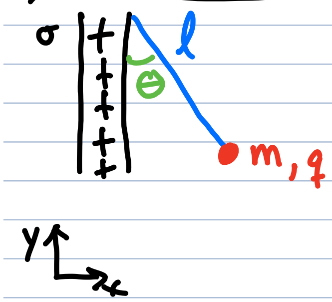
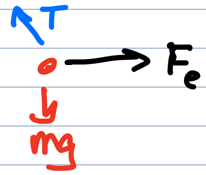
Practice Problem chapter 5 #75

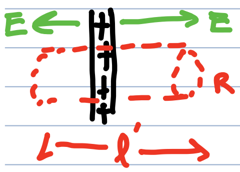


Given ℓ, m, q, and σ, what is θ?



$$\left.\begin{aligned} T\sin\theta &= qE \\ T\cos\theta &= mg \end{aligned}\right\} \tan\theta = \frac{qE}{mg}$$

What is $\vec{E}$ for a 2D sheet of charge?



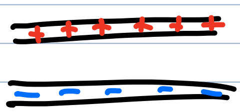
Gauss' Law

$$\phi = \int \vec{E}\cdot d\vec{A} = \frac{Q_{encl}}{\epsilon_0} = \frac{\pi R^2 \sigma}{\epsilon_0}$$

$$\rightarrow E\int dA = \frac{\pi R^2 \sigma}{\epsilon_0} \Rightarrow E\, 2\pi R^2 = \frac{\pi R^2 \sigma}{\epsilon_0}$$

$$\boxed{E = \frac{\sigma}{2\epsilon_0}}$$

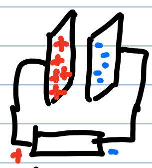
Chapter 8



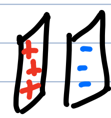
$\Delta V \propto Q$ on plates

$\frac{Q}{\Delta V}$ = constant $\equiv C$ capacitance

Some capacitor basics:



now remove battery



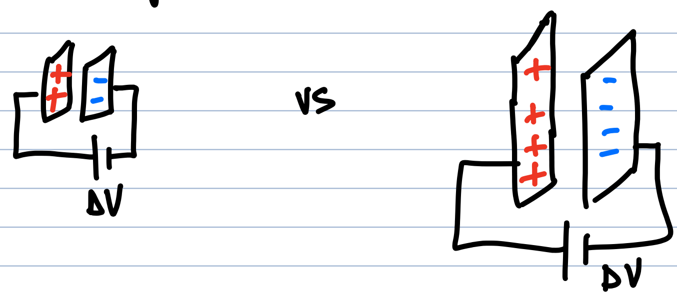
charges are held apart → potential energy is stored

Q: How can we retrieve this U?

A: Put a charge between them, and it will move (or light a light bulb)

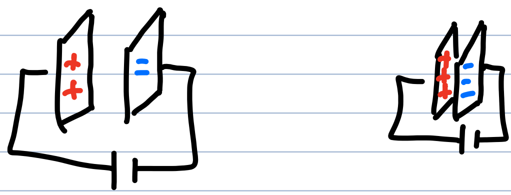
Q: How could we increase the amount of charge on a capacitor?

A: increase plate area



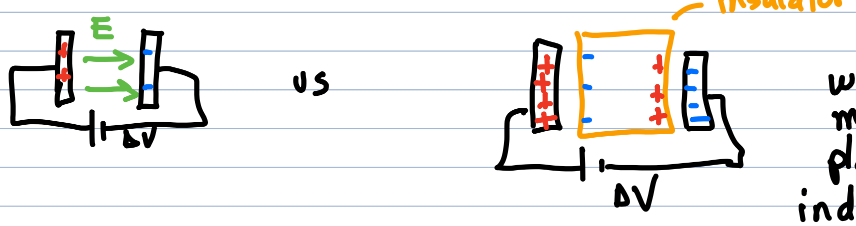
$$\boxed{C \propto A}$$

A: move plates closer together



ΔV hasn't changed here (b/c a battery remains connected) yet the Coulombic attraction is greater → $\boxed{C \propto \frac{1}{d}}$

A: Place an insulator between plates

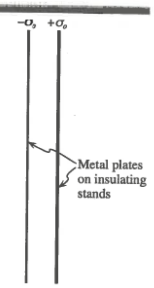


we effectively draw more charges to the plates, given the induced charge separation in the insulator

$$C \propto \frac{\kappa A}{d}$$

(κ — dielectric constant)

Two thin metal plates on insulating stands are placed side by side as shown. Assume the plates are large and close enough together that fringing effects can be ignored and that all the charge resides on the *inner surfaces* of the plates.



1. The charge density on one plate is $+\sigma_o$; on the other, $-\sigma_o$. How does each of the following quantities change (if at all) when the two plates are moved closer together? Explain.

- the charge density on each plate

remains unchanged

- the electric field between the plates

$E = \sigma/\epsilon_o$ see example 6.10

- the potential difference between the plates

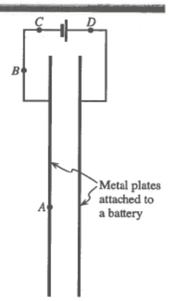
$V_a - V_b = \int \vec{E} \cdot d\vec{l}$ $\Rightarrow \Delta V$ decreases

- the capacitance of the pair of plates

$C = \frac{k\epsilon_o A}{d}$ increases

2. The two metal plates are discharged and then connected to a battery as shown.

How does each of the following quantities change (if at all) when the two plates are moved closer together? Explain.



- the potential difference between the plates

ΔV = constant

- the electric field between the plates

$E = \frac{\Delta V}{\Delta x}$ $\rightarrow$ increases

- the charge density on each plate

$Q = CV$ Q increases

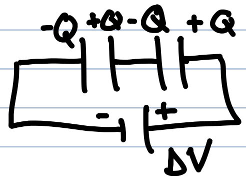
- the capacitance of the pair of plates

$C = \frac{k\epsilon_o A}{d}$ increases

3. Rank the absolute values of the electric potential differences ΔV_{AB}, ΔV_{BC}, ΔV_{CD}, and ΔV_{DA} between points *A*, *B*, *C*, and *D* in the diagram in question 2. Explain.

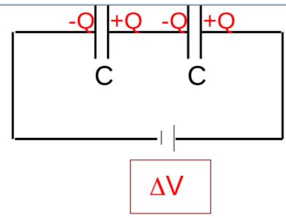
$|\Delta V_{CD}| = |\Delta V_{DA}| > |\Delta V_{AB}| = |\Delta V_{BC}$

2 identical capacitors in series



Concept Q ch8/s1.html

Two identical capacitors in series:



How are the various charges related if I slip in a dielectric?

a) $Q_1=Q_3$; $Q_2=Q_4$; $Q_2=-Q_3$

b) $Q_1=Q_2=Q_3=Q_4$

c) $Q_4>Q_2$; $Q_3>Q_1$

d) $Q_2>Q_4$; $Q_1>Q_3$