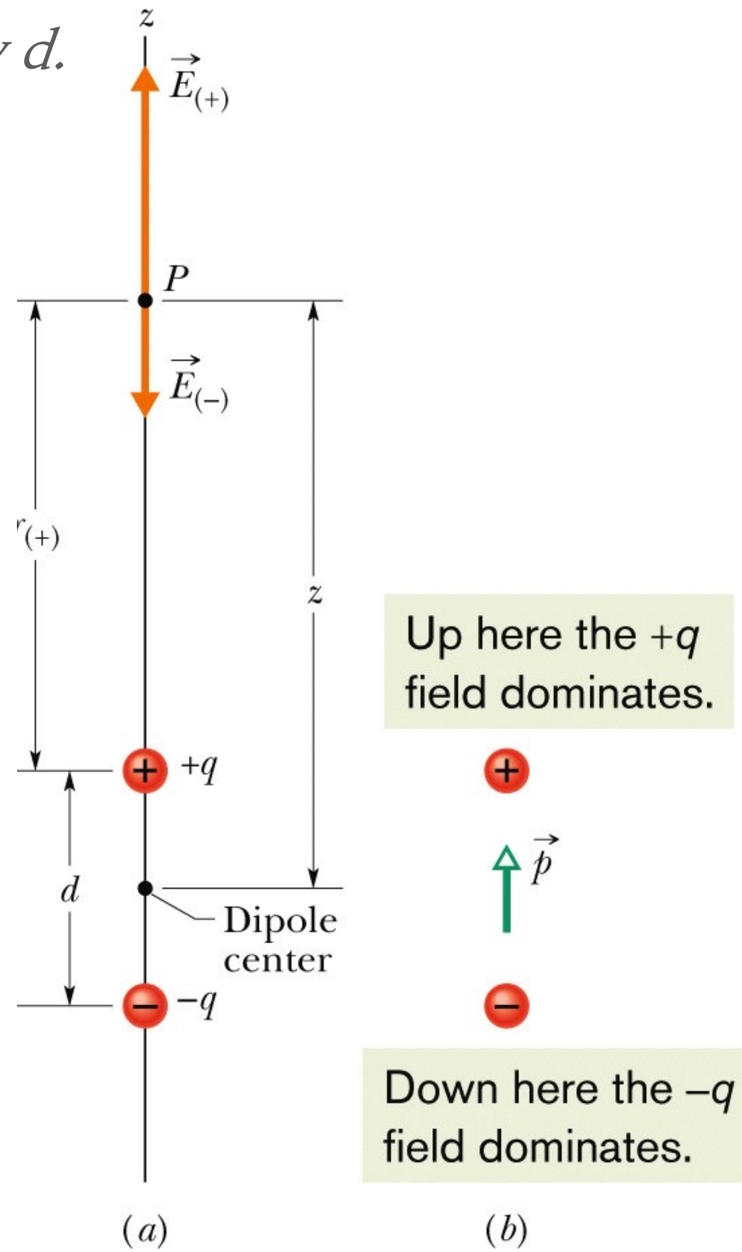
Magnitudes of Forces

$$\left|\vec{F}_{el}\right| = \left|q\right|\left|\vec{E}_{net}\right|$$

*UPSHOT: Don't need to remember if things are attracted or repelled, which only works for a few number of charges anyway. Instead, focus on first determining **Enet**, which then requires just one more thing to get the force — the object placed at the observation location!*

