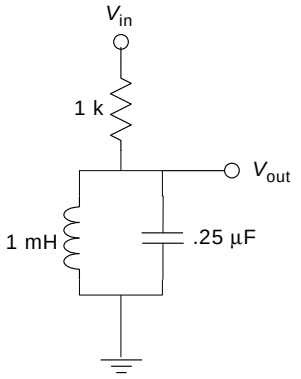
Spring 2014 Exam 1 Physics 338

Complete problems 1–4 and **one** of the last two problems

1. Design and provide the schematic diagram for a +3.3 volt regulated power supply that will supply .25 A of current. Use a ADP3335 three-terminal regulator, which is similar to the 7805 used in lab (but requires a 0.5 V "headroom" and is designed to produce 3.3 volts). The full-current peak-to-peak ripple before the regulator should be 1.5 V. Record on your drawing the ratings for all components (e.g., transformer rms secondary voltage, $C$ of capacitor, power dissipated in regulator at full current, rating for fuse on 120 V line cord, etc.)

2. The circuit shown acts as a (complex impedance) voltage divider for $V_{\text{in}}$ which you may assume is a perfect 10 V source (rms, of course) at a frequency of $f = 10$ kHz. Find the rms magnitude and phase of the current that flows from the source. Find the rms magnitude of the voltage out and the current through the capacitor. The result may strike you as surprising. Any idea what is happening?




3. We have discussed many different op-amp circuits: amplifiers (inverting and non-inverting), differentiators, integrators, followers, current sources, etc. Pick out three such circuits, provide a circuit diagram, brief description (e.g., name) and report the formula that describes the output.

4. Provide a very brief definition of the following electronics terms:

   (a) short circuit
   (b) output impedance
   (c) full-wave rectification
   (d) load regulation (power supply)
   (e) *stiff* power supply
   (f) resonance
   (g) amplifier $f_{-3dB}$
   (h) virtual ground
   (i) Coupling▶AC (scope)
   (j) Thévenin equivalent circuit

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 6 V. When you attach a 100 Ω resistor between the two terminals you measure 5 V. Calculate component values for a Thévenin equivalent circuit for the device and draw that equivalent circuit. If you attach a 10 Ω resistor between the terminals, how much power will be dissipated in the resistor?

6. A homework problem describes a series $LR$ circuit that is powered by a source producing a sine wave at 5 $V_{rms}$. Using the problem's component values and frequency a student calculates the current as $I = 5/(R + i\omega L)$ and gets $(3 - 4i)$ mA. Given all the proper components (inductor, resistor, properly adjusted function generator) and the the usual measurement tools available in our lab, report how this calculation could be confirmed by direct *measurement*. Display the measurement results; explain how the results correspond to the calculated answer. Use schematics to show exactly how any measurement tools would be attached to the circuit.