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**Introduction**

Each student must make one oral presentation in lab during the semester. Contents for oral presentations are listed below for Lab 1. Talks start the second or third week of Lab 1.

Presentations will last **five minutes** and will be given at the beginning of the lab session. The presentations will typically describe work performed the previous week in lab by way of review. Practice your talk and be succinct. Stick to the five-minute time frame.

**Presentation 1.1: Equivalent circuit for power supply**

- a) Explain that your presentation will discuss the schematic diagram representation for the Agilent power supply used in Lab 1a.
- b) Draw a pictorial representation of the leads for the power supply, (i.e., sketch Fig. 4 from Lab 1a).
- c) Draw the schematic diagram shown below and explain that it is equivalent to the power supply. Be sure to show the reference (triangle).
- d) Explain that the power supply is like two batteries in series and that the reference is arbitrarily assigned as a point in the circuit that we think of as being at zero volts.
- e) Explain that the green banana plug connector on the power supply, (which we did not use), is actually connected to the ground pin on the power plug where the power supply is plugged into an outlet. That ground pin in the outlet eventually is connected to a metal rod buried in the ground.
- f) Explain that the reference and the ground are two distinct things, although people often refer to the reference as ground in a circuit. The reference may or may not actually be connected to ground. The distinction becomes important when two different circuits are connected together. In that case, whether or not the reference is actually grounded will determine whether there may be a "ground conflict" between two circuits, meaning the circuits effectively try to create different voltages for the grounds.
- c) Conclude your presentation by reminding the audience that care should be taken to refer to references and grounds correctly in order to avoid design mistakes.

**Presentation 1.2: LED circuit model**

- a) Explain that your presentation will describe a simple circuit model for an LED.
- b) Explain that the simple circuit model for an LED is voltage source with a value around 2.0 V.
- c) Say that you will draw a model of the power indicator circuit from Lab 1a, and draw a resistor in series with the 2.0 V source representing LED.
- d) Observe that as the power supply is adjusted from 2 V to 25 V, the LED would always have 2 V across it in our simplified model. Comment that this is why the graphs made in Lab 1a of LED current versus voltage tended to look like vertical lines at about 2 V.
- e) Explain that the model fails to make sense when the power supply is less than 2 V. The voltage source representing the LED only makes sense if the power supply is higher than 2 V. Otherwise, the LED would be able to generate power when the power supply is turned off!
- f) Conclude your talk by noting that modeling the LED as a voltage source (or voltage drop) works fairly well when the power supply is 12 V, as it normally is for Lab 1a.

### Presentation 1.3: Exponential equation for LED

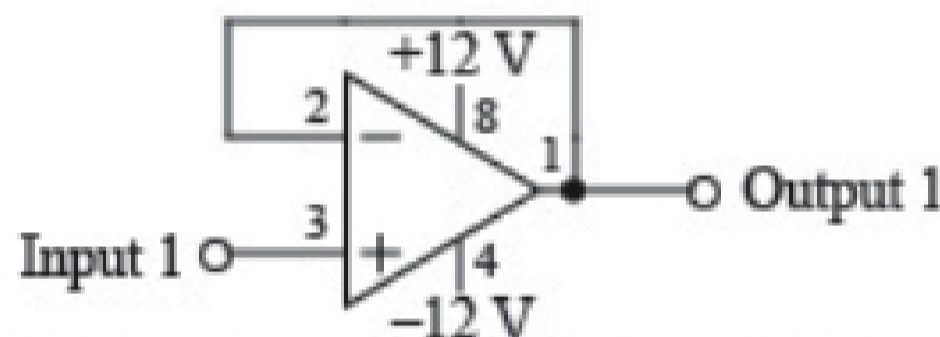
- Explain that your presentation will discuss a realistic model of an LED as having an exponential current versus voltage response.
- Sketch the data you obtained in Lab 1a for the LED current versus voltage. Make sure you have some data points for power supply voltages less than 2 V.
- Write the equation below that describes the current versus voltage for a diode:

