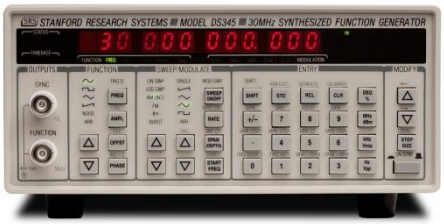
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
Department of Electronic and Computer Engineering
ELEC 1100

Laboratory 1: Instrumentation and Basic Circuits (4%)

A) Objectives:

- To familiarize with the equipment in the lab.
- To familiarize with breadboard circuit design.

B) Equipment in the lab:

Item	Required Cables
1) D.C. Power Supply 	1) D.C. Power Supply Cable 
2) Digital Multimeter 	2) Digital Multimeter Cable 
3) Function Generator 	3) Function Generator Probe 
4) Digital Storage Oscilloscope (DSO) 	4) DSO Probe 

C) Prelab (Solution included)

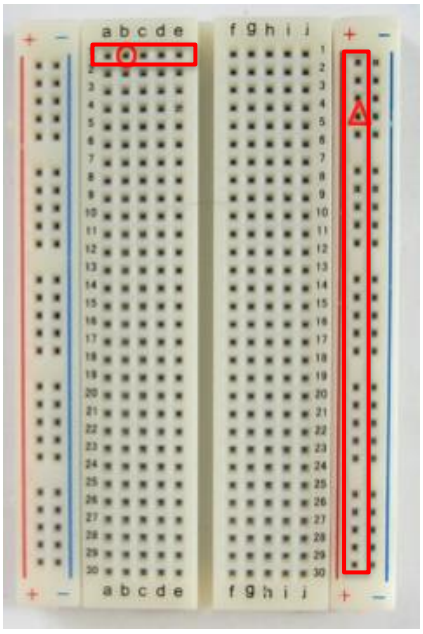
- Q1 What is the name of the instrument shown in the figure?

  ___DC Power Supply_____

- Q2 On the given figure, circle the On/Off button.

- Q3 A picture of a breadboard is given. On the picture, circle all the holes that is connected to the one marked with a circle.

- Q4 On the same breadboard, circle all the holes that is connected to the one marked with a triangle.

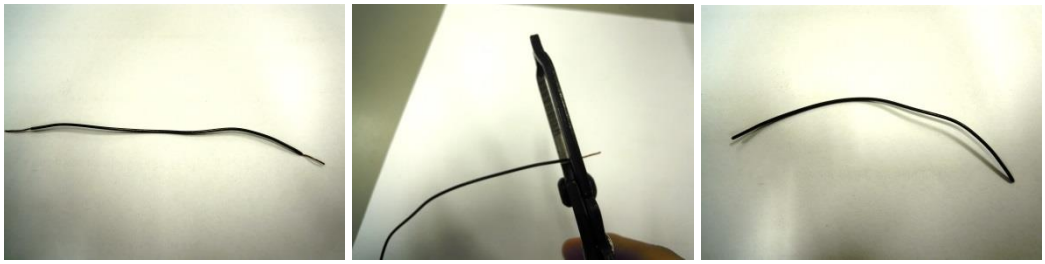


- Q5 What is the value of resistor as indicated with the color code? ____579Ω (±1%)_____

D) Experiment Procedures:

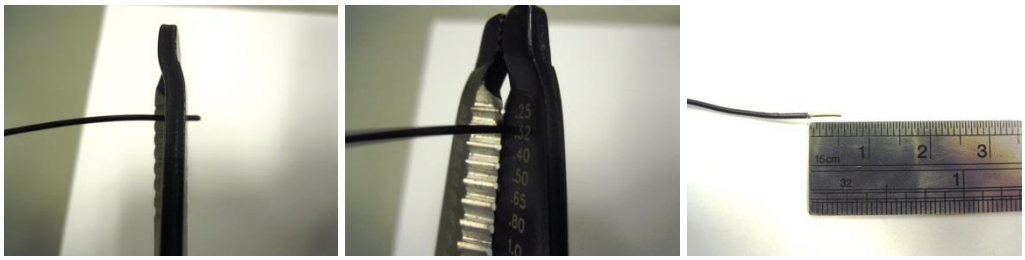
Experiment 1: Wire cutting with wire stripper (~5 mins)

Step 1: Take a wire from the wire box (preferably one with rusty openings). Cut off the openings on both sides of the wire as shown.



(Left) Rusty Wire; (Middle) Cutting off the rusty openings; (Right) Wire without opening

Step 2: Use the wire stripper to cut openings on both sides of the wires. The openings should be ~6mm. Use the first or second clipping hole (from the edge) of the clipper. Do not cut too short or too long. A short opening may result in a bad connection; while a long one may result in a short circuit.

