Review Session: Tuesday, 9/27 7:30-9 pm : Location TBA

In-class quiz 1: Thursday, 9/22 4:30-4:55 pm

[to be returned on Tuesday, solutions will be posted right away]

Plan for 3~4 quizzes in the semester to be worth 5 % of the total grade

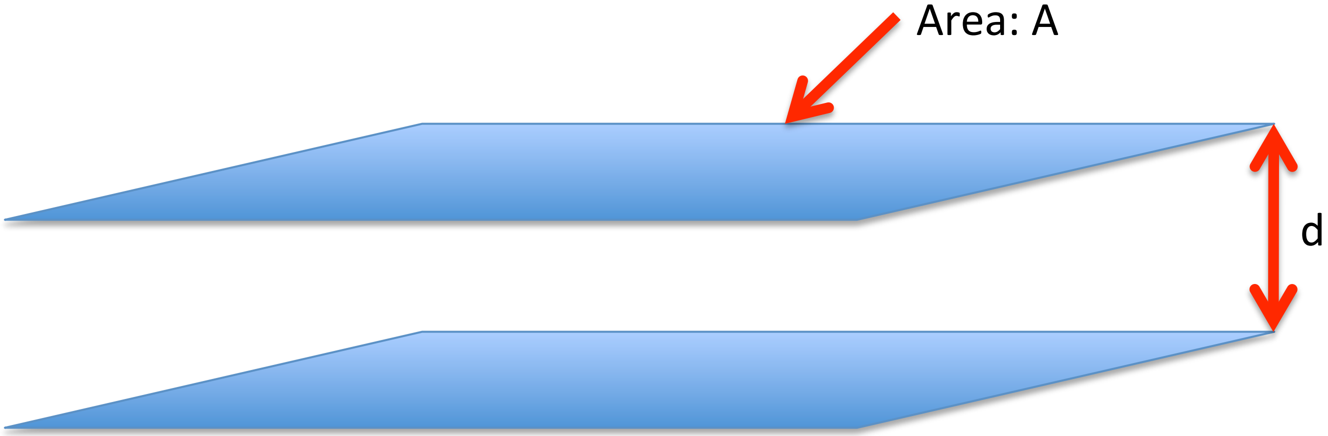
Exam format: to be announced on Thursday

Capacitance

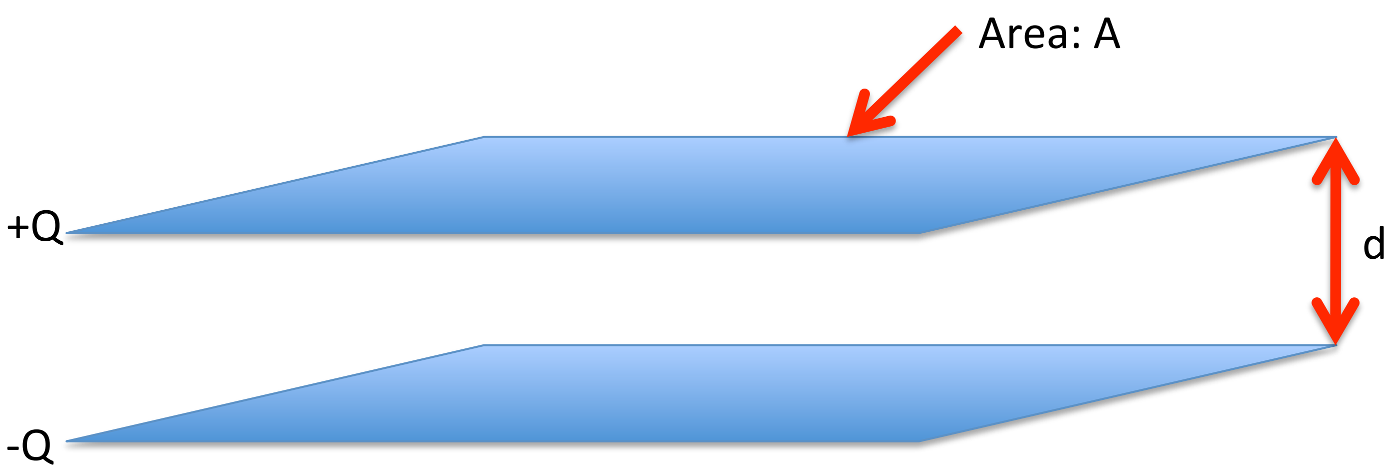
$$C = \frac{Q}{|\Delta V|}$$

Units: Farads (Coulomb per Volt)

