ECE 209 - PHASOR CIRCUITS - INVESTIGATION 5
INTRODUCTION TO PHASOR CIRCUITS

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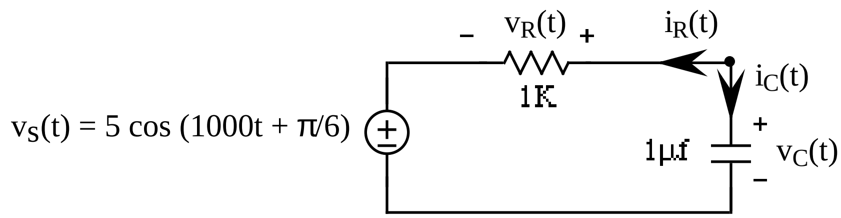
To do "well" on this investigation you must not only get the right answers but must also do neat, complete and concise writeups that make obvious what each problem is, how you're solving the problem and what your answer is. You also need to include drawings of all circuits as well as appropriate graphs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

The objective of this investigation is to see if we can come up with phasor equations like we did in the last investigation but without having to write any differential equations.

1. Assuming that the following nice innocent circuit



   is in the sinusoidal steady state

   a. Make use of your results in the previous investigation to express $I_R(j1000)$ and $I_C(j1000)$ in the following phasor node equation

Node	Equation
1	$I_R(j1000) + I_C(j1000) = 0$

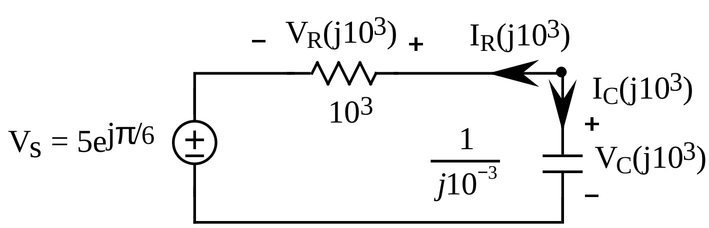
   in terms of the phasor $V_C(j1000)$ of the voltage across the capacitor and the phasor $V_S = 5e^{j\pi/6}$ of the input voltage

   b. Then solve your phasor equation for $V_C(j1000)$ and use your result to find

$$v_c(t) = \mathrm{Re}\left[V_c(j10^3)e^{j1000t}\right] = \mathrm{Re}\left[\left|V_c(j10^3)\right|e^{j\angle V_c(j1000)}e^{j1000t}\right]$$

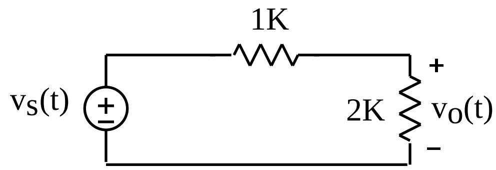
$$= \left|V_c(j10^3)\right|\cos\left(10^3 t + \angle V_c(j10^3)\right)$$

2. Believe it or not, you just found the sinusoidal steady state response of the circuit in Problem (1) without having to write a differential equation!! Now let's take things one step further. Suppose we take our time domain circuit above and innocently redraw it with the sinusoidal steady state voltages and currents $v_R(t)$, $i_R(t)$ and so on replaced with their phasors and the real circuit element values replaced with their impedances as follows



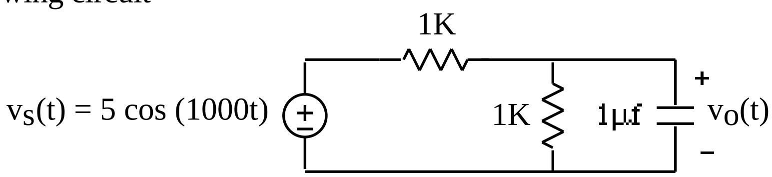
   We call this the **phasor circuit** for the circuit in Problem (1).

a. Now see if you can come up with an algorithm for writing the node equation for $V_C(j1000)$ directly from the phasor circuit. Justify your scheme. Then write your equation and verify that it's the same one you got in Problem (1) above
b. How is the analysis of phasor circuits similar to and how different from the analysis of purely resistors like



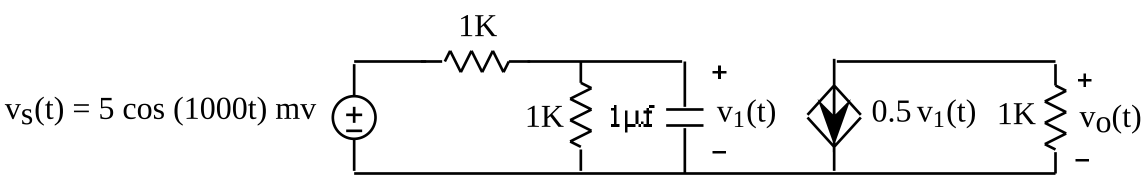
c. Does it matter that our phasor circuits are not real - cannot be built. Explain

3. Given the following circuit



a. Draw the phasor circuit
b. Then find $V_O(j10^3)$ and the corresponding steady state $v_O(t)$

4. Given the following circuit



a. Draw the phasor circuit
b. Write the node equations and then put them in matrix form
c. Then find $V_O(j10^3)$ and the corresponding steady state $v_O(t)$