Coordination - Level up! [7]

Level 0: Basic combos

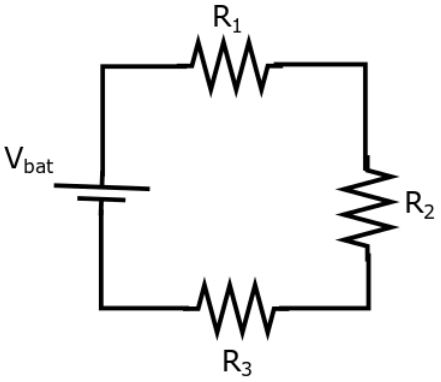
For the circuit(s) below, say that $V_{bat} = 5V$, $R_1 = 2\Omega$, $R_2 = 3\Omega$, $R_3 = 4\Omega$, $C_1 = 6mF$, $C_2 = 7mF$, and $C_3 = 8mF$. For your given circuit:

(a) What is the equivalent capacitance or resistance of the circuit?

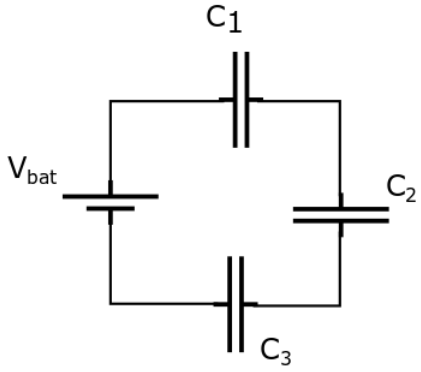
(b) Which circuit element would have the largest voltage drop?

(c) Which circuit element would have the smallest charge or smallest current?

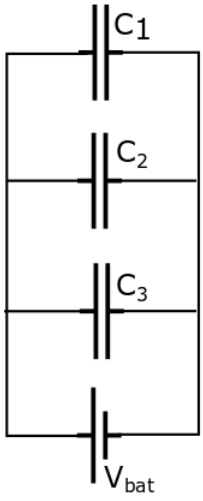
Circuit A:



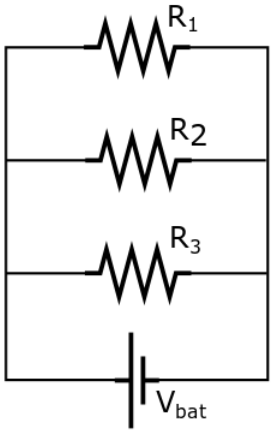
Circuit B:



Circuit C:



Circuit D:



[7] Levels 0 - 2: Modified by Daryl McPadden for Fab Physics from University Modeling Instruction
Levels 3 - Bonus: Written by Daryl McPadden for Fab Physics

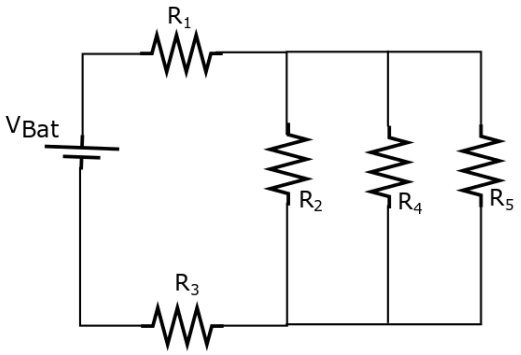
Level 1: Equal circuit elements

For the circuit(s) below, say that $V_{bat} = 16V$, all resistors are $R = 150\Omega$ and all capacitors are $C = 470\mu F$. For your given circuit:

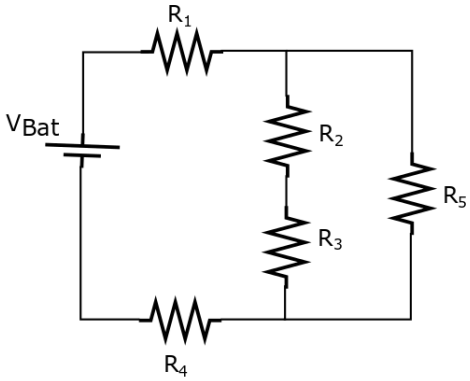
(a) What is the equivalent capacitance or resistance of the circuit?

