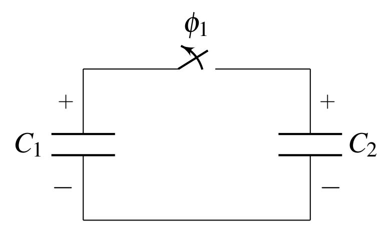
1. Capacitors and Charge Sharing

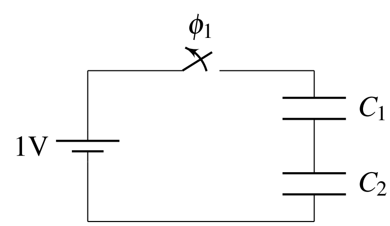
(a) Consider the circuit below, with $C_1 = C_2 = 1\mu F$. Suppose initially C_1 is charged to $+1V$, and C_2 is charged to $+2V$. How much charge is on C_1 and C_2? How much energy is stored in each of the capacitors? What is the total stored energy?



(b) Now the switch is closed (i.e. the capacitors are connected together.) What are the voltages and charges on C_1 and C_2? What is the total stored energy?

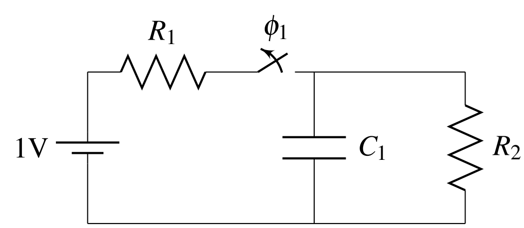
(c) Is this more or less energy than before the switch was closed? Why?

(d) Consider the following circuit, with $C_1 = 1\mu F$, $C_2 = 3\mu F$. Suppose both capacitors are initially uncharged ($0V$).



What are the voltages across the capacitors after the switch is closed? What are the charges on the capacitors?

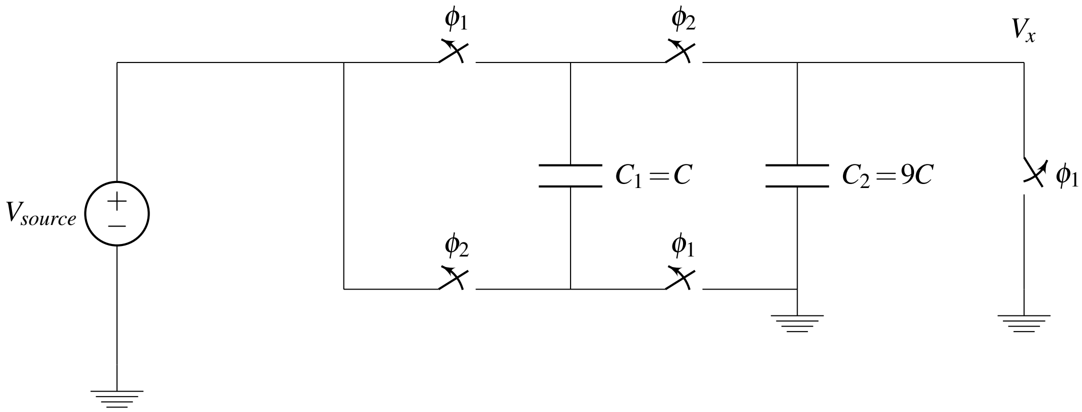
(e) Consider the circuit below, with $C_1 = 1\mu F, R_1 = 1k\Omega, R_2 = 1k\Omega$.



After the switch is closed, and the circuit is allowed to settle, what is voltage across and current through all circuit elements?

2. More Charge Sharing

Consider the following circuit:



In the first phase, all of the switches labeled ϕ_1 will be closed and all switches labeled ϕ_2 will be open. In the second phase, all switches labeled ϕ_1 open and all switches labeled ϕ_2 close.

(a) Draw polarity of voltage (+ and - signs) on the two capacitors C_1 and C_2. (It doesn't matter which terminal you label $+$ or $-$; just remember to keep these consistent through phases 1 and 2!)

(b) Draw the circuit in the first phase and in the second phase. Keep your polarity in part (a) in mind.

(c) Find the voltages and charges on C_1 and C_2 in the first phase. Be sure to keep the polarities of the voltages the same!

(d) Now, in the second phase, find the voltage V_x.

(e) (BONUS) If capacitor C_2 did not exist (i.e., had a capacitance of 0F), what would the voltage V_x be?