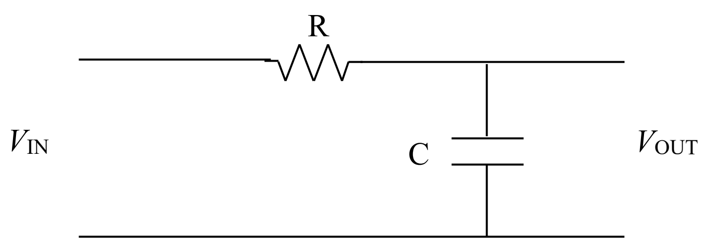
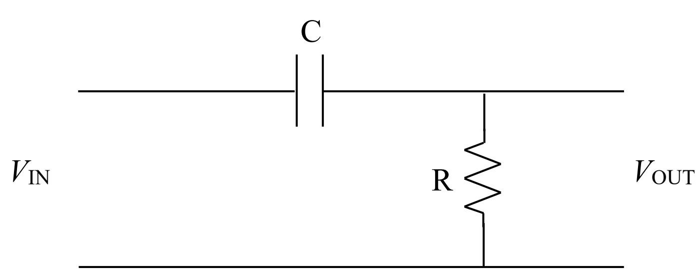
Physics 321: HW 6

1. For the circuit shown below, calculate $\left|\frac{V_{OUT}}{V_{IN}}\right|$ for $V_{IN} = V_0 \cos(\omega t)$. Also calculate the phase difference $\delta_{Vout} - \delta_{Vin}$ in degrees. Draw the asymptotes for and sketch in $\log\left(\left|\frac{V_{OUT}}{V_{IN}}\right|\right)$ as a function of $\log(\omega\tau)$, where $\tau = RC$. Note that $\omega_C \equiv 1/\tau$ is called the "corner frequency" due to the appearance of the asymptotes, and that $\omega\tau = \frac{\omega}{\omega_C} = \frac{f}{f_C}$. Also sketch the phase difference $\delta_{Vout} - \delta_{Vin}$ in degrees (linear scale) vs $\log(\omega\tau)$, showing the asymptotic behavior for frequencies much lower and much higher than the corner frequency.



2. Do the same for the following circuit:



The circuit in problem 1 is called a "single pole low-pass filter," and the one in problem 2 is a "single pole high pass filter." ***These are important enough you should try to memorize the asymptotic behavior shown in your plots.***

Also do problem 5.10 in Sprott.

Hint for 5.10: The V(t) function shown is the product of two functions at the top left of the cheatsheet. Can you identify these and use the convolution theorem to find the Fourier transform of their product? This should allow you to make a fairly quantitative answer. (You can count cycles to estimate the width of the envelope in units of *T*. $e^{-1/2} = 0.61$)