(b) Which elements are in series? Which are in parallel? How do you know?

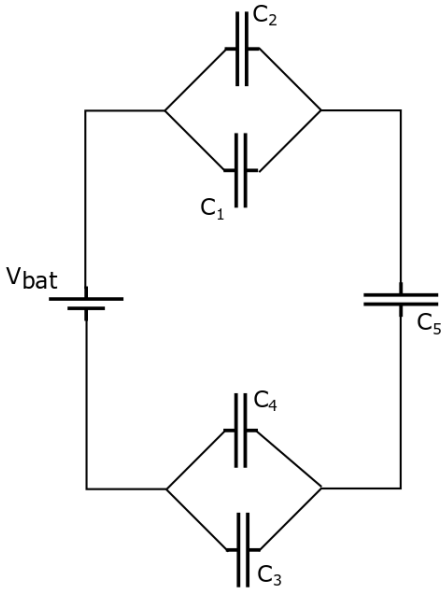
Circuit A:



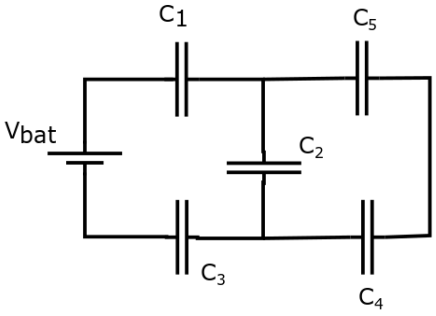
Circuit B:



Circuit C:



Circuit D:



Level 2: Resistor Circuits

For the circuit(s) below, you have been given some of the quantities for various elements around the circuit. For example, V_1 would correspond to the voltage across Resistor 1. For your given circuit,

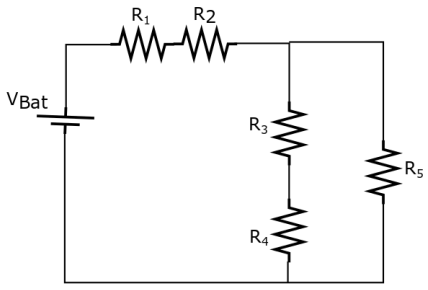
(a) Which resistors are in series and which resistors are in parallel? How do you know?

(b) Find all the missing quantities for each resistor (R, V, I, and P).

(c) What is the voltage, current, and power provided by the battery in your circuit?

(d) If the resistors in the circuit were lightbulbs, which would be the brightest?

Circuit A:



V_{bat}=7 V

V_5=4 V

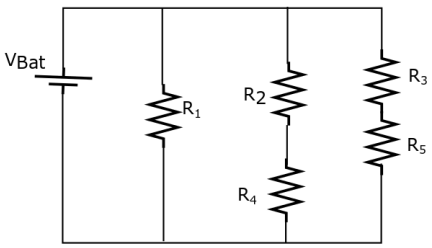
I_4=3 A

V_3= 2 V

V_1=1 V

I_1=6 A

Circuit B:



V_1=12 V

V_2=9 v

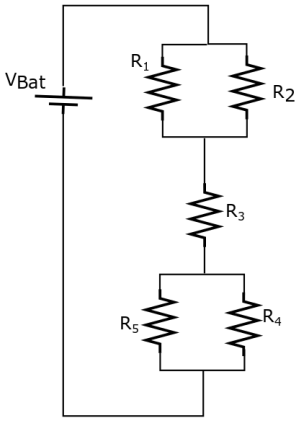
P_1=24 W

V_3=4 V

I_4=2 A

I_5=2 A

Circuit C:



I_2=3 A

V_3=2.5 V

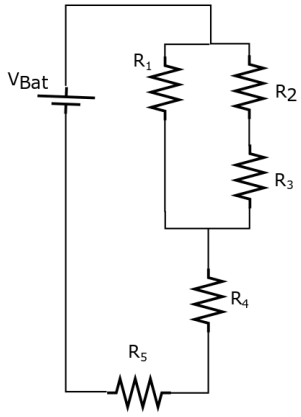
I_5=5 A

P_5=20 W

P_1=6 W

V_1=2 V

Circuit D:



V_1=12 V

P_1=36 W

V_2=1.5 V

P_4=16 W

P_5=12 W

I_{bat}=4 A

Level 3: Capacitor Circuits

For the circuit(s) below, you have been given some of the quantities for various elements around the circuit. For example, V_1 would correspond to the voltage across Capacitor 1. For your given circuit,

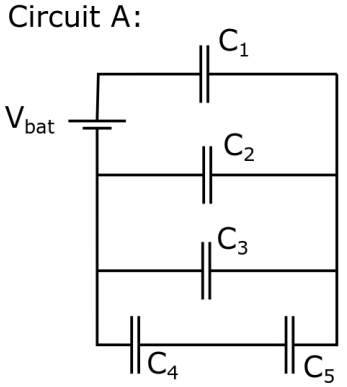
(a) Which capacitors are in series and which capacitors are in parallel? How do you know?

(b) Find all the missing quantities for each capacitor (C, V, Q, and U).

(c) What is the voltage provided by the battery in your circuit?

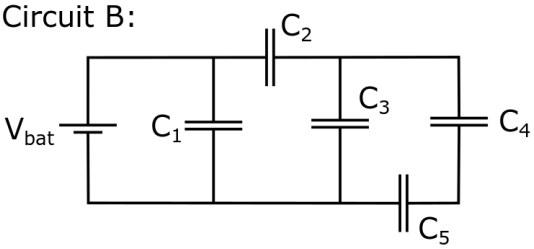
(d) What is the total charge stored by the circuit? What is the total energy?

Circuit A:



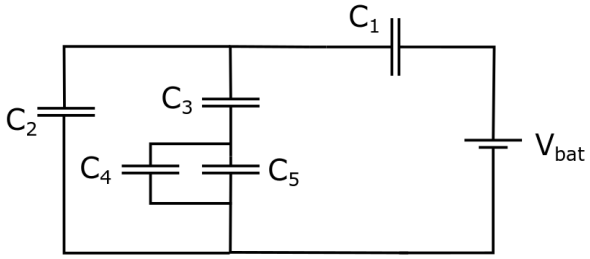
V_{bat} = 9 V
V_2 = 2.86 V
V_4 = 1.43 V
Q_1 = 1.84 mC
Q_3 = 1.3 mC
U_2 = .415 mJ

Circuit B:



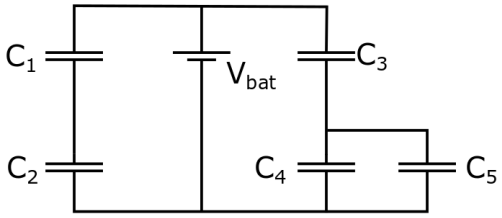
U_1 = .128 J
V_2 = 11.54 V
U_4 = .0243 J
Q_1 = .016 C
Q_3 = .089 C
Q_5 = .027 C

Circuit C:



V_{bat} = 3 V
Q_1 = 178 nC
U_2 = 74.4 nJ
V_3 = .25 V
U_4 = 4.7 nJ
V_5 = .97 V

Circuit D:



Q_1 = .034 C
U_1 = .058 J
V_2 = 1.6 V
U_3 = .096 J
V_4 = 2.97 V
U_5 = .097 J

Level 4: But why do you need multiple batteries?!
For the circuit(s) below, say that $V_{bat1} = 9V$, $V_{bat2} = 6V$, and all resistors are $R = 100\Omega$. For your given circuit:

(a) Are there places in your circuit that can simplify? (AKA resistors in series or in parallel?)