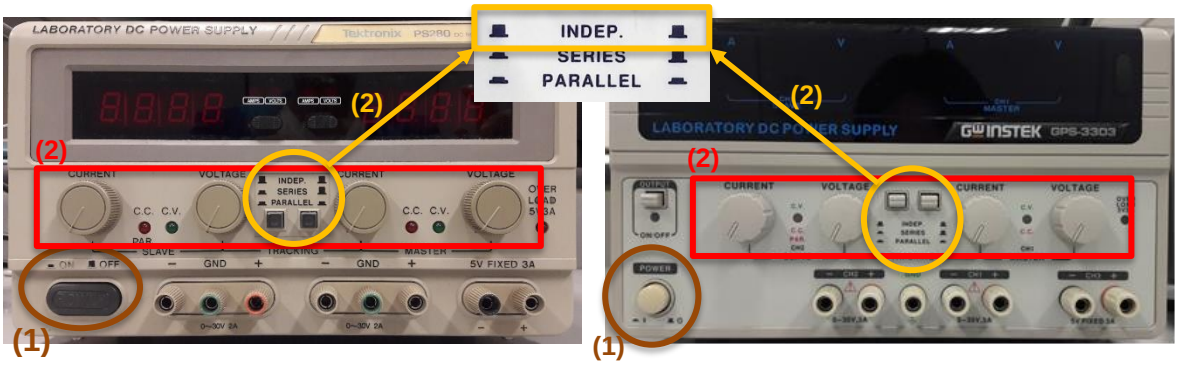


(Left) Cutting openings; (Middle) The clipping hole; (Right) ~6mm opening

After practicing, demo steps 1-2 to the TA and obtain his/her signature. Each member of a group should demo once.

Experiment 2: Generating a specific DC voltage (~10 mins)

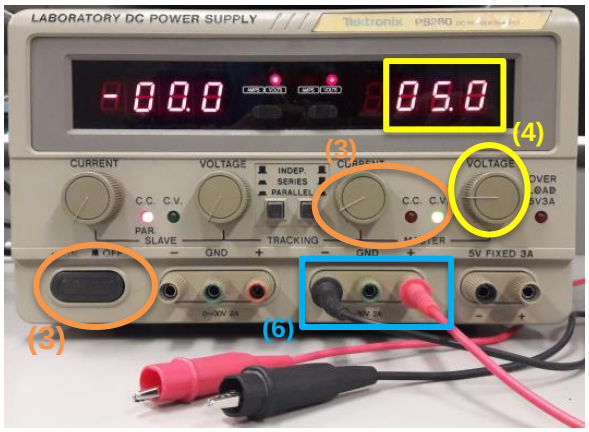
Step 1: Identify the DC power supply. There are two models in the lab as shown. The only difference is that Model 2 has an extra "Output button". Switch off the power supply if it is on.

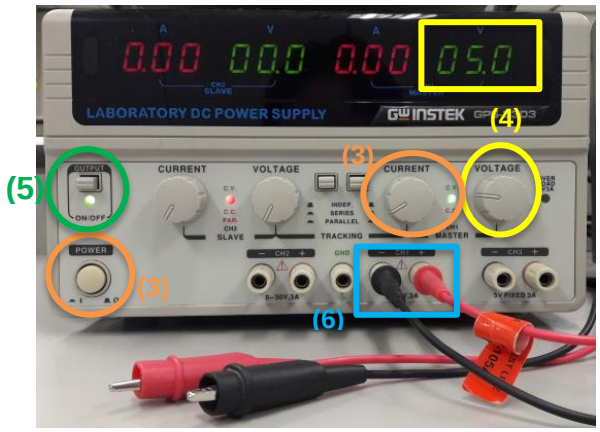


Model 1: Standard power supply

Model 2: Power supply with extra output button

Step 2: There are two variable output channels (Master and Slave) available, each controlled by two circular knobs. Turn all of them fully anti-clockwise. This is a safety practice. Also, at the middle there are two push buttons. Make sure both buttons are NOT pressed down so that two output channels are independent to each other.





Step 3: Switch on the power supply. Select one variable channel and slowly turn its "CURRENT" knob clockwisely until the CV light (green) is on. *CV stands for Constant Voltage*.

Step 4: Slowly turn the "VOLTAGE" knob clockwisely until the voltage reading is "5" as shown in the figure.