Example 1: Parallel Plate Capacitor



Calculate the capacitance of parallel plate capacitor

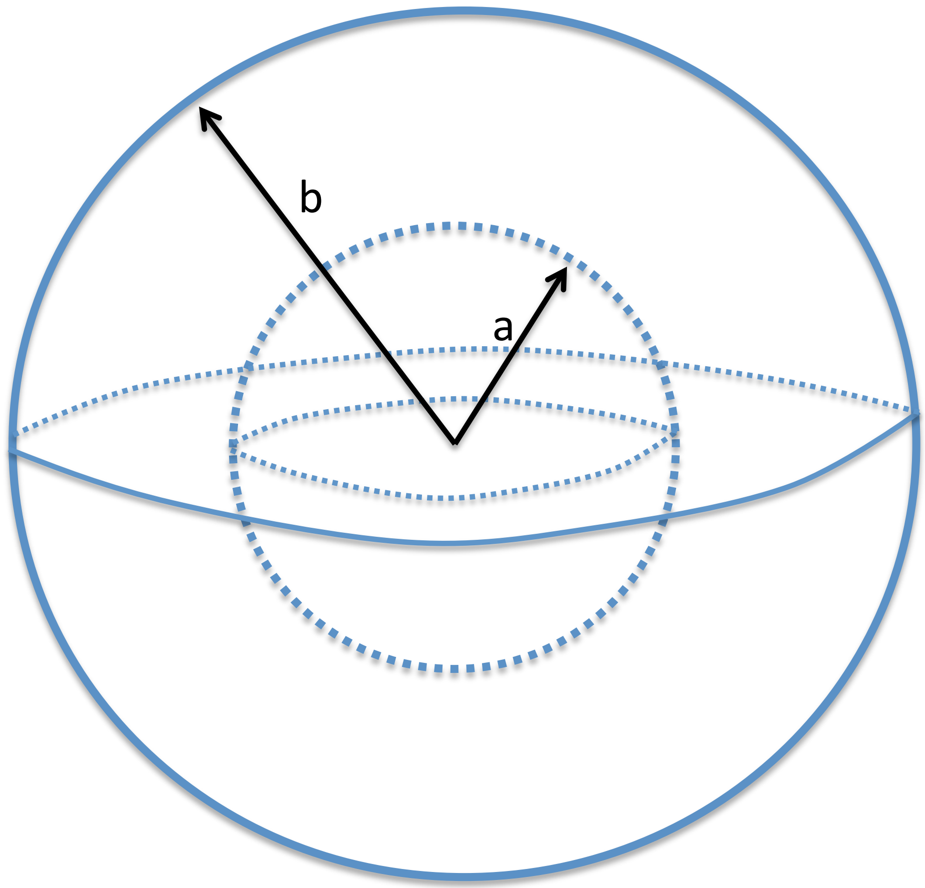


1. Put equal and opposite charge on each plate (imagine)
2. Calculate the voltage difference between the plates
3. Apply $C = \frac{Q}{|\Delta V|}$

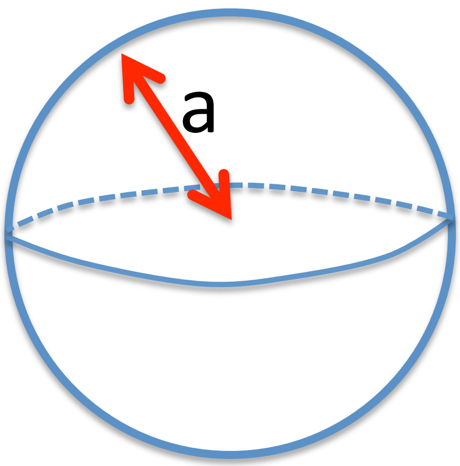
When you apply voltage how much charge will you induce?

