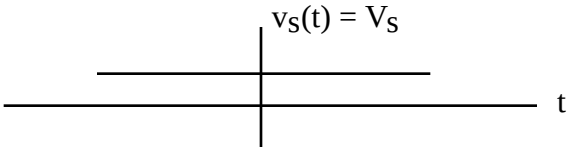
ECE 109 - TIME-VARYING INPUTS - INVESTIGATION 26
GENERAL ANALYSIS

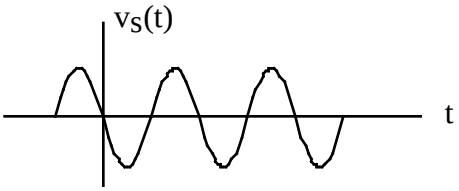
FALL 2006 **A.P. FELZER**

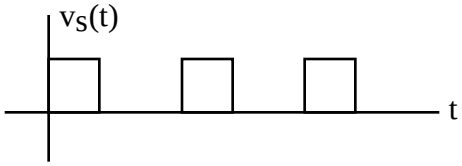
To do "well" on this investigation you must not only get the right answers but must also do neat, complete and concise writeups that make obvious what each problem is, how you're solving the problem and what your answer is. You also need to include drawings of all circuits as well as appropriate graphs and tables.

Up to now all the sources in our resistor circuits have been constant functions of time as follows



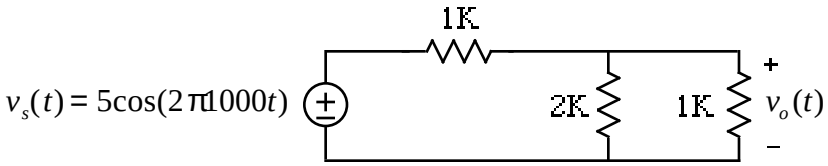
But most circuits have inputs that do vary with time like the following sinusoid and pulse train





To figure out how to analyze circuits with these kinds of time-varying inputs we have to go into the lab and see what they do. What we find is that **at each time t** the voltages and currents of resistor circuits with time-varying inputs satisfy Kirchhoff's Laws and Ohm's Law. And so all the results we've derived from Kirchhoff's Laws and Ohm's Law including voltage and current division, node equations, superposition and Thevenin all hold for resistor circuits with time-varying inputs. The objective of this investigation is to make use of node analysis to investigate linear resistor circuits with time-varying inputs. Be sure to take a look at the **Computer Demos** on Resistor Circuits With Sinusoidal Inputs.

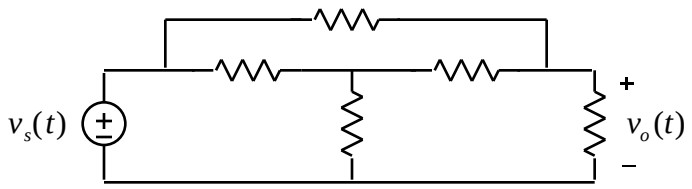
1. Given the following linear resistor circuit with sinusoidal input



   a. First sketch $v_s(t)$. What's the frequency in Hertz (cycles/sec) of the sinusoid. What's its amplitude
   b. Make use of node equations to find $v_o(t)$
   c. Sketch $v_o(t)$
   d. How are the graphs of $v_o(t)$ and $v_s(t)$ the same and how different

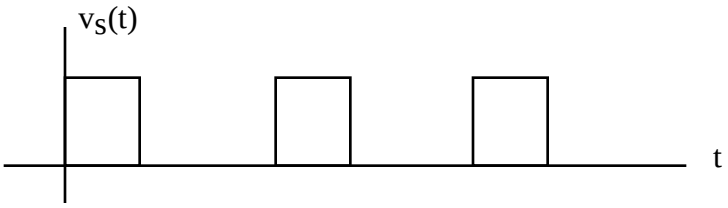
2. From Problem (1) we know that $v_o(t)$ is proportional to $v_s(t)$. How would you expect the voltages and currents in arbitrary circuits to be related to the source.

3. Sketch what you expect $v_o(t)$ to look like in the following circuit

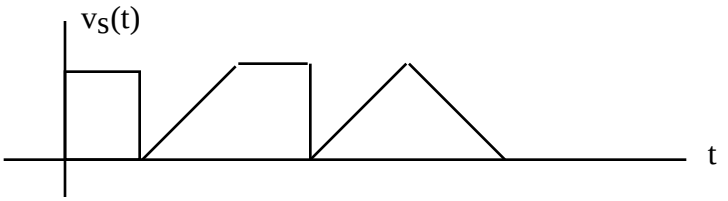


if $v_s(t)$ looks like

a.

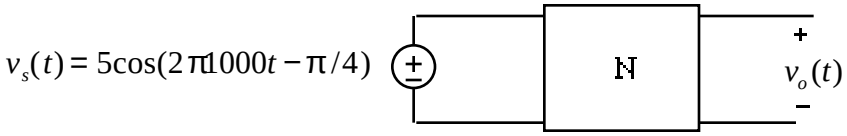


b.



Justify your results

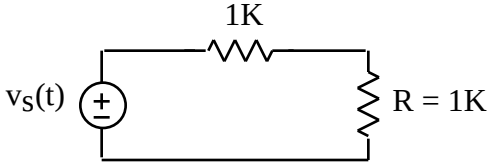
4. Find and sketch $v_o(t)$ in the following circuit



if the open circuit voltage gain $G = v_o / v_s$ of N is $G = 0.5$. Justify your analysis. What was the affect of the phase shift of $\theta = -\pi/4$ on your graph. Be careful

5. Make up and analyze a circuit with a time-varying input

6. Find and sketch the power being delivered to R in the following circuit



if $v_s(t) = 10\cos(2\pi 100t)$. Remember that $\cos^2(x) = 0.5 + 0.5\cos(2x)$

7. Math Review: What is the frequency in cycles/sec of $x(t) = \cos(2\pi 100t) + \cos(2\pi 200t)$