Physics 322 Study Guide 1

October 5, 2026

Your name: _____

This exam happens in 3 steps:

1:00–2:00 (60 min.)	You will complete Problems 1–5 on your own.
	Problems 1 and 2 are written questions.
	Problems 3 and 4 are done at the lab bench.
	Problem 5 asks you to design a circuit.
2:00–2:15 (15 min.)	We discuss as a group the circuit you designed in Problem 5.
2:15–3:15 (60 min.)	You will build the circuit on your own (Problem 6).

The exam is in a limited open-book format: you may bring your notes and a laptop or tablet and refer to any course materials on the Canvas site, including pre-labs, labs, and lectures (and their solutions), as well as any of your own notes. Calculators, including graphing calculators or app equivalents such as Desmos, are also allowed. However, you may not search the open Internet or ask for answers from classmates, AI, or others on the internet.

If you do not understand what a question is asking for, please ask for clarification.

During the hands-on portions, if you become stuck and need to ask me for help, you must be able to describe the problem (what you expected to see, and how your observation differs from that expectation) as well as at least **three** things you have already tried to fix the problem.

Below is a list of learning goals with associated questions. Some are questions that you can (and should) work out on paper; others are about skills (e.g. "can you set the trigger level on the scope?"). For the skills questions, you can answer yes or no, and come to open lab to practice until your answer is "yes"! Keep in mind that the questions don't necessarily cover the whole learning goal (especially e.g. the learning goals about recognizing several different types of circuits), but should give you an idea of your understanding and what you should look back on in the labs, prelabs and lectures.

1 Instrumentation

- Oscilloscope
  - How to use a scope: trigger, measurements, 10x scope probe, how the ground clip is connected.
  - Can you set the trigger level and change the trigger channel? Can you measure the amplitude and frequency of a waveform?
- Function Generator: waveform, frequency, amplitude, offset.
  - Can you output sine, square, and triangle waveforms with given frequency, offset, and amplitude?
- How to use a DMM: current, voltage, continuity, resistance.
  - Can you make measurements of current, voltage, continuity, and resistance? How do you ensure that you do not blow the fuse in the current-measuring mode?
  - What is the ideal resistance of an ammeter, and why? What about a voltmeter?
- Protoboard: How are the breadboard holes connected? Can you use the BNC connector, function generator, and power outputs?

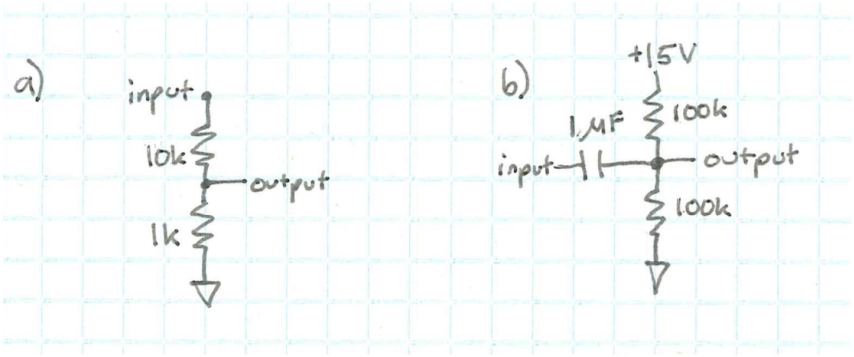
2 Reading/Building Circuits

- Be able to draw the circuit diagram, given a circuit on a breadboard. Understand the concept of ground. Given a breadboard with a circuit, could you draw a diagram?
- Read resistor values, given a color code chart.
- Understand the difference between AC and DC voltage.
- Reading simple circuit diagrams: identify in a diagram and explain the purpose of a voltage divider, potentiometer (used as a voltage divider and used as a variable resistor), and RC filter. Locate grounded components and identify voltage differences.

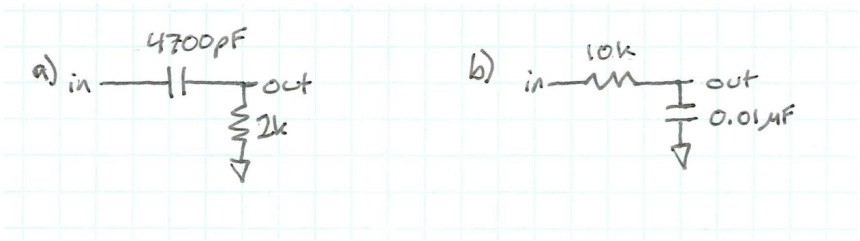
3 Circuit Analysis

- Determine input and output impedance (aka load and source resistance) of circuit blocks. See prelabs for more example problems.

  What are the input and output impedances of the two circuits shown below at a) DC and b) infinite frequency? (Calculate input impedance assuming the circuit is not attached to a load, and output impedance assuming the circuit is driven by perfect voltage source.)

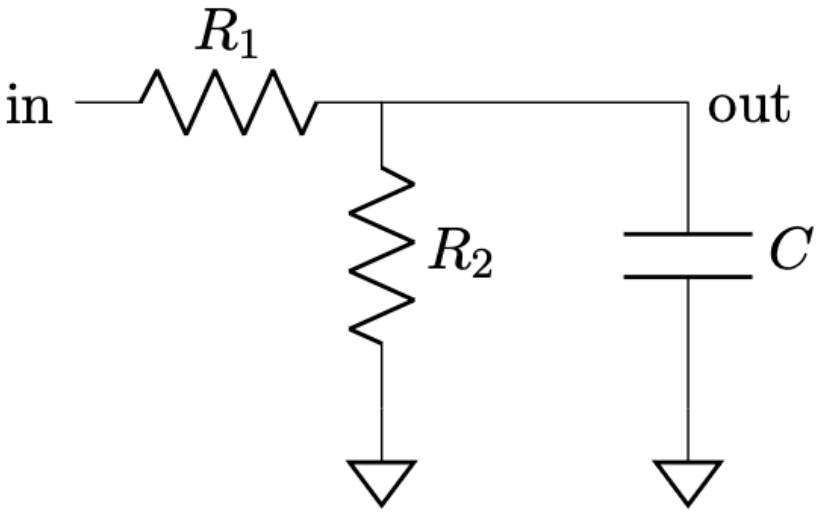


- Recognize a low pass filter and a high pass filter, and be able to calculate the corner frequencies (aka cutoff or 3dB frequencies).



- Qualitatively interpret the transfer function of a circuit composed of resistors and capacitors in the limits of high and low frequency. Identify any points (corner frequencies) where the transfer function qualitatively changes. Try some variations on the simple high and low pass filters. What happens if you add more resistors and capacitors in different places?

  What is the gain $G = V_{out}/V_{in}$ of the following circuit, in terms of Z_R and Z_C (keep it qualitative, using $A||B$ to mark parallel combinations)? What are the zero- and infinite-frequency limits for the gain? Bonus (this requires complex algebra): what is the cutoff frequency?



- How to choose input and output impedances to cascade circuits. (see band-pass filter, lab 5)

  What resistor values would you choose for the two situations shown below, to prevent the input

voltage from dropping by more than 10% when loaded?