$$C = \frac{A\varepsilon_0}{d}$$

Spherical capacitor



Example: Conducting sphere with charge Q and radius a

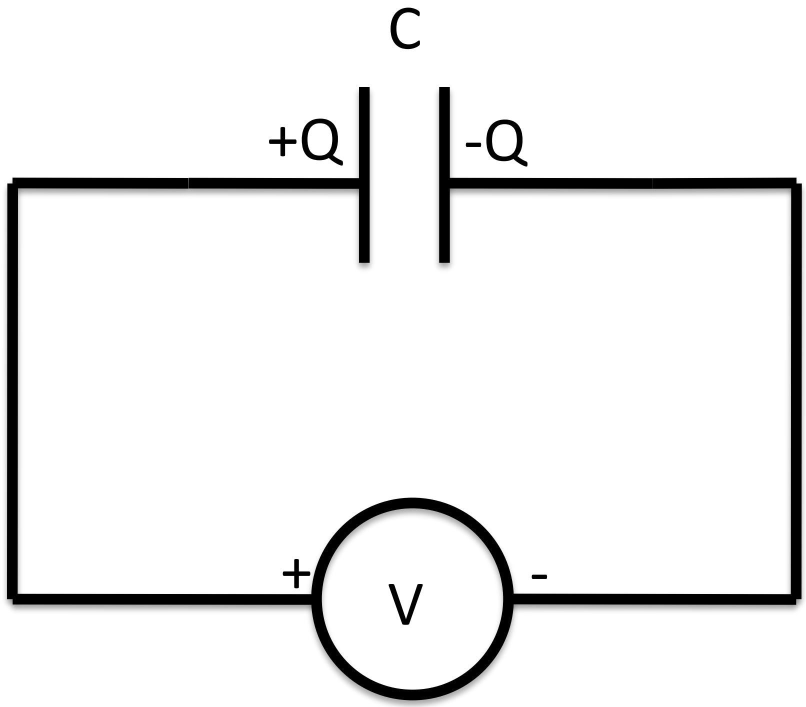


$$V(a) = \frac{1}{4\pi\varepsilon_0}\frac{Q}{a}$$

$$Q = CV(a)$$