$$i_{LED} = I_0 \left( e^{v_{LED}/v_T} - 1 \right)$$

- Explain that this equation is derived from solid state physics, (that EE students will cover in ECE 2280 and ECE 3200).
- Make the observation that  $I_0$  is a constant that depends on how the diode is made, and  $v_T$  is the "thermal voltage" that has a value of about 26 mV.
- Sketch  $i_{LED}$  versus  $v_{LED}$  curve given by the above equation. (Use Matlab<sup>®</sup> or Excel to make a plot of the function beforehand.)
- Comment that the  $i_{LED}$  versus  $v_{LED}$  curve measured in lab looks similar to the calculated curve.
- Conclude by observing that the exponential curve may be crudely approximated by a vertical line, which is equivalent to the voltage drop model described in Talk 1.2.

### Presentation 1.4: Derivation of *Output 1* versus *Input 1* for pre-amp

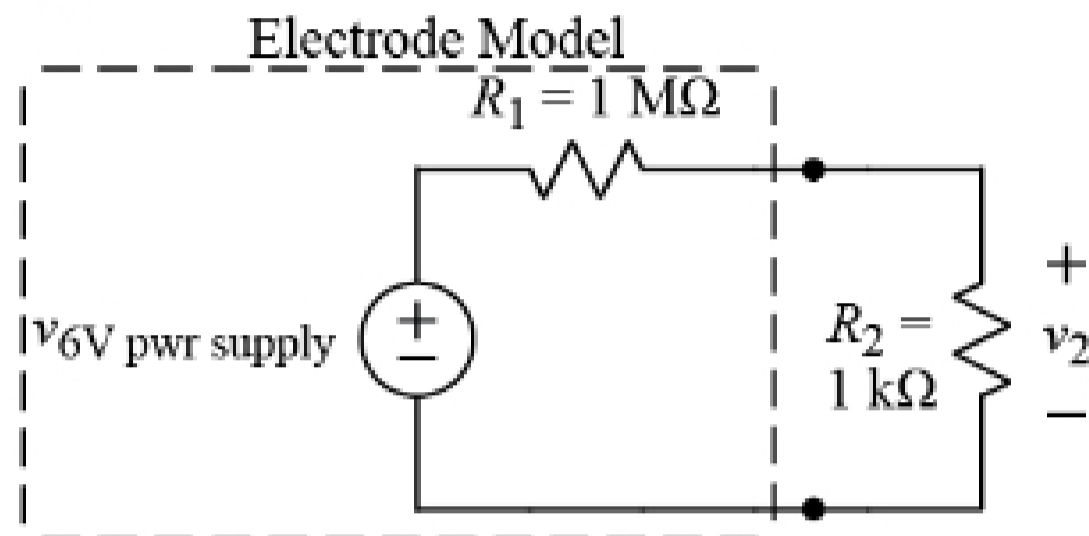
- Explain that your presentation will discuss the equations for voltage loops and current sums at nodes used to derive the equation for *Output 1* for the pre-amp circuit in Fig. 6 of Lab 1a.
- On the board, draw the circuit from Fig. 6 of Lab 1a, reproduced below.



- Add a wire across the bottom of the circuit and attach a triangle symbol for reference to it. The *Input 1* and *Output 1* voltages will be measured with the minus sign on this wire.
- Erase the op-amp and show a voltage-source between *Output 1* and the wire on the bottom.
- Add a voltage source labeled *Input 1* from the + input to the wire on the bottom.
- Comment that the voltage at the + input of the op-amp is *Input 1*.
- Comment that the op-amp has negative feedback from the output to the - input, which causes the voltage measured from the - input to the reference wire on the bottom to be the same as the voltage measured from the + input to the reference wire on the bottom.
- Observe that this means the voltage at the - input is also *Input 1*.
- Observe that since there is no voltage drop on a wire, this means the voltage at the op-amp output is also *Input 1*.
- Conclude your talk by noting that the pre-amp output voltage is the same as the input voltage, but the op-amp can supply up to 10 mA of current, whereas the input signal may be able to supply far less.

