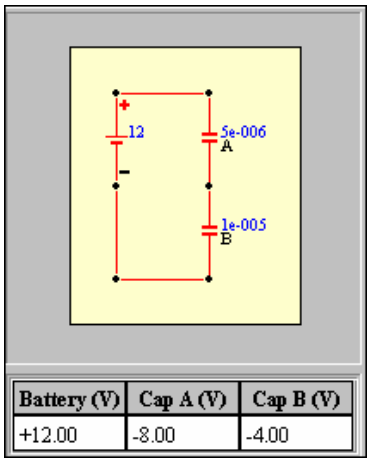
Worksheet for Exploration 26.4: Equivalent Capacitance



Battery (V)	Cap A (V)	Cap B (V)
+12.00	-8.00	-4.00

This animation contrasts two configurations of capacitors and a battery **(capacitance is given in farads)**. The table shows the voltage across the battery as well as across each capacitor.

First, consider capacitors in series. Pick a value of the capacitance for capacitor A that is bigger than capacitor B.

a. What is the charge on each capacitor (use Q = CV)?

   i. Carefully note the units used for each capacitor.
   ii. Write out the electric potential drop across each.
   iii. For the next several questions you may fill out the table below to help answer several questions.

b. Why are the charges equal (explain in terms of where the charge originates to charge the plates)?

This is the total charge stored in this circuit. If the battery were removed from this circuit and we wanted to use the stored charge for an electrical appliance, notice that the charges stored on the two sides of the capacitors connected to each other (the bottom plate of A and the top plate of B), would not be available to another circuit. Thus, the total charge stored is the charge stored on either capacitor.

c. If you wanted to replace the two capacitors in this circuit with one capacitor that stored the same amount of charge at the same total voltage, what would the value of that capacitance be?
   i. Again complete the table below.

d. Verify that the equivalent capacitance is equal to $(1/C_A + 1/C_B)^{-1}$.

SERIES

C_A	C_B	C_{eff}	Q_A	Q_B	ΔV_A	ΔV_B	ΔV_{tot}
15μF							
20							
25							
30							

Now consider capacitors in parallel. Pick a value of the capacitance for capacitor A that is different from capacitor B.

e. What is the same for the two capacitors? What is different?
   i. Again complete the table below for several values of capacitor A.

This time, the charge stored on each capacitor would be available to an electrical appliance if the battery were removed, thus the total charge is the sum of the charge stored individually on each plate.

f. What is the equivalent capacitance for these two capacitors? (i.e., what size capacitor would store the same total charge at this voltage?)

g. Show that it is equal to ($C_A + C_B$).

Parallel

C_A	C_B	C_{eff}	Q_A	Q_B	Q_{tot}	ΔV_A	ΔV_B

h. If you have not done so, discuss similarities and differences in each of the two tables you have filled out. Explain in each case.