Duke University
Department of Physics

Physics 271 Spring Term 2017

PRACTICE MIDTERM

I will abide by the Duke Community Standard. Name: _____

This is a closed book exam, with one side of one page cheat sheet allowed. Calculators are allowed, but only for basic calculations: you may not use special memory, graphing etc. functions. You must always show your work for credit; all answers must be justified. **You must hand in your cheat sheet with your test.**

Problem 1: (10 points)

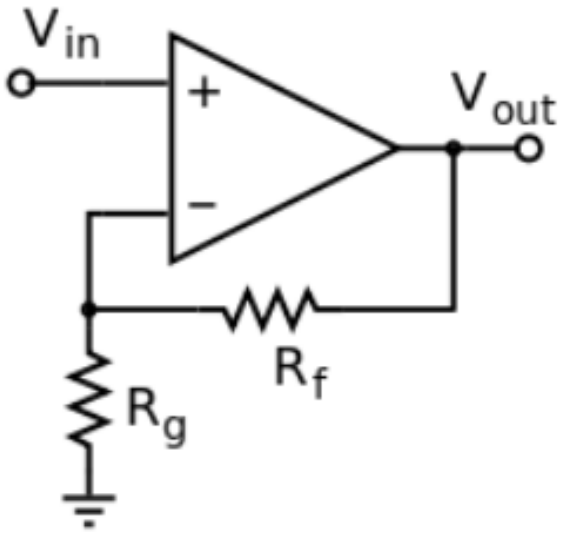
Using only capacitors and resistors, make a sketch of a two-pole band-pass filter. Roughly sketch the resulting Bode plot, labeling the slopes of any lines. Don't use specific values for R and C but indicate relative sizes of them.

Problem 2: (10 points)

Design a diode clipper circuit that limits the output to no more than +2.3 V and -1.6 V. Sketch the output for a 100 Hz sine wave with 6 V amplitude, and for a 50 Hz square wave with 2 V amplitude.

Problem 3: (10 points)

Determine the gain of the given amplifier circuit, assuming that the amplifier's open-loop DC gain is A.



Problem 4: (10 points)

Determine the locations of the poles and zeroes of the transfer function $\hat{H}(\omega) = \frac{\omega-3}{\omega^2-4j\omega-13}$. Express your answers in the form of values of $\hat{s}$, and indicate their positions (in standard notation) on the complex frequency plane.

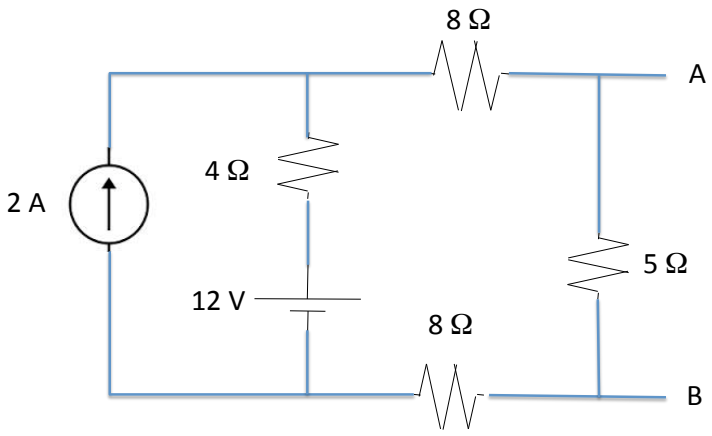
Problem 5: (20 points)

For the given circuit

a. Determine the Thevenin resistance R_T.

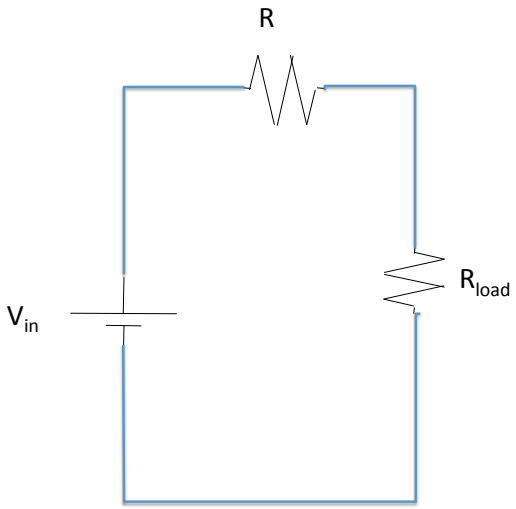
b. Find the Norton equivalent current I_N.

c. Find the Thevenin equivalent voltage V_T.



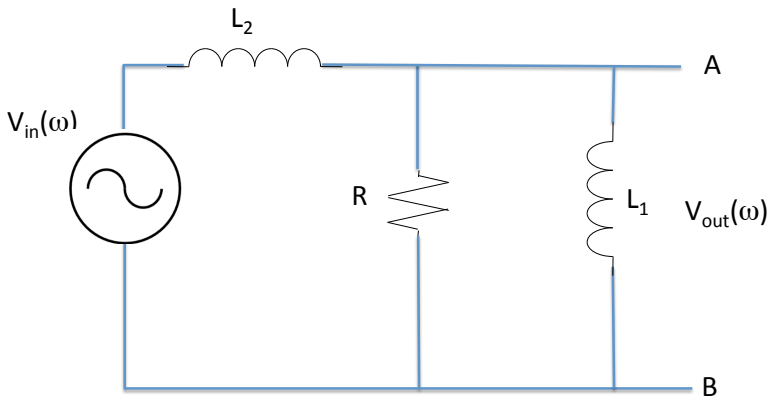
Problem 6: (20 points)

For the given circuit, show that the maximum power will be dissipated in R_{load} if $R = R_{\text{load}}$. (This is known as impedance matching, and is a useful result.)



Problem 7: (25 points)

For the given filter



a. What is $\hat{H}(\omega)$? Answer in terms of L_1, L_2, R and ω.

b. Is this a low-pass, high-pass, band-pass or band-rejection filter? Explain. Sketch the Bode plot.

c. Determine the corner frequency or frequencies.

d. Determine the values of the zeroes and poles and sketch them on the complex frequency plane.

e. Write down $|\hat{H}(\omega)|$ using the results of part d.