Outline

- Capacitors

Makeup Exam TODAY 3pm-4pm Rm 1305 Physics

Two sheets of charge
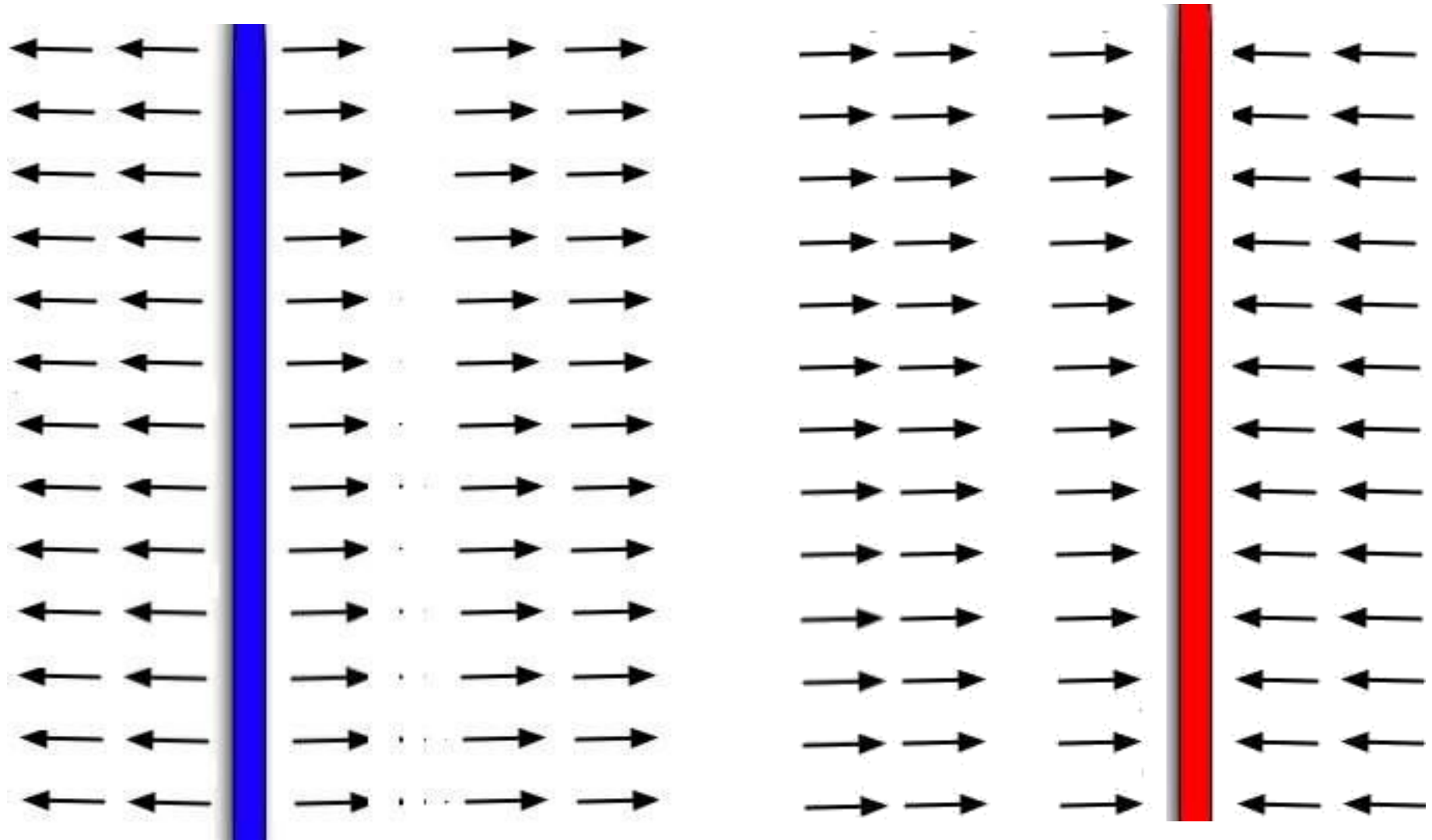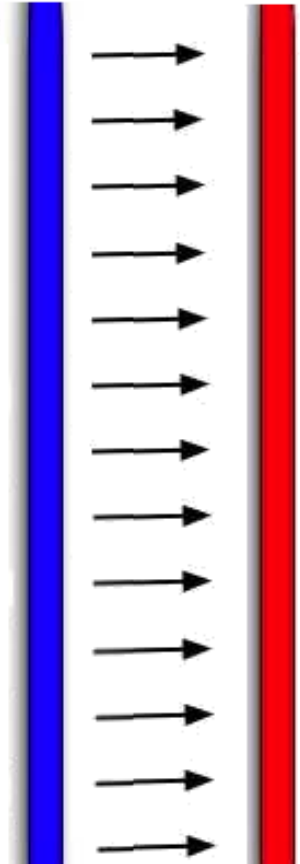
Capacitor Equations

