1. Capacitors and Charge Sharing Revisited

(a) Consider two capacitors, \( C_A \) and \( C_B \) that have been charged to \( Q_{A_1} \) and \( Q_{B_1} \) respectively. 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 \(-10V\) to \(10V\) for part (a) and from \(0V\) to \(10V\) for part (b). Let \( A = 100 \) for your plots.

(a)
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 $A_{vin}$? 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 $A \to \infty$?