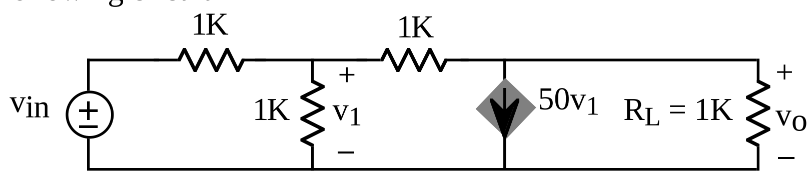
PROBLEMS YOU SHOULD BE ABLE TO DO AFTER YOU COMPLETE ECE 207

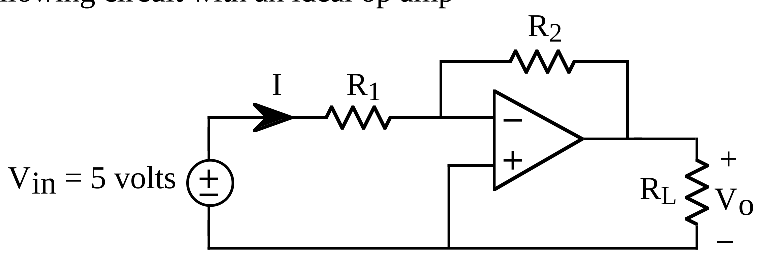
FALL 1995 **A.P. FELZER**

1. Given the following circuit



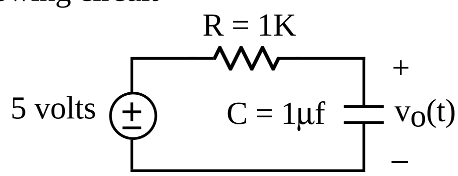
   a. Write and put in matrix the node equations
   b. Solve your equations in part (a) for the node voltages if $v_{in} = 5$ mv
   c. Find the power being supplied by the source v_{in} and the power being received by the load R_L if $v_{in} = 5$ mv
   d. Find R_{eq} as seen by the source v_{in}
   e. Find the transfer function $G = v_o/v_{in}$. Then make use of your result to find v_o if $v_{in} = 5$ volts. Make sure you get the same result as in part (b)
   f. Find and draw the Thevenin Equivalent as seen by R_L if $v_{in} = 5$ mv
   g. Make use of your Thevenin Equivalent circuit in part (f) to find v_o. Make sure you get the same results as in parts (b) and (e)
   h. Make use of SPICE to check your result for v_o when $v_{in} = 5$ mv

2. Given the following circuit with an ideal op amp



   a. Assuming $R_1 = 1K$, $R_2 = 2K$ and $V_{cc} = 15$ volts
      (i) Find V_o if $V_{in} = 5$ volts
      (ii) Find the input resistance $R_{in} = V_{in}/I$
      (iii) Sketch $v_o(t)$ if $v_{in}(t) = 10 \cos 100t$
      (iv) Find V_- if $V_{in} = 10$ volts
   b. Sketch V_o as a function of R_1. Explain why your curve looks the way it does
   c. Sketch V_o as a function of R_2. Explain why your curve looks the way it does
   d. Sketch I as a function of R_1. Explain why your curve looks the way it does
   e. Sketch I as a function of R_2. Explain why your curve looks the way it does

