Phy 2B 1/28

Wednesday, January 28, 2015 10:02 AM

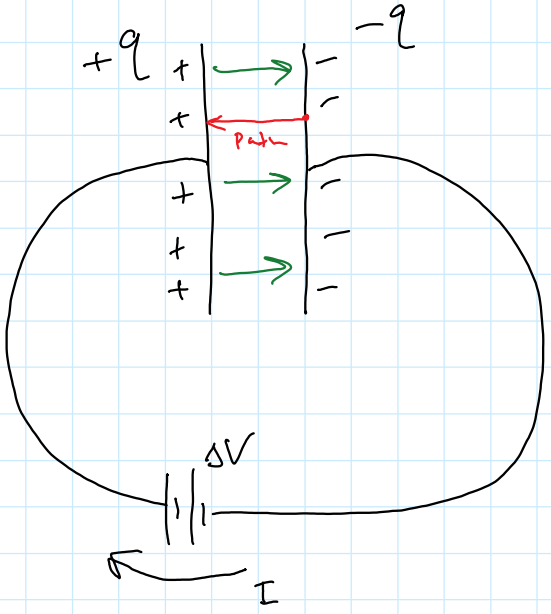
Exam #2 → Wed 2/4

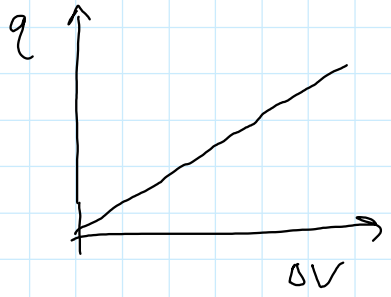
DC Circuits

Series + parallel

Resistors + Capacitors

Capacitors





$Q = CV$

↑ Capacitance

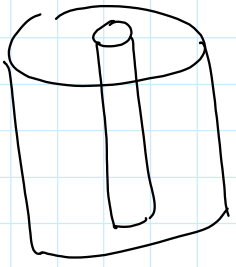
↑ depends on physical properties

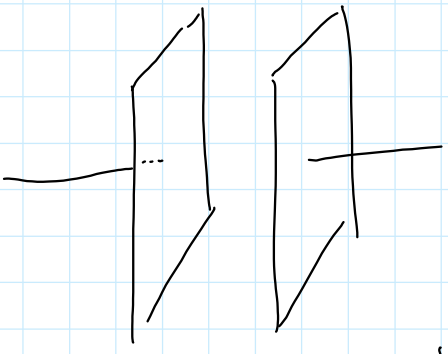
→ size of plates

→ spacing between plates

Types of Capacitors:

Spherical Capacitor





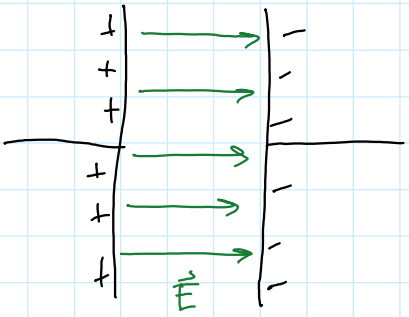
← most common

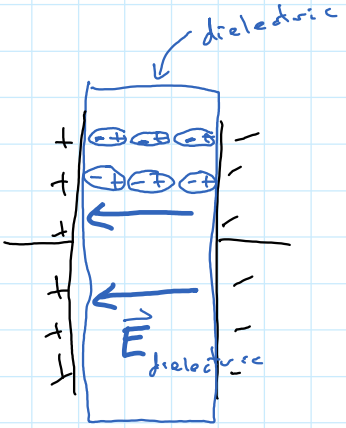
parallel plate Capacitor

Parallel plate Capacitor

$$C = \frac{A \epsilon_0}{d}$$

Dielectric





$$C = K C_0$$

↑ dielectric Constant

$K \geq 1$

Cov.