$$C = 4\pi\varepsilon_0 a$$

Capacitor

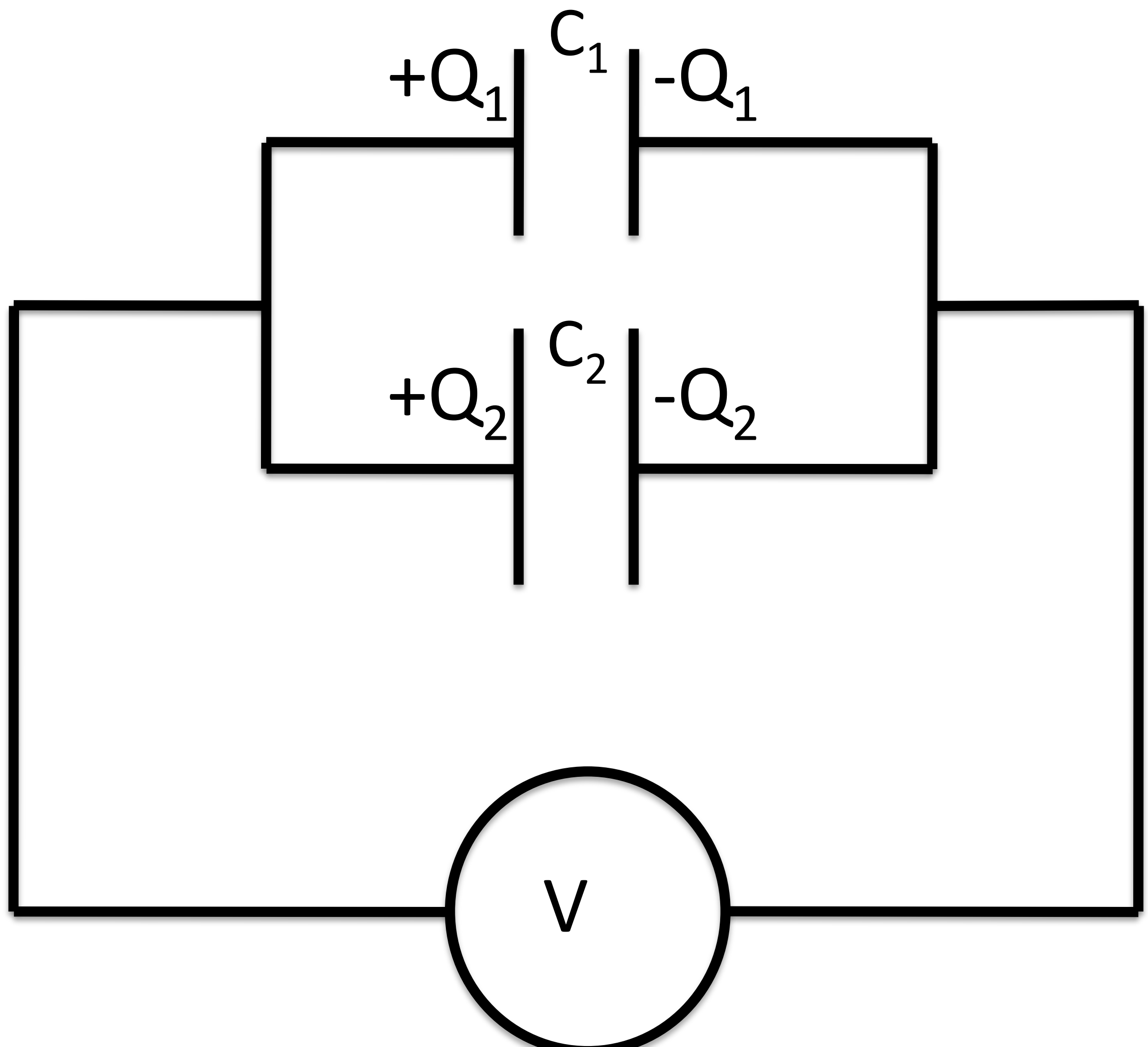


$$C = \frac{Q}{|\Delta V|}$$

Example: 12 V applied on 1 μF capacitor

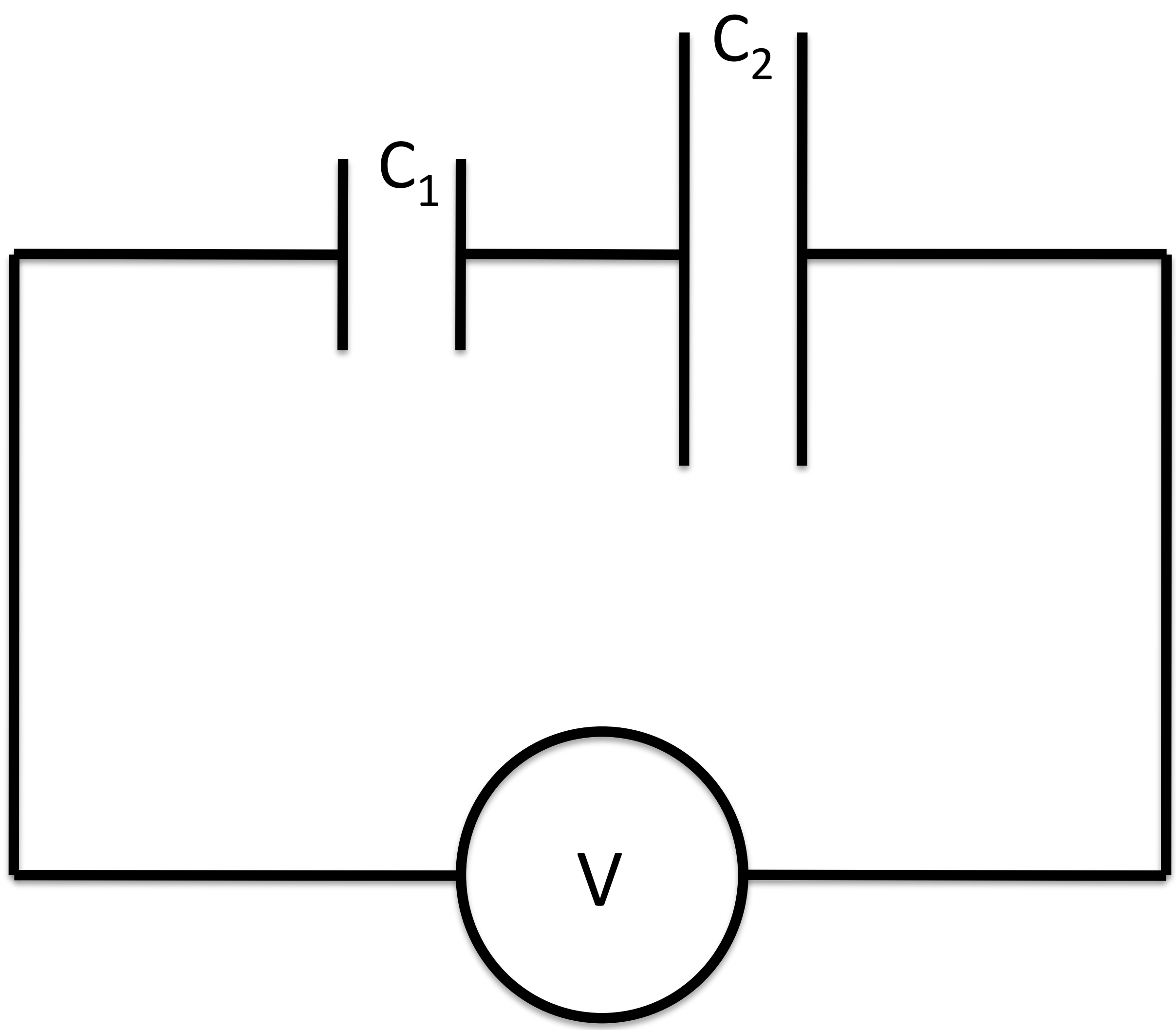
Means there are 12 μC of charge on each plate

