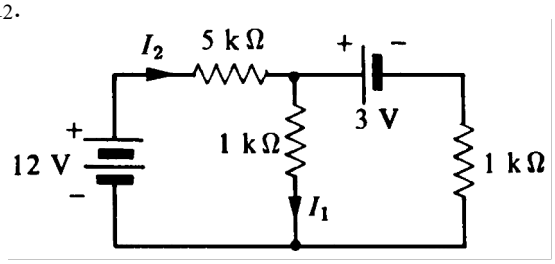
Physics 4700 HOMEWORK 2

Due September 23

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 $A = 2 + 4j$

   $B = -1 + 3j$

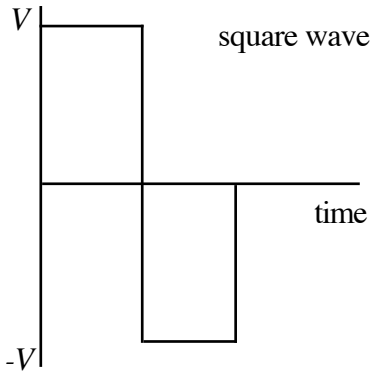
   $C = 3 - 2j$

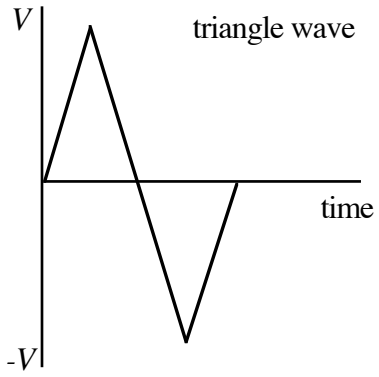
   Find the magnitude and phase of,

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

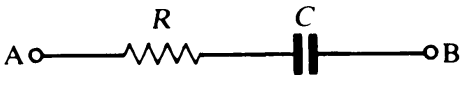
3. A current of 1 mA charges a capacitor of 1 μF capacitor. How long does it take for the capacitor to reach 10 V?

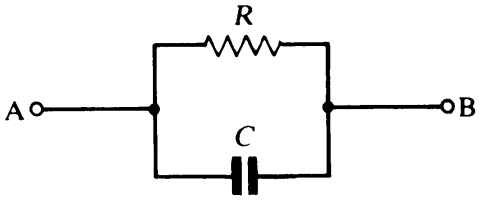
4. Calculate the V_{RMS} for the following waveforms:



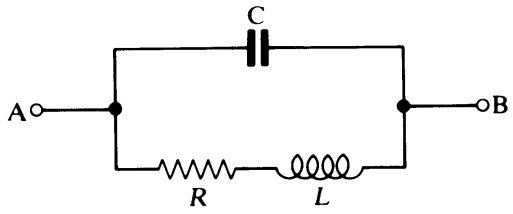


5. **Simpson Page 104, #10**
   Calculate the impedance Z_{AB} in the form $a + jb$ and $|Z|e^{j\theta}$.





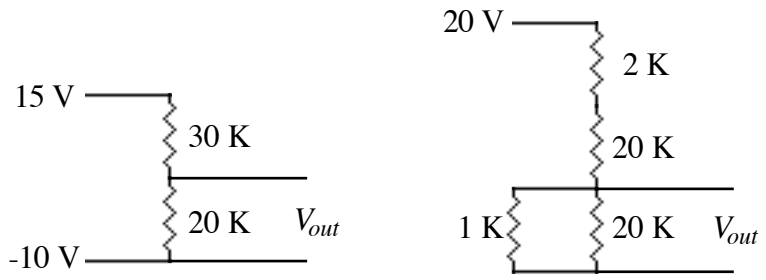
6. **Simpson Page 104, #12**
   Calculate the impedance Z_{AB} in the form $a + jb$ and $|Z|e^{j\theta}$.



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 rise 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.