$K \geq 1$

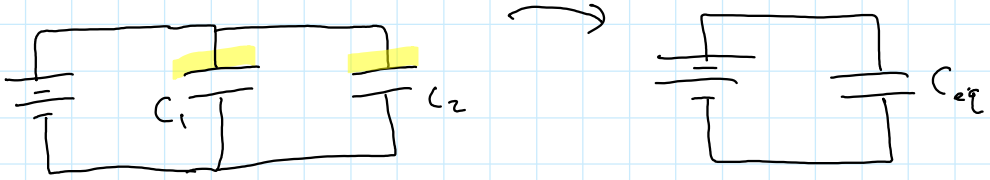
Worksheet p. 85

1)	↓	7)	↓
2)	↑	8)	↑
3)	same	9)	same
4)	↑	10)	↑
5)	same	11)	↑
6)	same	12)	same

$Q = CV$

Series and Parallel Capacitors

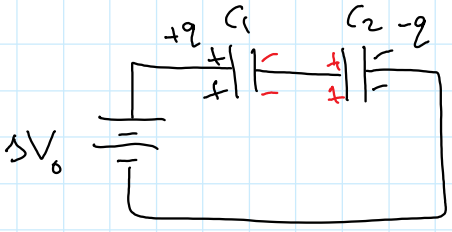
Parallel



$$C_{eq} = C_1 + C_2 + \cdots$$

Parallel

Series



$q = CV$

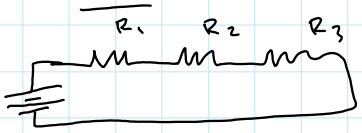
$q_1 = q_2$

$\Delta V_1 + \Delta V_2 = \Delta V_0$

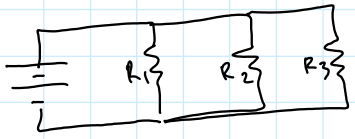
$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots$$ series

	Resistor	Capacitor
Series	I same $I_1 = I_2 = I_3 \cdots$ $\Delta V_{total} = \Delta V_1 + \Delta V_2 + \cdots$	$Q_{total} = Q_1 = Q_2 = Q_3 \cdots$ $\Delta V_{total} = \Delta V_1 + \Delta V_2 + \Delta V_3 + \cdots$
Parallel	$I_{total} = I_1 + I_2 + I_3 \cdots$ $\Delta V_{total} = \Delta V_1 = \Delta V_2 = \Delta V_3$	$Q_{total} = Q_1 + Q_2 + Q_3 + \cdots$ $\Delta V_{total} = \Delta V_1 = \Delta V_2 = \Delta V_3 \cdots$

Series



Parallel



Application of the Day:

Capacitors: Store charge or energy

Flash on cameras

Defibrillators

Super Capacitors or Ultra Cap. → like a battery

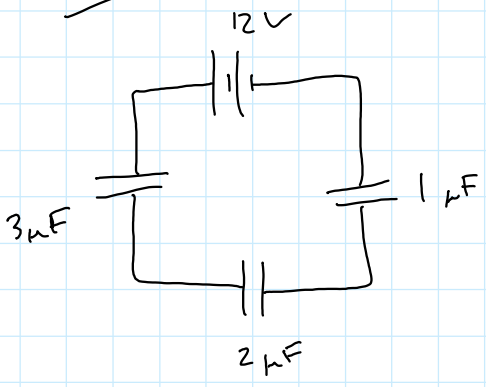
Worksheet

1) Find C_{eq} for each circuit

Worksheet 9.8 9

1) Find C_{eq} for each circuit
2) if $V_{battery} = 12\ V$
   find q on each capacitor
3) find ΔV for each capacitor

Series



$$\frac{1}{C_{eq}} = \frac{1}{3} + \frac{1}{2} + \frac{1}{1}$$

$$= \frac{2}{6} + \frac{3}{6} + \frac{6}{6}$$

$$= \frac{11}{6}$$

$$C_{eq} = \frac{6}{11}\ \mu F$$

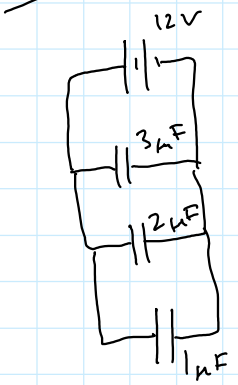
$$Q_{total} = C_{eq}\ \Delta V_{battery}$$