$$\mathrm{D}V = E\mathrm{D}x = Ed$$

$$E = 4pk_C S = 4pk_C \frac{Q}{A} \quad \Rightarrow \quad Q = \left(\frac{A}{4pk_C} \right) E$$

$$Q = \left(\frac{A}{4pk_C d} \right) \mathrm{D}V$$

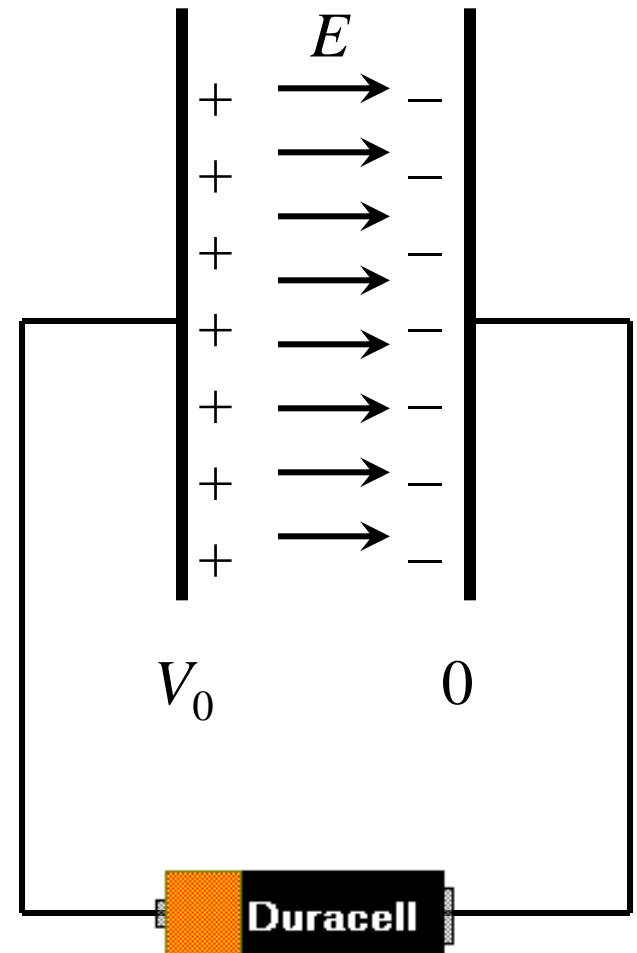$4\pi k_c$ is often written as "$1/\varepsilon_0$"

$$Q = C\mathrm{D}V$$

Some basic electrical ideas

■ *Conductor* – a material that permits some of its charges to move freely within it.

■ *Insulator* – a material that permits some of its charges to move a little, but not freely.

■ *Battery* – a device that creates and maintains a constant potential difference across its terminals.