**Presentation 1.5: Voltage-divider models of electrode and pre-amp output**

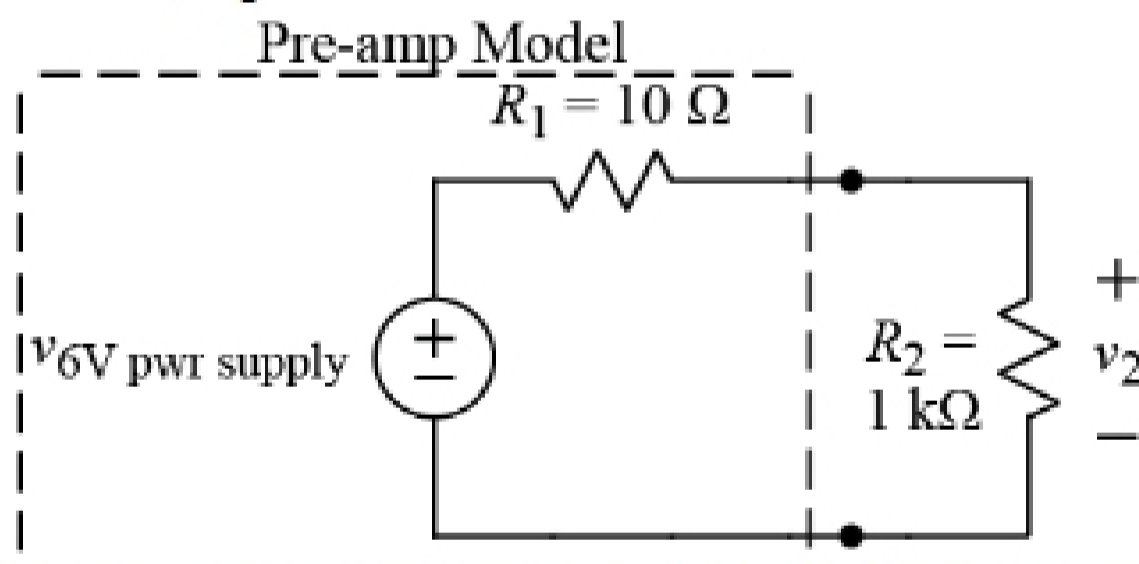
- Explain that your presentation will discuss the voltage-divider equations for the electrode model in Fig. 2 of Lab 1b and for the pre-amp model in Fig. 3 of Lab 1b. voltage loops and current sums at nodes used to derive the equation for Output 1 for the pre-amp circuit in Fig. 6 of Lab 1a.
- On the board, draw the voltage-divider model of an electrode from Fig. 2 of Lab 1b, reproduced below.



- Write the following voltage divider equation for  $v_2$  versus  $v_{6V\text{ pwr supply}}$  on the board:

$$v_2 = v_{6V\text{ pwr supply}} \cdot \frac{R_2}{R_1 + R_2} \approx v_{6V\text{ pwr supply}} \cdot \frac{1k}{1M} = \frac{v_{6V\text{ pwr supply}}}{1k}$$

- Comment that an electrode will produce an input voltage on the order of millivolts and the output voltage will be on the order of microvolts for this circuit.
- Comment that noise levels in a circuit may on the order of millivolts. Thus, microvolts would be lost in the noise.
- On the board, draw the voltage-divider model of the pre-amp output from Fig. 3 of Lab 1b, reproduced below.



- Write the following voltage divider equation for  $v_2$  versus  $v_{6V\text{ pwr supply}}$  on the board:

$$v_2 = v_{6V\text{ pwr supply}} \cdot \frac{R_2}{R_1 + R_2} \approx v_{6V\text{ pwr supply}} \cdot \frac{1k}{1k} = v_{6V\text{ pwr supply}}$$

- Comment that an electrode will produce an input voltage on the order of millivolts and the output voltage will be on the order of millivolts for this circuit.
- Conclude by commenting that noise levels in a circuit may on the order of millivolts. Thus, the output of the pre-amp may be somewhat noisy—but it is one thousand times