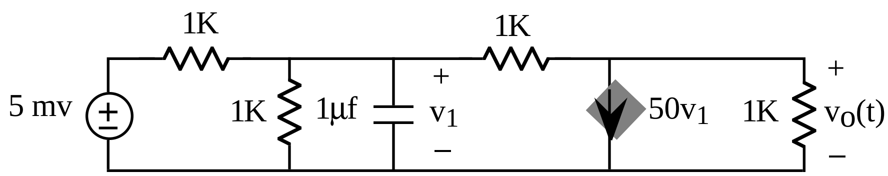
3. Given the following circuit



$v_o(0) = 0$

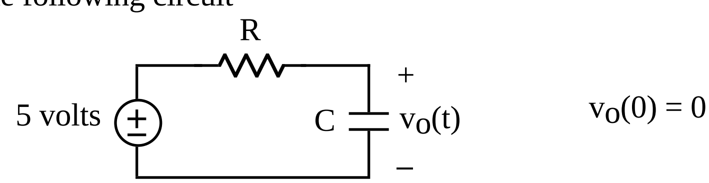
a. Find and sketch $v_o(t)$. Explain why the curve looks the way it does. Identify the forced and transient parts of the response
b. How will increasing C affect the response of $v_o(t)$. Explain why. Sketch a graph to illustrate what $v_o(t)$ looks like when C is small and another graph to illustrate what $v_o(t)$ looks like when C is large
c. How will increasing R affect the response of $v_o(t)$. Explain why. Sketch a graph to illustrate what $v_o(t)$ looks like when R is small and another graph to illustrate what $v_o(t)$ looks like when R is large

4. Given the following circuit



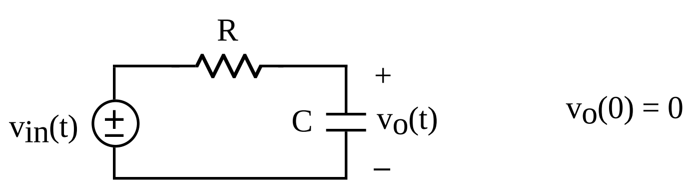
a. Find the steady state value of $v_o(t)$
b. Find R_{TH} as seen by the capacitor
c. Sketch $v_o(t)$ assuming zero initial conditions. About how long will it take the circuit to reach steady state. Explain how you got your results
d. Verify that SPICE gives the same result

5. How does the time constant τ of a first order circuit affect its response. Sketch the response of the following circuit



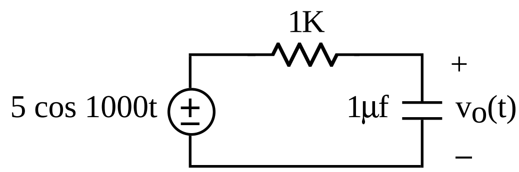
if τ is small and then if τ is large. Describe and explain the difference between the two responses

6. Sketch the response of the following circuit



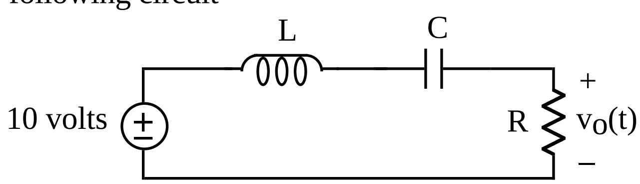
to a pulse and then a pulse train. Describe and explain the responses. Explain, in particular, how the relative magnitudes of the circuit's time constant τ and the pulse width and period T (of the pulse train) affect the circuit's responses. Then use SPICE to get plots of $v_o(t)$ for R = 1K, C = 1μf for a pulse of magnitude one and duration 2 msec and then for a pulse train of these pulses with period T = 5 msec

7. Given the following circuit



a. Find and then sketch the sinusoidal steady state response of $v_o(t)$ by writing and solving the differential equation for the forced response
b. Use a SPICE transient analysis to check your results in part (a). Explain how you were able to determine the phase of the steady state response from the graph
c. How will increasing the frequency of the input affect the magnitude of the sinusoidal steady state $v_o(t)$. Explain why

8. Given the following circuit



$v_o(0) = 0$

with $v_o(t) < 0$ and $v_o'(0) < 0$. Sketch $v_o(t)$ if the circuit is
a. Underdamped
b. Overdamped
c. Critically Damped
Make use of SPICE to find the response of the circuit with values of R, L and C of your choice

9. How can you tell from a circuit's characteristic roots whether it's underdamped, overdamped or critically damped