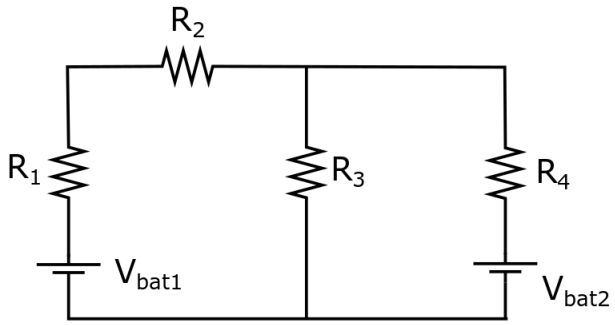
(b) Redraw the circuit after making the simplifications that you can.

(c) How many different currents do you have in your circuit? Draw and label this on your picture. What node rule equations can you make?

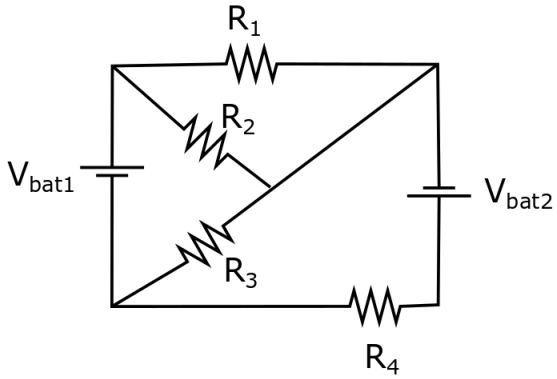
(d) How many different loops do you have in your circuit? What loop rule equations can you make?

(e) Solve for your unknown currents. Note: you can use Wolfram Alpha or other resources online to solve the system of equations.

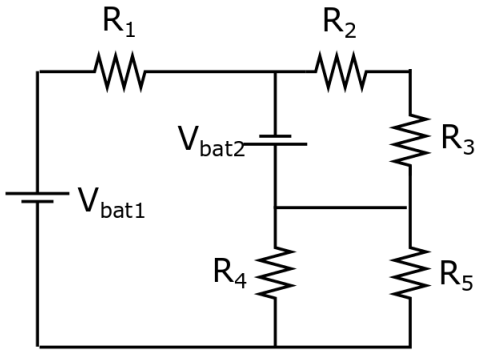
Circuit A:



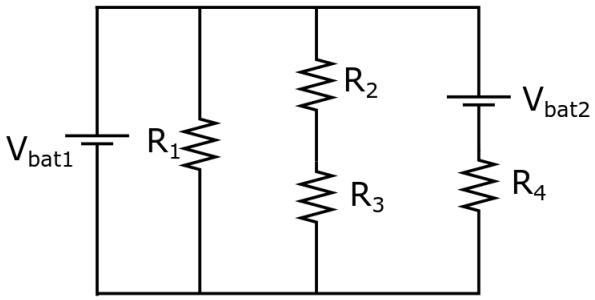
Circuit B:



Circuit C:



Circuit D:



Bonus: Combine all of the things!

Consider the circuit below where initially the capacitors are all uncharged.

(a) Initially, where is there current in the circuit?

(b) What is the initial current provided by the battery if $V_{bat} = 6V$, all resistors are $R = 1000\Omega$, and all capacitors are $C = 2200mF$? (At the moment the switch is closed.)

(c) What would the V vs t, Q vs t, and I vs t graphs look like for each of the capacitors?

(d) After the switch has been closed for a long time, where is there current in the circuit?

(e) What is the final current provided by the battery? (After the switch has been closed for a long time.)

(f) If the switch is then opened again, what would you expect to happen? Explain in words.