Dipoles *Two charges, +Q and -Q, separated by d.*





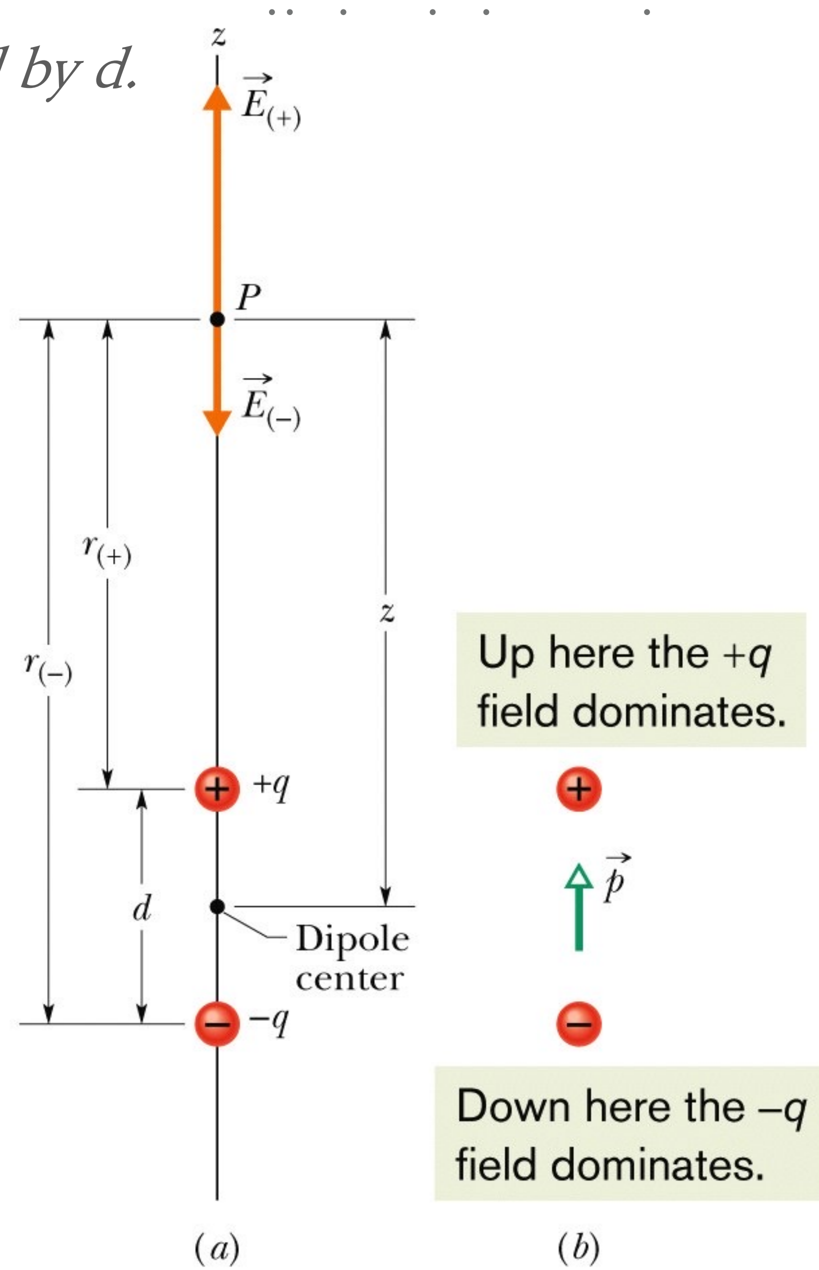
CHAPTER 22 – ELECTRIC FIELDS

Dipoles *Two charges, +Q and -Q, separated by d.*

$$|\vec{E}_{||,axis}| = k\frac{2qd}{z^3} = k\frac{2p}{z^3}$$

$$when\ d \ll z$$

p = qd, is the dipole moment, and points from negative charge to positive charge



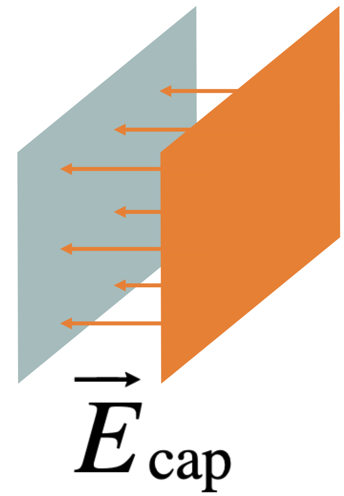
CHAPTER 22 – UNIFORM ELECTRIC FIELDS

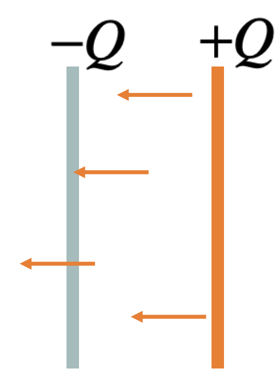
CAPACITORS!

Two conducting parallel plates, oppositely charged, +Q and -Q, separated by some insulator.

$$\left|\vec{E}_{\text{cap}}\right| = \frac{Q/A}{\varepsilon_0}$$

$$\epsilon_0 = 8.85\times10^{-12}\ \frac{\text{C}^2}{\text{Nm}^2}$$





Uniform Electric Fields are sweet!

CHAPTER 22 – UNIFORM ELECTRIC FIELDS

CAPACITORS! Numerical Example Problem, A Classic!

An electron, with an initial velocity of $4.7x10^7$ m/s ***i*** *is fired through two horizontal capacitor plates, which causes a downward deflection in the electron's path. Each plate is square, measuring 6 cm on a side. Each plate has a net charge |Q|=3nC.*

What is the speed, direction, and vertical deflection of the electron when it leaves the plates?