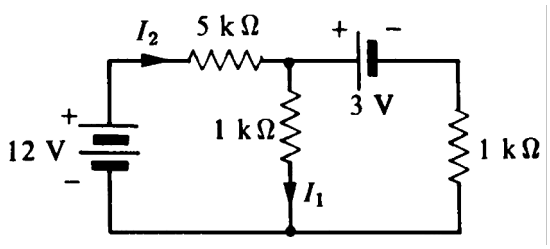
Physics 4700 HOMEWORK 2

Due February 10

1. Calculate I_1 and I_2.



2. This is a review problem on complex numbers. Manipulating complex numbers will become important when we discuss AC circuits.

Let $A = 2 + 4j$

$B = -1 + 3j$

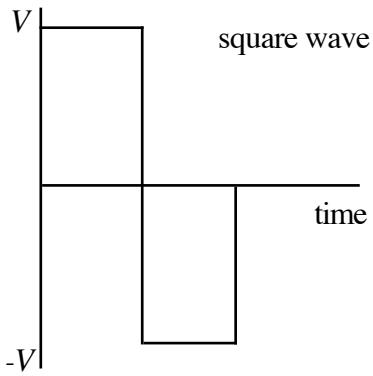
$C = 3 - 2j$

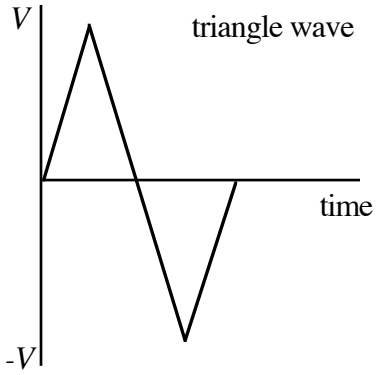
Find the magnitude and phase of,

a. A, B and C
b. $(A + B)/C$
c. $(2A - 3B^*)/(A - C^*)$, * = complex conjugate

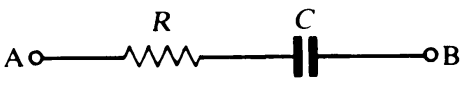
3. A current of 1 mA charges a capacitor of 1 μF capacitor. How long does it take for the capacitor to reach 10 V?

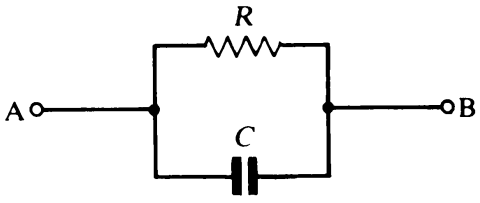
4. Calculate the V_{RMS} for the following waveforms:



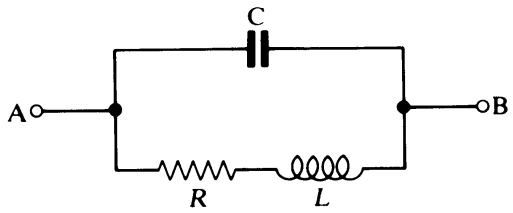


5. Calculate the impedance Z_{AB} in the form $a + jb$ and $|Z|e^{j\theta}$.





6. Calculate the impedance Z_{AB} in the form $a + jb$ and $|Z|e^{j\theta}$.



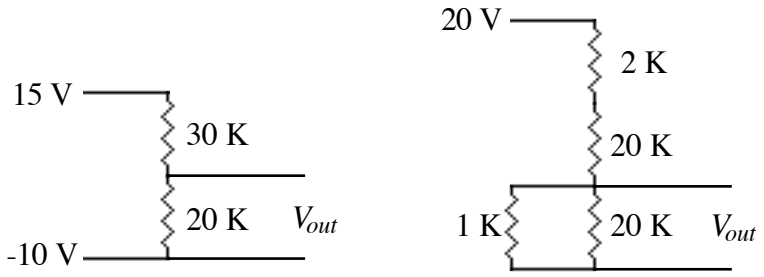
7. Design a low pass RC filter that will attenuate a 60 Hz sinusoidal voltage by 12 dB relative to the DC gain. Use a 100 Ω resistance. Explain in words why the low pass RC filter attenuates the high frequencies.

8. For a low pass RC filter prove that

a. at the frequency $\omega = 1/RC$ the voltage gain equals $0.707 = \frac{1}{\sqrt{2}}$.

b. the rise time of the output pulse equals $2.2RC$ for a zero rise time input pulse (See e.g. p. 107 of Simpson for definition of rise time.)

9. Draw the Thevenin equivalent circuit for the following two circuits:
(note: the load resistor across the V_{out} terminals is not shown).



10. For a high Q parallel RLC circuit prove that $Q = \omega_0/\Delta\omega$, where ω_0 is the (angular) resonant frequency and $\Delta\omega$ is the width at the half power points.