Capacitors in parallel

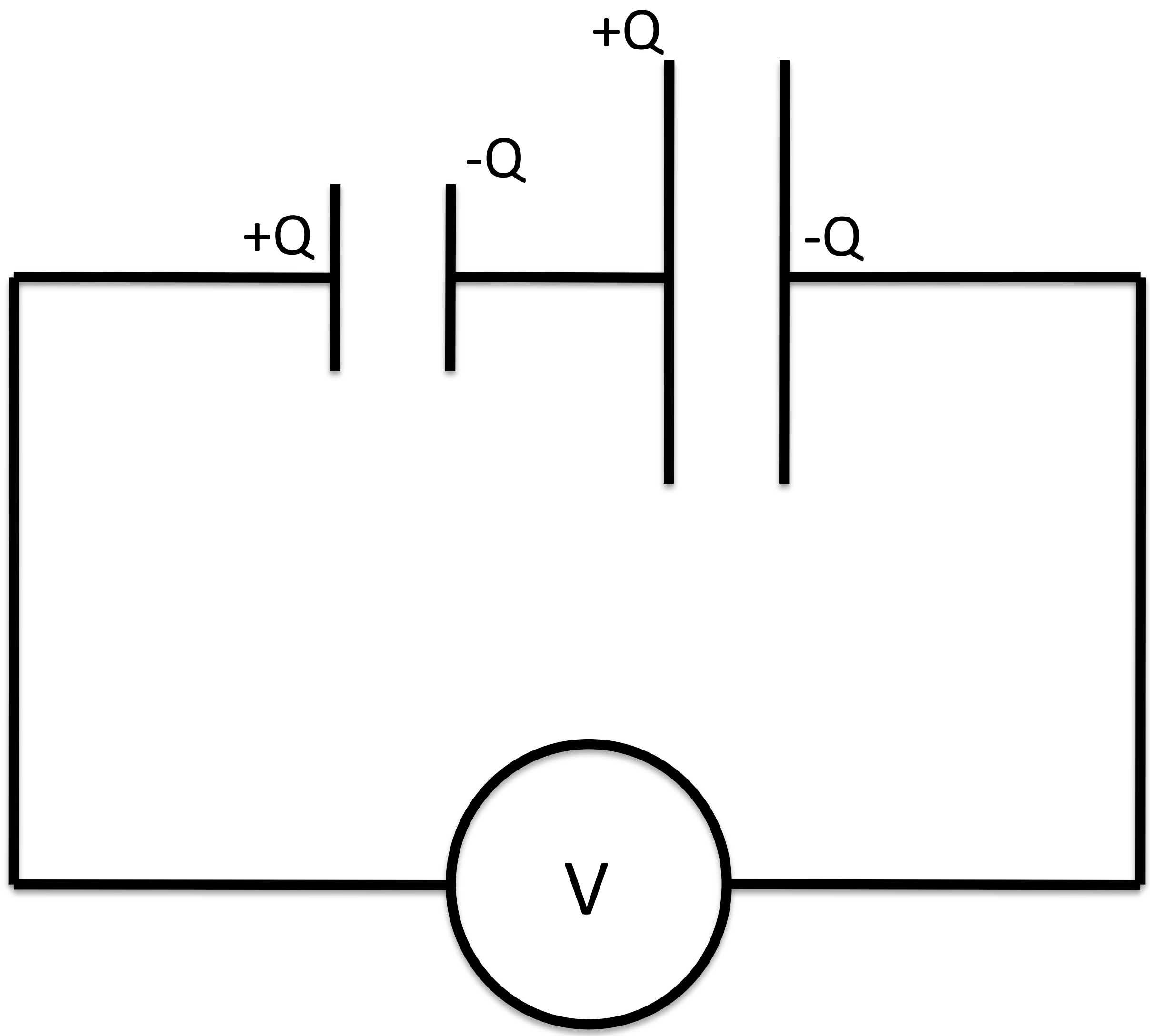


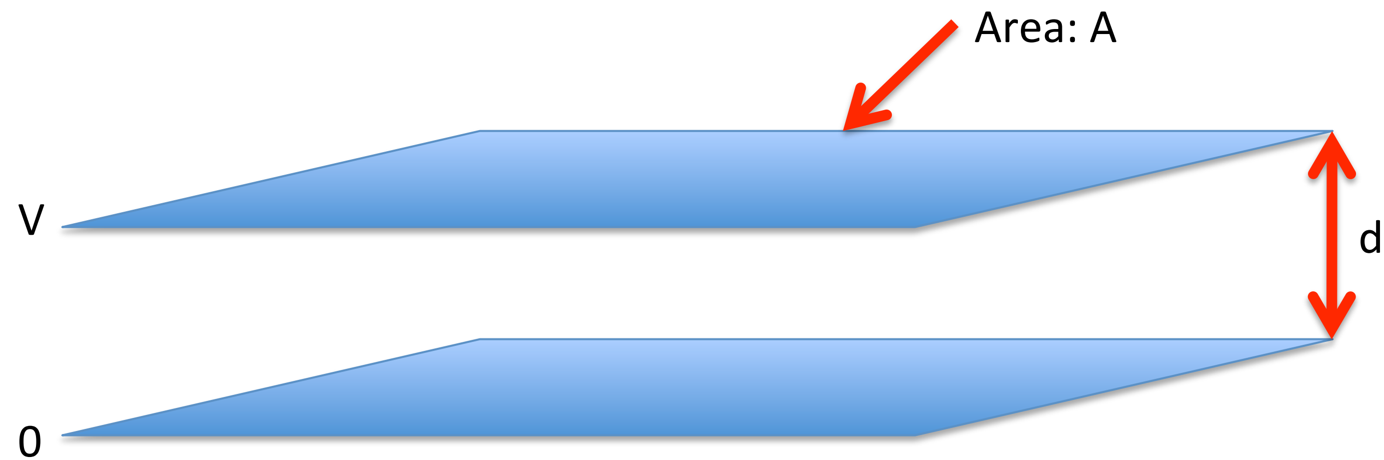
What is C_{total}?

