EECS 16A Designing Information Devices and Systems I
Fall 2022 Discussion 9B

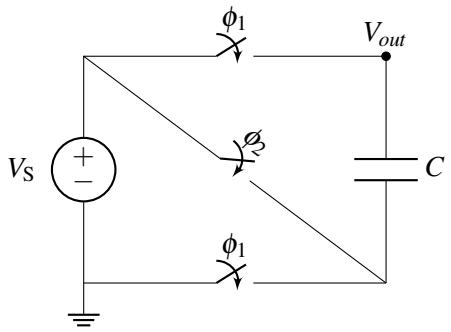
Mid Semester Survey

Please fill out the mid semester survey: https://tinyurl.com/midsemester16a

We highly appreciate your feedback!

1. Voltage Booster

We have made extensive use of resistive voltage dividers to reduce voltage. What about a circuit that boosts voltage to a value greater than the supply $V_S = 5\,\text{V}$? We can do this with capacitors!

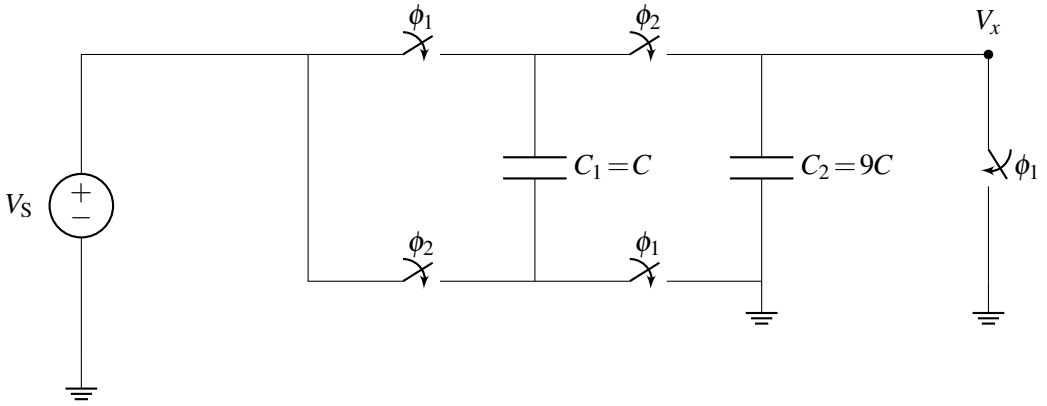


(a) In the circuit above switches ϕ_1 are initially closed and switch ϕ_2 is initially open. Calculate the value of the output voltage, V_{out} with respect to ground, and the amount of charge stored on capacitor, C, at that state (phase 1).

(b) Now, after the capacitors are charged, switches ϕ_1 are opened and switch ϕ_2 is closed. Calculate the new voltage output voltage, V_{out}, at steady state (phase 2).

2. 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 are opened and all switches labeled ϕ_2 are closed.

(a) Draw the polarity of the voltage (using $+$ and $-$ signs) across the two capacitors C_1 and C_2. It doesn't matter which terminal you label $+$ or $-$; just remember to keep these consistent through phase 1 and 2! Also, label the charge on at each plate: $+Q_{C_1}$, $-Q_{C_1}$, $+Q_{C_2}$, and $-Q_{C_2}$.

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

(c) Find the voltages and charges on C_1 and C_2 in phase 1. Be sure to keep the polarities of the voltages the same!

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

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