$\Delta V = V_0 \text{ volts}$

High end   Low end   **4**
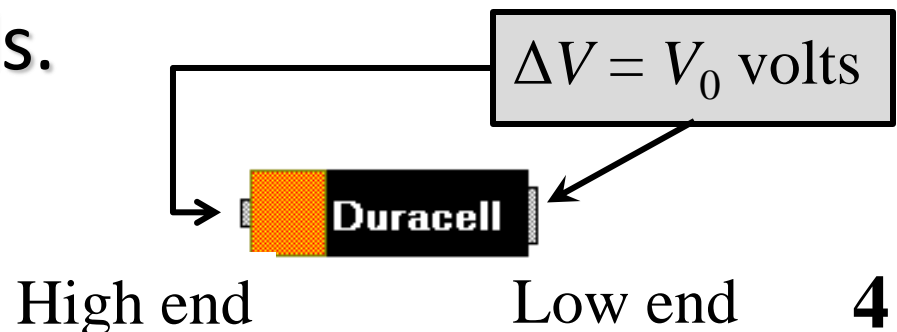
Charging a capacitor

- What is the potential difference between the plates?
- What is the field around the plates?
- How much charge is on each plate?

E

$+$ $\longrightarrow$ $-$
$+$ $\longrightarrow$ $-$
$+$ $\longrightarrow$ $-$
$+$ $\longrightarrow$ $-$
$+$ $\longrightarrow$ $-$
$+$ $\longrightarrow$ $-$
$+$ $\longrightarrow$ $-$
$+$ $\longrightarrow$ $-$

V_0 0

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# The charges on the capacitor plates are Q_1 and Q_2

1. Q_1 equals Q2
2. Q_1 equals $-Q_2$
3. The can have different magnitude but need to have opposite signs
4. The can have different magnitude but need to have the same signs
5. None of the above
6. Depends on the situation