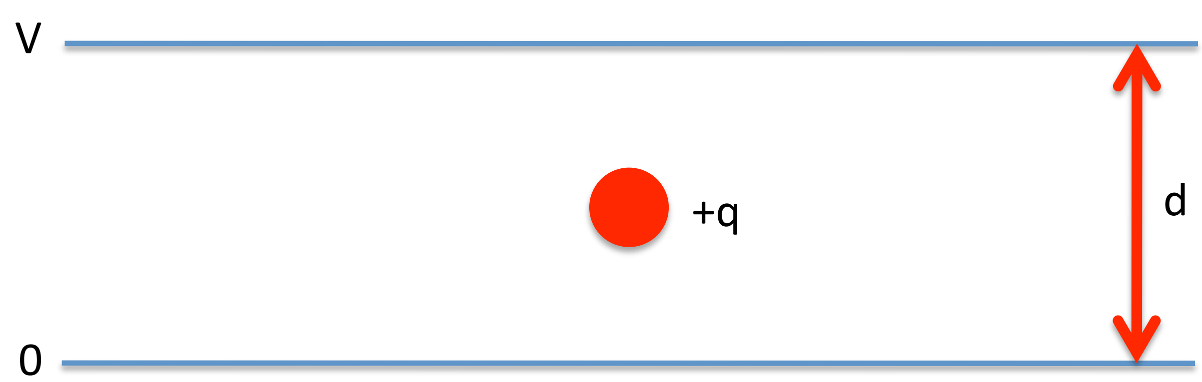
Capacitors in series



Capacitors in series



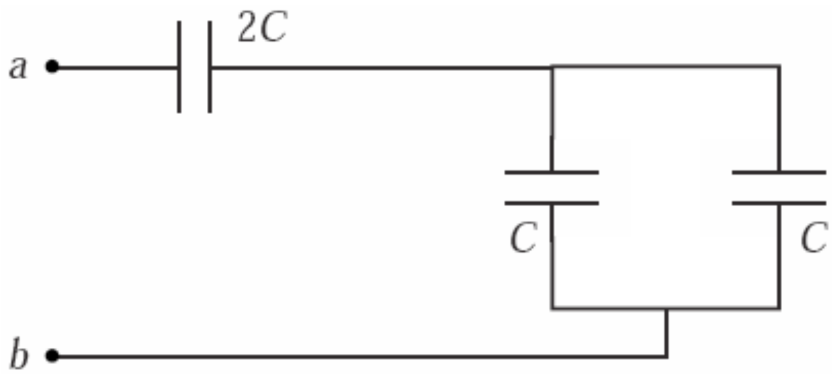




Potential of +q : V/2

Potential energy of +q: qV/2

The equivalent capacitance of the circuit shown below is

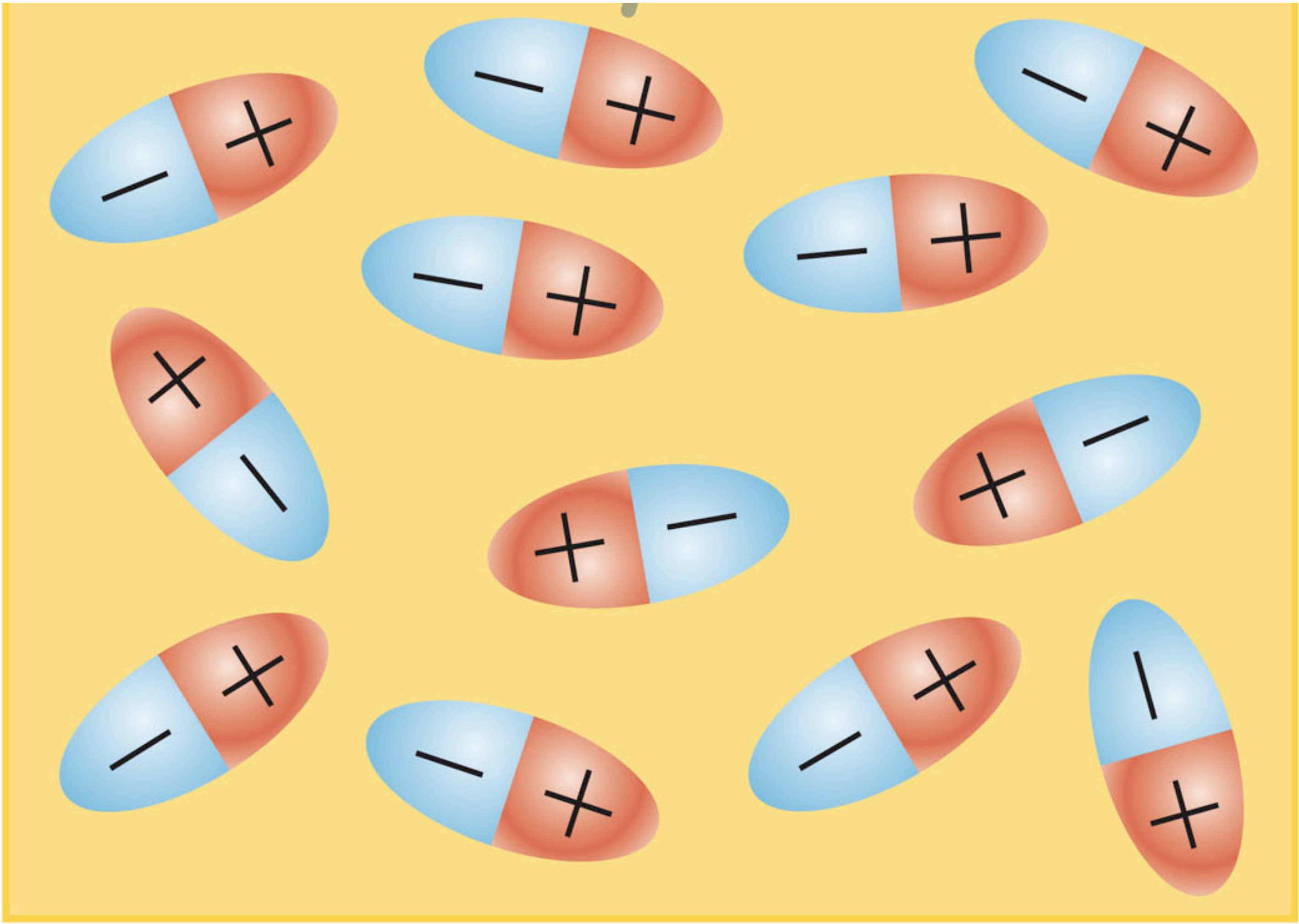


a. 0.50 C.
b. 1.0 C.
c. 1.5 C.
d. 2.0 C.
e. 2.5 C.