$$= \left(\frac{6}{11}\ \mu F\right)(12\ V)$$

$$= \frac{72}{11}\ \mu C$$

$$Q_A = Q_B = Q_C = Q_{total} = \frac{72}{11}\ \mu C$$

Parallel



$$C_{eq} = 3 + 2 + 1$$

$$= 6\ \mu F$$

$$Q_{total} = C_{eq}\ \Delta V_{battery}$$

$$= (6\ \mu F)(12\ V)$$

$$= 72\ \mu C$$

$$Q_A = C_A V_A$$

$$Q_A = Q_B = Q_C = Q_{total} = \frac{72}{11}\ \mu C$$

$$Q_A = C_A V_A$$

$$V_A = \frac{Q_A}{C_A} = \frac{\frac{72}{11}}{3} = \frac{24}{11}\ V$$

$$V_B = \frac{Q_B}{C_B} = \frac{\frac{72}{11}}{2} = \frac{36}{11}\ V$$

$$V_C = \frac{Q_C}{C_C} = \frac{\frac{72}{11}}{1} = \frac{72}{11}\ V$$

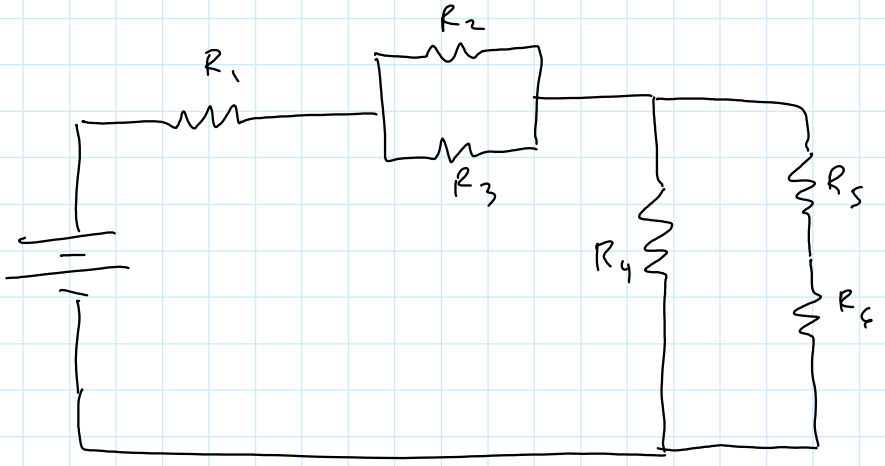
$$V_A + V_B + V_C = 12\ V \quad \checkmark$$

$$Q_A = C_A V_A$$
$$= (3\ \mu F)(12\ V)$$
$$= 36\ \mu C$$

$$Q_B = C_B V_B$$
$$= (2\ \mu F)(12\ V)$$
$$= 24\ \mu C$$

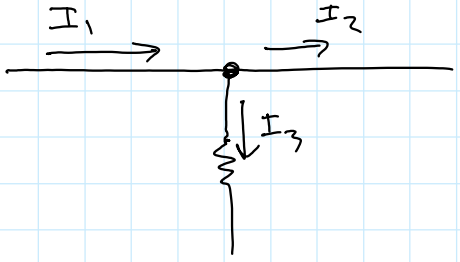
$$Q_C = 12\ \mu C$$

$$Q_{total} = Q_A + Q_B + Q_C = 72\ \mu C \quad \checkmark$$



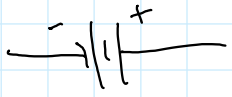
Kirchhoff's Rules

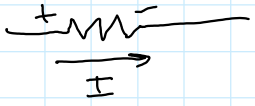
Junction Rule: $\Sigma I_{in} = \Sigma I_{out}$

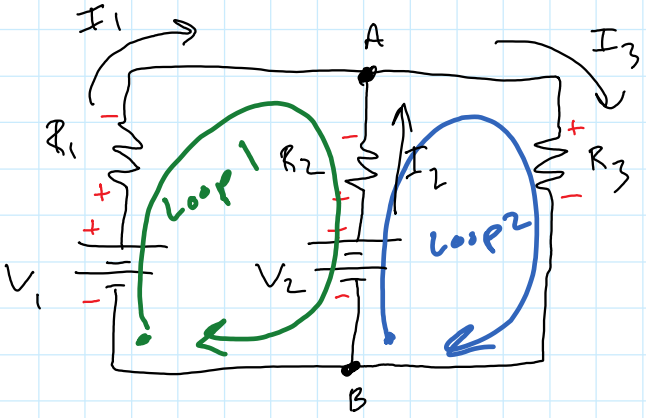


$$I_1 = I_2 + I_3$$

Loop Rule: $\sum_{Loop} \Delta V = 0$

battery: 

Resistor: 



1) Assign direction to current in each branch (guess)

2) Indicate the high / low potentials with +/− signs for each device

3) Apply Junction Rule

4) Apply 2 loop Rules

Junction: $\sum I_{in} = \sum I_{out}$

$$I_1 + I_2 = I_3$$

Loop 1: $$+V_1 - I_1 R_1 + I_2 R_2 - V_2 = 0$$

Loop 2: $\boxed{+V_2 - I_2 R_2 - I_3 R_3 = 0}$

Solve for I_1, I_2, and I_3