Q_1 Q_2

E

$+$ $-$
$+$ $-$
$+$ $-$
$+$ $-$
$+$ $-$
$+$ $-$
$+$ $-$
$+$ $-$

V_0 0

Duracell
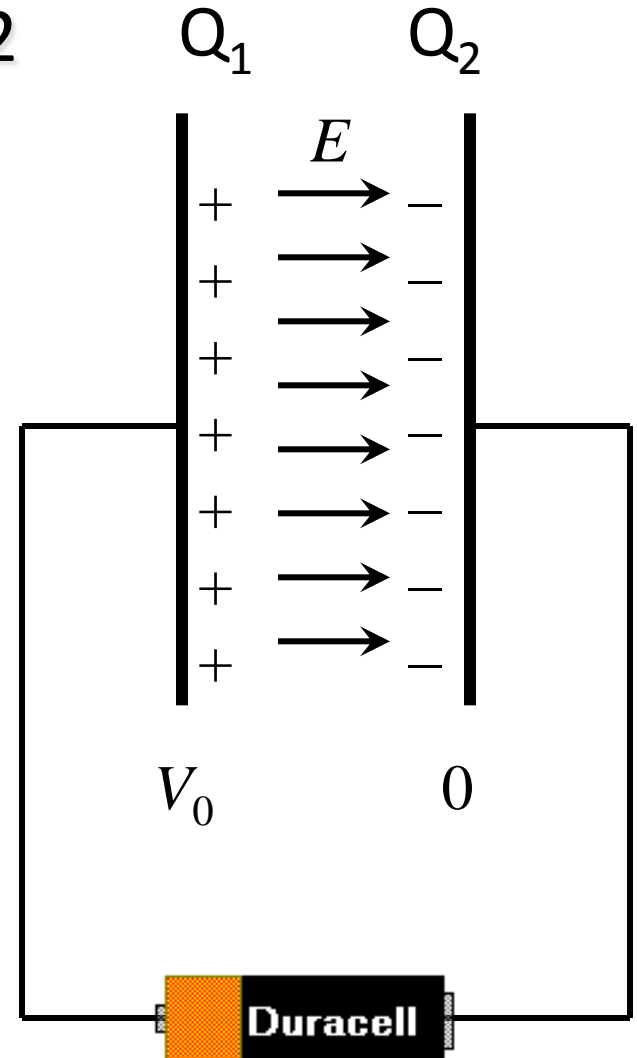
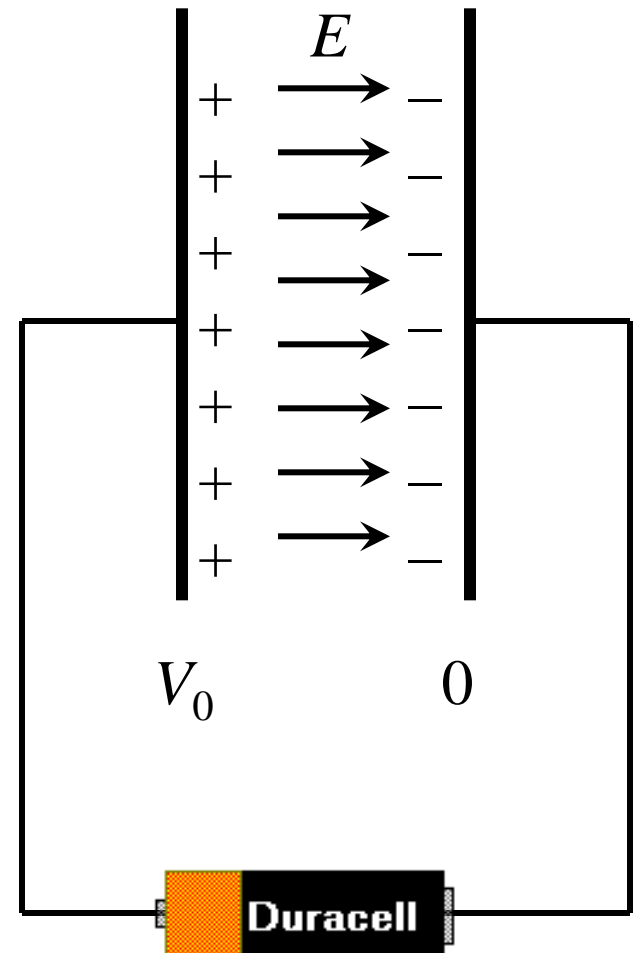# Why are the charges the same magnitude and opposite sign?

What would happen to the voltage if you first disconnected the battery and pulled the plates further apart

1. The potential difference would increase

2. The potential difference would decrease

3. The potential difference would stay the same

4. Not enough information

E

$+$ $-$
$+$ $-$
$+$ $-$
$+$ $-$
$+$ $-$
$+$ $-$
$+$ $-$

V_0 0

Duracell

What would happen to the voltage if I keep it connected to the battery and pulled the plates further apart

1. The potential difference would increase
2. The potential difference would decrease
3. The potential difference would stay the same
4. Not enough information