When a capacitor has a charge of magnitude 80 μC on each plate the potential difference across the plates is 16 V. How much energy is stored in this capacitor when the potential difference across its plates is 42 V?

a. 1.0 mJ
b. 4.4 mJ
c. 3.2 mJ
d. 1.4 mJ
e. 1.7 mJ

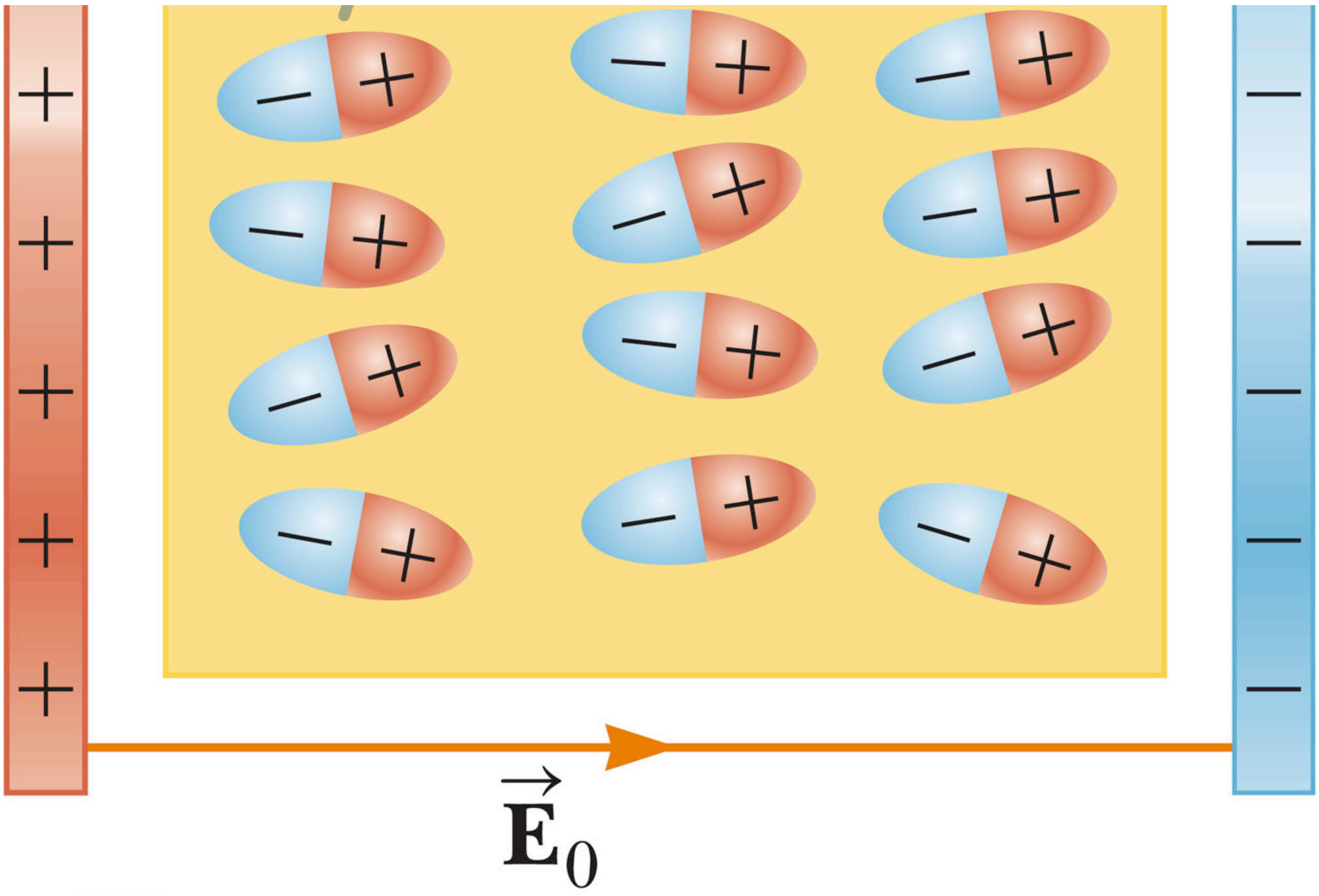
Dielectrics



•The molecules that make up the dielectric are modeled as dipoles.

