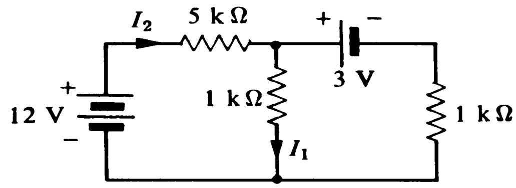
Physics 4700 HOMEWORK 2

Due September 25

1. **Simpson Page 50, #32**
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,

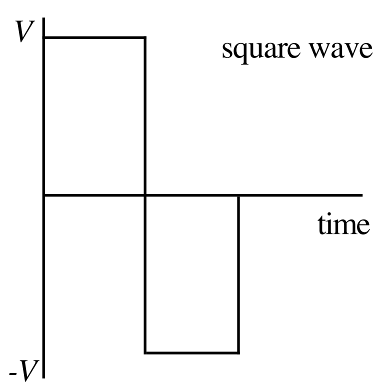
a. $A, B\ and\ C$
b. $(A + B)/C$
c. $(2A - 3B^*)/(A - C^*)$, * = complex conjugate

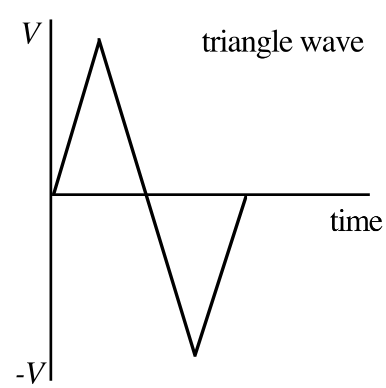
3. A current of 1 mA charges a capacitor of 1 μF capacitor. How long does it take for the capacitor to reach 10 V?

4. **Simpson Page 103, #2**
Prove that the root mean square (RMS) value of

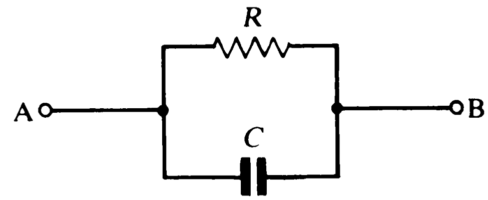
$$V(t) = V_0 cos\omega t$$

is equal to $\frac{V_0}{\sqrt{2}}$. What is the RMS value of the voltage of Problem 1? Also calculate the V_{RMS} for the following waveforms:

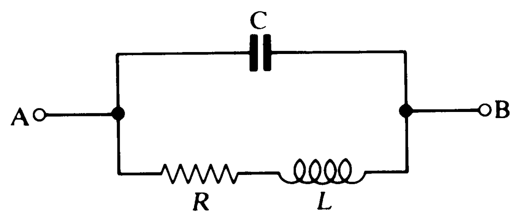




5. **Simpson Page 104, #10**
Calculate the impedance Z_{AB} in the form $a + jb$ and $|Z|e^{j\theta}$.



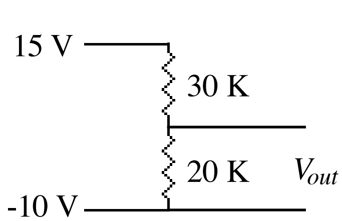
6. **Simpson Page 104, #12**
Calculate the impedance Z_{AB} in the form $a + jb$ and $|Z|e^{j\theta}$.

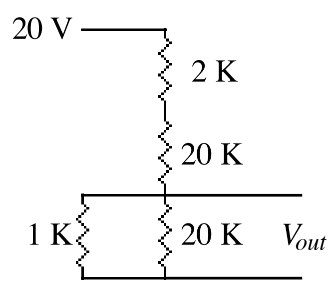


7. **Simpson Page 105, #14**
Design a low pass RC filter that will attenuate a 60 Hz sinusoidal voltage by 12 dB relative to the DC gain. Use a 100 Ω resistance. Explain in words why the low pass RC filter attenuates the high frequencies.

8. **Simpson Page 105, #15.** (The rise time is defined on page 107 of Simpson.)
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 time input pulse

9. Draw the Thevenin equivalent circuit for the following two circuits:
(note: the load resistor has already been taken out of the circuit, if it were in the circuit, it be across the V_{out} terminals).





10. **Simpson Page 105, #23**
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.