E

$+$ $+$ $+$ $+$ $+$ $+$ $+$ $+$

$-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$

V_0 0

Duracell
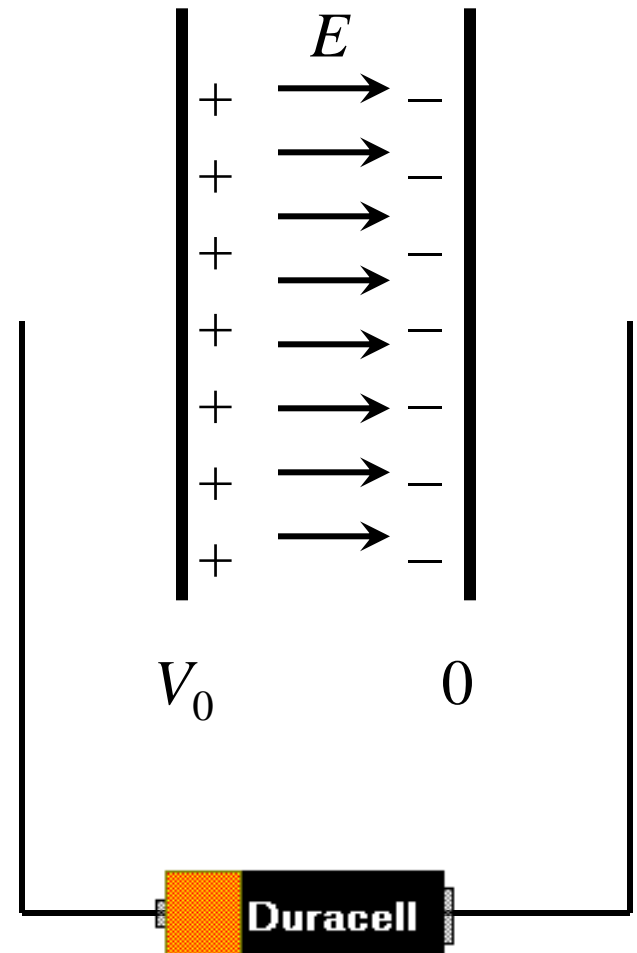
What would happen to the voltage if I keep it connected to the battery and pulled the plates further apart

1. The charges on the plate would increase
2. The charges on the plate would decrease
3. The charges on the plate would stay the same
4. Not enough information

E

$+$ → $-$

V_0 0

Duracell
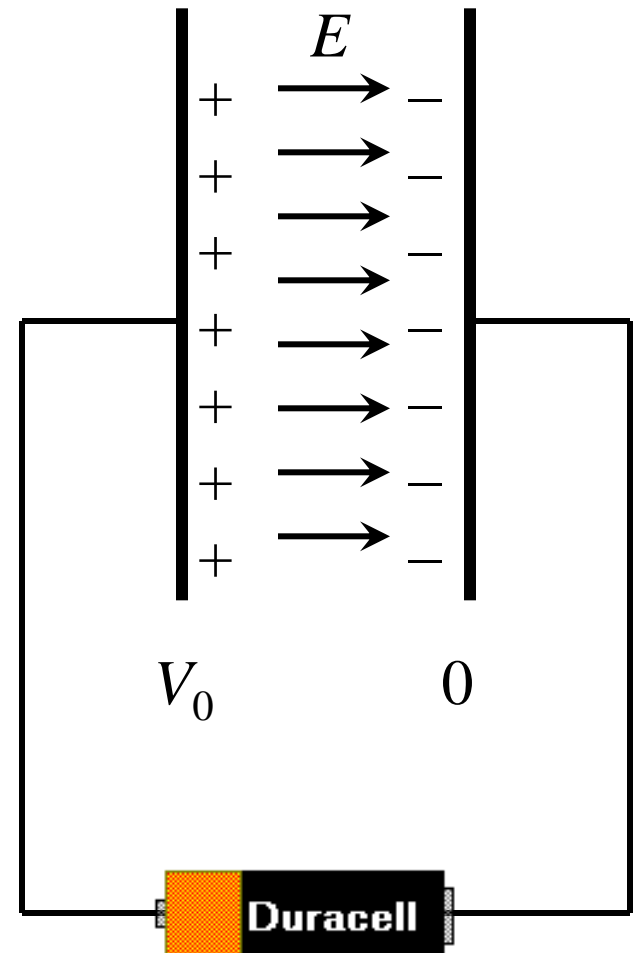
Cap #1 is charged by connecting it to a battery.
#2 is not charged.
C#1 is disconnected from the battery
and connected to C#2.
How does the magnitude of the E field
in C#1 change?

1. Same

2. Bigger by ~X2

3. Bigger but not by ~X2

4. Smaller by ~X2

5. Smaller but not by ~X2

6. Can't tell