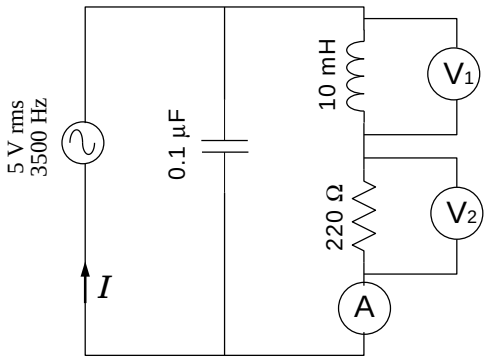
Spring 2016 Exam 1 Physics 338

Complete all five problems.

1. Design and provide the schematic diagram for a +10 volt regulated power supply that will supply 0.5 A of current. Use a 7810 IC regulator, which is similar to the 7805 used in lab (e.g., it requires a 2 V "headroom"), but is designed for 10 volts. The full-current peak-to-peak ripple before the regulator should be 3 V. Record on your drawing the ratings for all components (e.g., transformer rms secondary voltage, C of capacitor, worse-case power dissipated in regulator, rating for fuse on 120 V line cord, etc.)

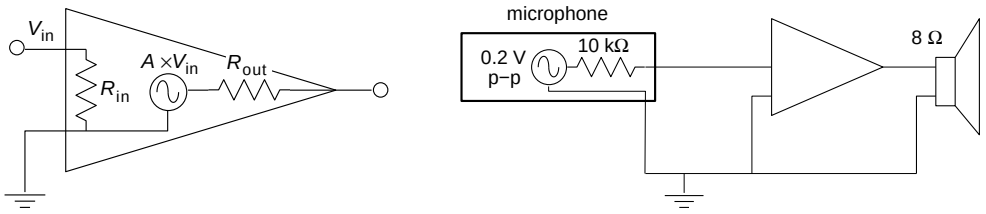
2. A function generator (output: 5 V_{rms} at a frequency of 3500 Hz) powers the circuit shown right. The ammeter (A) and voltmeters (V) shown in the circuit are ideal and like, ordinary DMMs, they report rms values.



   (a) Find the complex current I; report its magnitude and phase. Does the function generator's voltage lead or lag I?

   (b) Report the three values found by the three meters.

3. The following problems deal with a generic amplifier (see below, left) with gain A, input impedance of R_{in}, and output impedance of R_{out}, driven with a sine wave input. The amplifier has a voltage gain of 40 dB with an input impedance of 500 Ω and an output impedance of 32 Ω.

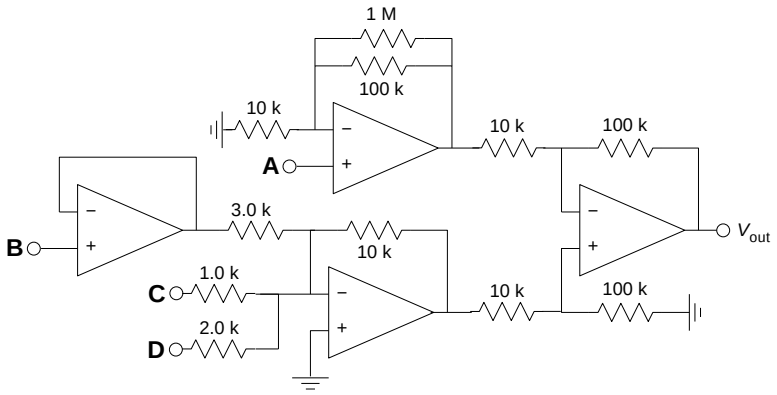


   (a) As shown above right, a microphone with a Thévenin equivalence circuit of a 0.2 V peak-to-peak voltage source in series with 10 kΩ drives a speaker through the amplifier. Assuming the speaker acts exactly like an 8 Ω resistor, find the power dissipated in the speaker.

   (b) The amplifier in part (a) is replaced with a follower (unit-gain [i.e., A=1] 'amplifier') with an input impedance of 1 MΩ and an output impedance of 1 Ω. Find the power dissipated in the speaker.

   (c) If the microphone is directly connected to the speaker, what power will be dissipated in the speaker?

4. The below mess-of-op-amps circuit has four input voltages: **A, B, C, D**. Find the equation for the output voltage V_{out} in terms of the four input voltages. Show work for partial credit!



5. You are trying to understand the behavior of a device with two terminals. When you measure the voltage between the two terminals with a digital voltmeter you get 5 V. When you attach a 500 Ω resistor between the two terminals you measure 4 V. Calculate component values for a Thévenin equivalent circuit for the device and draw that equivalent circuit. If you attach a 100 Ω resistor between the terminals, how much power will be dissipated in that resistor?