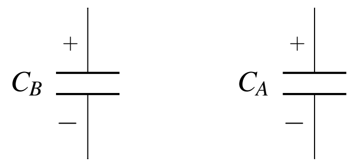
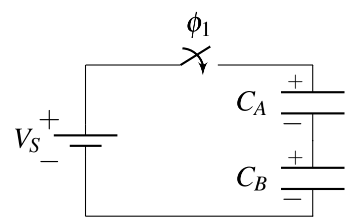
EECS 16A Designing Information Devices and Systems I
Summer 2017 D. Aranki, F. Maksimovic, V. Swamy **Discussion 5C**

1. **Capacitors and Charge Sharing Revisited**

(a) Consider two capacitors, C_A and C_B that have been charged to Q_{A_1} and Q_{B_1} repectively. Compute the voltages across each one, V_{A_1} and V_{B_1}.



(b) Consider the following circuit set up with an open switch. Given that these were the same charged capacitors as in the previous part, in phase 1, what is the charge and voltage across both capacitors, **before** the switch is closed?

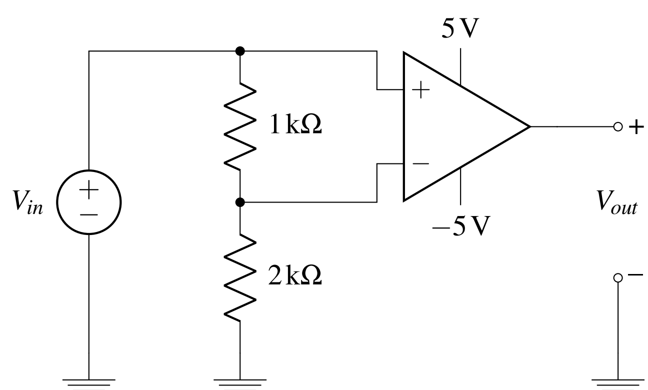


(c) Now the switch is closed, and the circuit is allowed to settle. Compute V_{B_2}, the final voltage drop across C_B, in terms of the given capacitances, the voltages computed in part (a), and V_S.

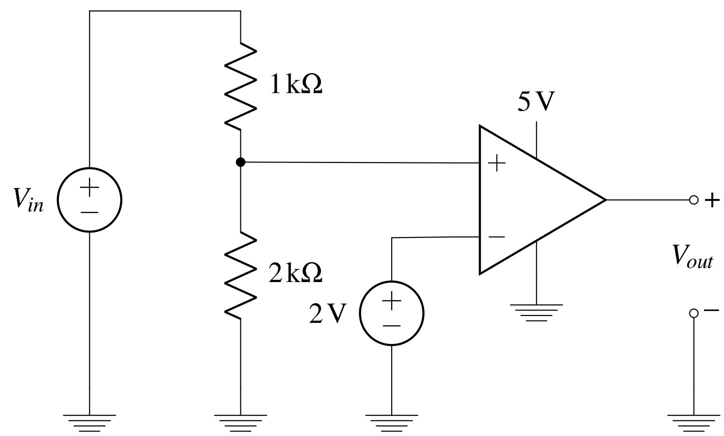
2. **Op-Amps As Comparators**

For each of the circuits shown below, plot V_{out} for V_{in} ranging from $-10\,\text{V}$ to $10\,\text{V}$ for part (a) and from $0\,\text{V}$ to $10\,\text{V}$ for part (b). Let $A = 100$ for your plots.

(a)

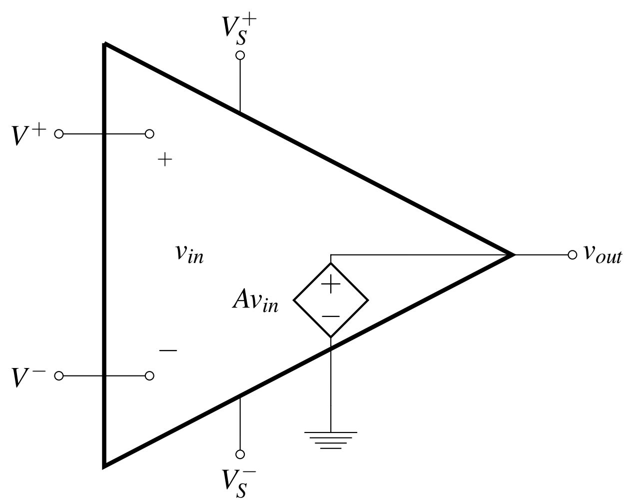


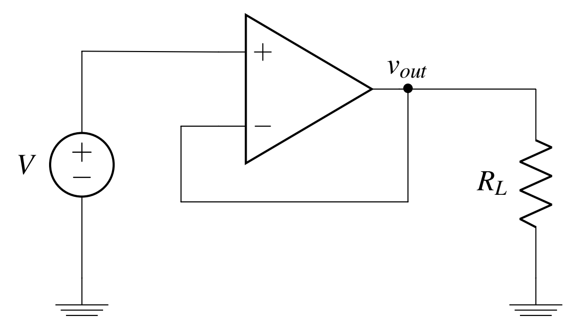
(b)



3. Op-Amp Golden Rules

On the left is the equivalent circuit of an op-amp for reference.





(a) What are the currents flowing into the positive and negative terminals of the op-amp (i.e., what are I^+ and I^-)? What are some of the advantages of your answer with respect to using an op-amp in your circuit designs?

(b) Suppose we add a resistor of value R_L between v_{out} and ground. What is the value of v_{out}? Does your answer depend on R_L? In other words, how does R_L affect Av_{in}? What are the implications of this with respect to using op-amps in circuit design?

(c) Now consider the circuit on the right. Assuming that this is an ideal op-amp, what is v_{out}?

(d) Draw the equivalent circuit for this op-amp and calculate v_{out} in terms of A, V, and R_L. Does v_{out} depend on R_L? What is v_{out} in the limit as $A \to \infty$?