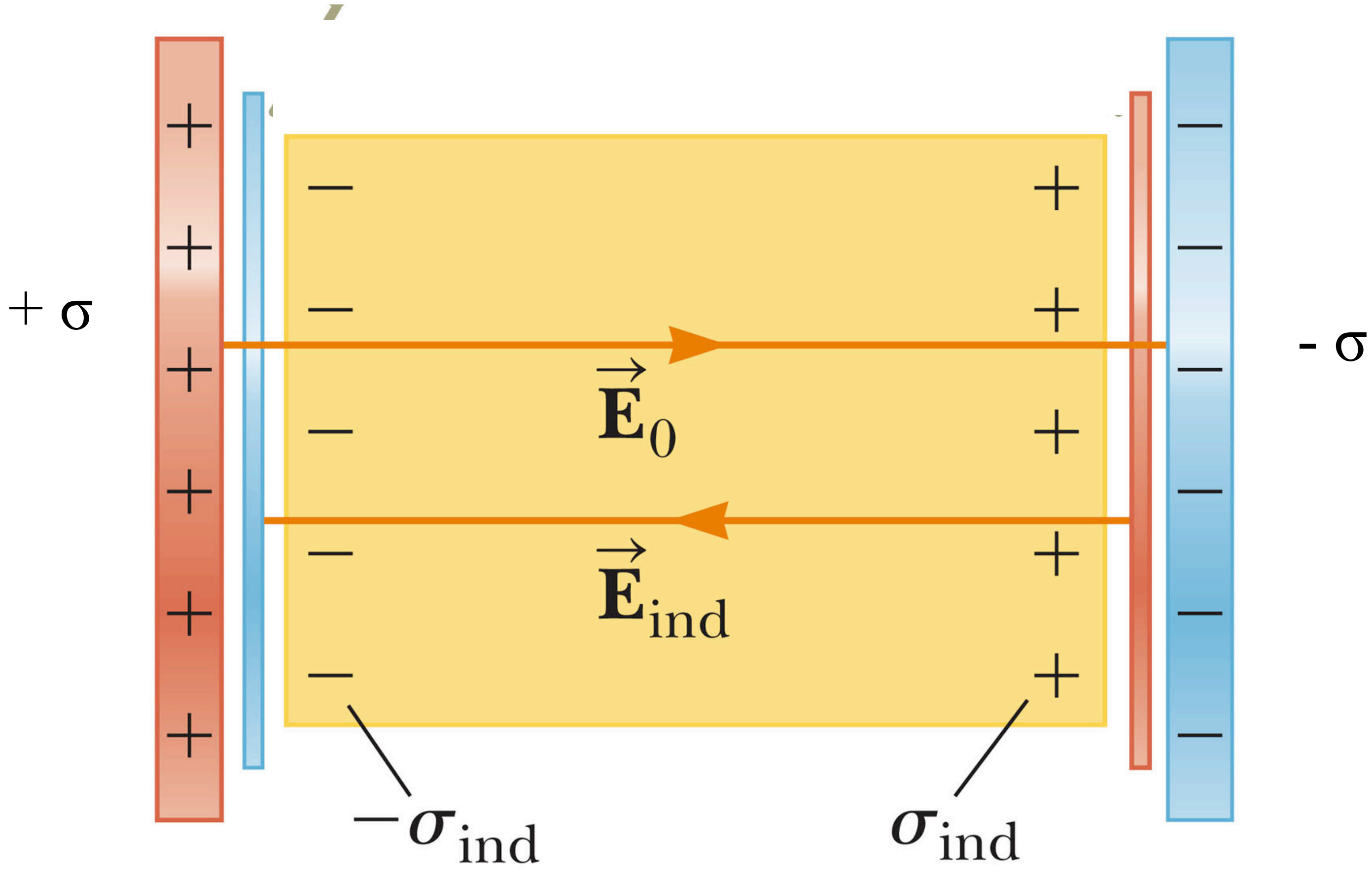
•Dipoles randomly oriented in absence of external field

Dielectrics under external field



- Electric field aligns the dipoles
- Degree of alignment depends on magnitude of electric field

Dielectrics



- Voltage between the plates are lowered by dielectrics
- Q = CV
- Capacitance is raised by dielectrics

Some Dielectric Constants and Dielectric Strengths

TABLE 26.1 *Approximate Dielectric Constants and Dielectric Strengths of Various Materials at Room Temperature*

Material	Dielectric Constant κ	Dielectric Strength[a] (10^6 V/m)
Air (dry)	1.000 59	3
Bakelite	4.9	24
Fused quartz	3.78	8
Mylar	3.2	7
Neoprene rubber	6.7	12
Nylon	3.4	14
Paper	3.7	16
Paraffin-impregnated paper	3.5	11
Polystyrene	2.56	24
Polyvinyl chloride	3.4	40
Porcelain	6	12
Pyrex glass	5.6	14
Silicone oil	2.5	15
Strontium titanate	233	8
Teflon	2.1	60
Vacuum	1.000 00	—
Water	80	—

[a]The dielectric strength equals the maximum electric field that can exist in a dielectric without electrical breakdown. These values depend strongly on the presence of impurities and flaws in the materials.