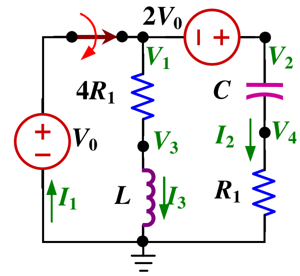
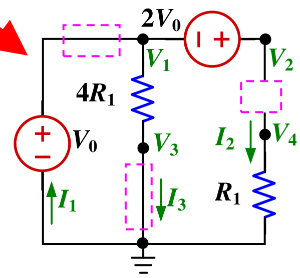
Part of our goal is not merely to *solve* the ODE, but to find it! Let's find $I_3(t)$.



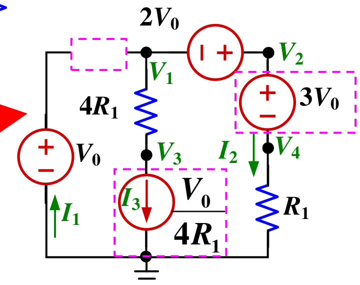
1. With the switch in the initial position, replace each capacitor with a broken wire, and each inductor with a wire. Use these results to find initial conditions for voltages across capacitors, or for currents through inductors.



In this example: $V_1 = V_0$, $V_2 = 3V_0$, $V_3 = V_4 = 0$
$I_2 = 0$, $I_1 = I_3 = V_0/4R_1$

Goal: $V_2(0) - V_4(0) = 3V_0$, and $I_3(0) = V_0/4R_1$

2. With the switch in the final position, replace each capacitor and inductor with a source matching step 1. Compute the initial current through each capacitor, and voltage across each inductor! Then convert the results **into initial slopes** (V' for capacitors, I' for inductors).

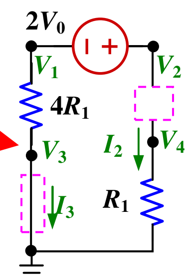


In this example: $V_1 = ¾V_0$, $V_2 = {}^{11}/_4 V_0$, $V_3 = -¼V_0$, $V_4 = -¼V_0$
$I_1 = 0$, $I_2 = -V_0/4R_1$

Capacitor equation: $I_2 = -V_0/4R_1 = C\,V_2'(0) - C\,V_4'(0)$

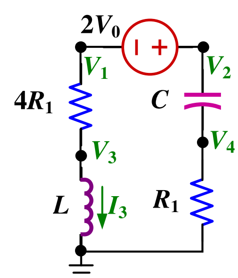
Inductor equation: $V_3 - 0 = -¼V_0 = L\,I_3'(0)$

3. With the switch in the final position, replace each capacitor with a broken wire, and each inductor with a wire. Use these results to find final conditions for voltages across capacitors, or for currents through inductors. This step is needed whenever the ODE is non-homogeneous, so we can find the "particular" solution.



In this example: $V_1 = V_3 = V_4 = 0$, $V_2 = 2V_0$
$I_2 = I_3 = 0$
Goal: $V_2(\infty) - V_4(\infty) = 2V_0$, and $I_3(\infty) = 0$

4. With the switch in the final position, write the "real" equations needed to create the 2nd order ODE for time between 0 and ∞. It's my opinion that it's easier to find an equation for current rather than voltage.



<u>Basic equations</u>: $V_2 = V_1 + 2V_0$, $V_1 - V_3 = 4R_1 I_3$, $0 - V_4 = R_1 I_3$,
$V_3 - 0 = L\,I_3'$, $I_3 = C\,V_4' - C\,V_2'$

Algebra: A general procedure might be to take first and second derivatives of every resistor equation, a first derivative of every capacitor and every inductor equation,

$C\,L\,I_3'' + 5\,R_1 C\,I_3' + I_3 = 0$ $\qquad I_3(0) = V_0/4R_1$ $\qquad I_3'(0) = -V_0/4L$

… since this equation is homogeneous for I_3, we didn't need step 3!