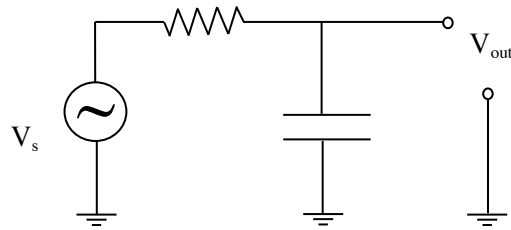**PHY2250 "Homework 6". Dr. Hawley's answers.**

1. Part of the crossover for a 2-way loudspeaker system has a capacitance of 2 µF and a resistance of 1 kΩ, and has the following schematic:

   a. What is the time constant τ for this part of the circuit?
   b. Calculate the turnover frequency $f_0 = 1/(2\pi\tau)$ and explain briefly what happens to the ratio V_{out}/V_s (just the amplitudes, ignore phase effects) for freq's above & below this frequency.
   c. Which signals are phase-shifted more relative to the source voltage: low or high frequencies?
   d. ~~Calculate the phase shift in degrees from V_s to V_{out} for a 150 Hz sine wave. Include the sign (+ or –) of the shift to indicate leading or lagging.~~
   Hint: Use a phasor diagram!
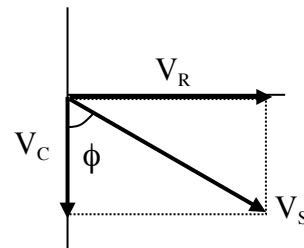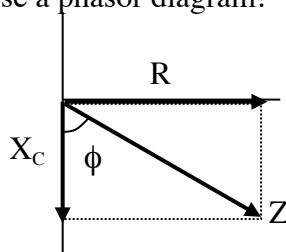
2. A signal from a mic is coming in at 20mV. It then connects to a transformer… What turns ratio is needed to step the voltage up to 1.5V (assuming an ideal transformer)?
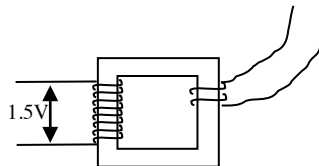
3. Describe Faraday's Law of induction, and list three different examples of how it arises (or is used) in audio engineering.

4. Given your answer to #3, would you expect induction to be a more significant effect at *high* or *low* frequencies, and why?

5. Some people like to say that "and inductor is like the opposite of a capacitor." Describe in what sense(s) this can be true.
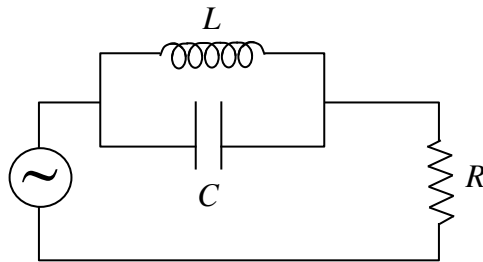
6.

L = 10mH

V_{T_RMS} = 60VAC

R = 15.7 Ω
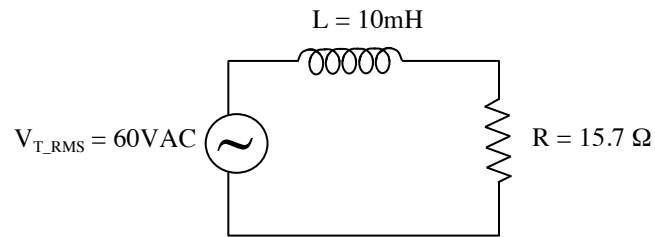
For the circuit shown, find

a) V_T (peak)
b) For the frequency $f = 63$ Hz, find
    i. X_L
    ii. Z_T
    iii. The angle θ between Z_T and R.
    iv. V_R
c) Repeat (b) for $f = 250$ Hz
d) Repeat (b) for $f = 2000$ Hz

7. Notch Filter

L

C

R

In the schematic shown, $V_T = 100$ V, $L = 100$ mH, $C = 10$ μF, and $R = 8$ Ω.

a) At what frequency f_n is $X_C = X_L$?
b) Show that the impedance value at this frequency is equal to $X_n = \sqrt{L/C}$ and find the value of X_n

8. Do the exercise at the end in the Phasor Diagram handout. (Answers at bottom of handout.)