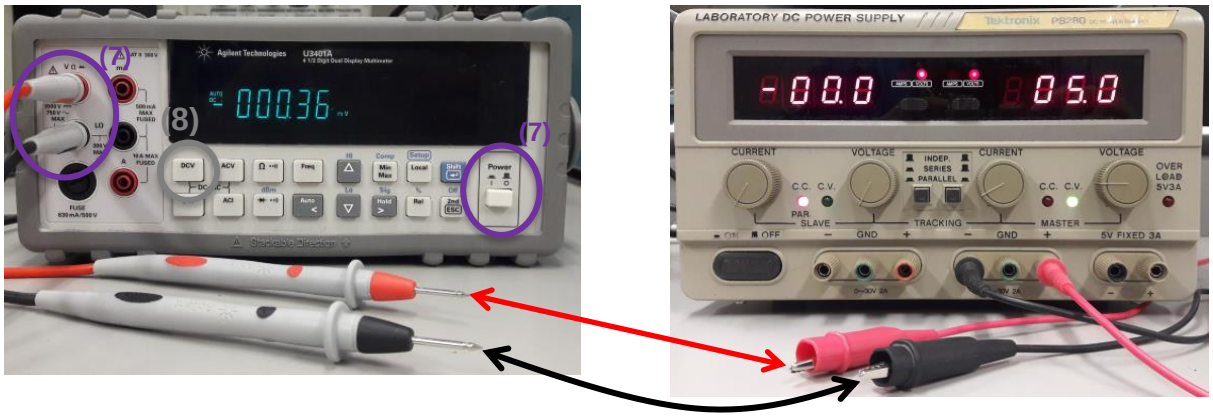
Step 5: (Only for Model 2) Press the Output button. The green LED should light up.

Step 6: Connect the power supply cable to the output terminals. In common convention, **red** cable to **positive** terminal and **black** cable to **negative** terminal. *DO NOT connect GND terminal. We do not use it in all of our experiments.*

Step 7: Switch on the digital multimeter and connect the red and black leads (the wires) to the corresponding sockets as shown.

Step 8: Select "DCV" (to measure DC voltage) in the digital multimeter.

Step 9: Connect the digital multimeter using the red and black leads to the power supply output terminals to check the voltage. Demo steps 1-8 to your TA and obtain his/her signature.

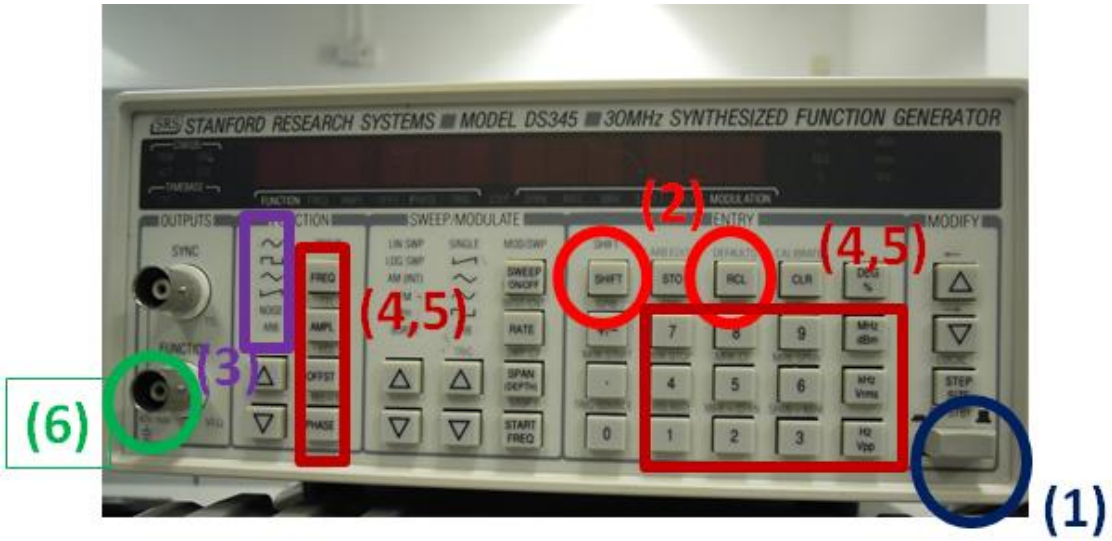


Digital Multimeter Power Supply

Experiment 3: Generate and measure an AC voltage using the oscilloscope (~20 mins)

Part A

Step 1: Identify the Signal Generator and turn it on.



Step 2: Reset the Signal Generator by pressing "SHIFT" then "RCL". Later in the course, if you suspect that something is wrong about the setting of the generator, just reset it.

Step 3: Select a sine wave as shown.

Step 4: To set a 3V peak-to-peak (V_{pp}) signal, press AMPL, then press 1.5 (Amplitude=1.5), then press Hz Vpp.

Step 5: Set the frequency to be 1.25kHz. First press FREQ, then press the frequency 1.25, then press kHz Vrms.

Step 6: Connect the Generator probe (shown at page 1) to the function generator. Do **NOT** mistaken the Generator Probe with the DSO Probe.

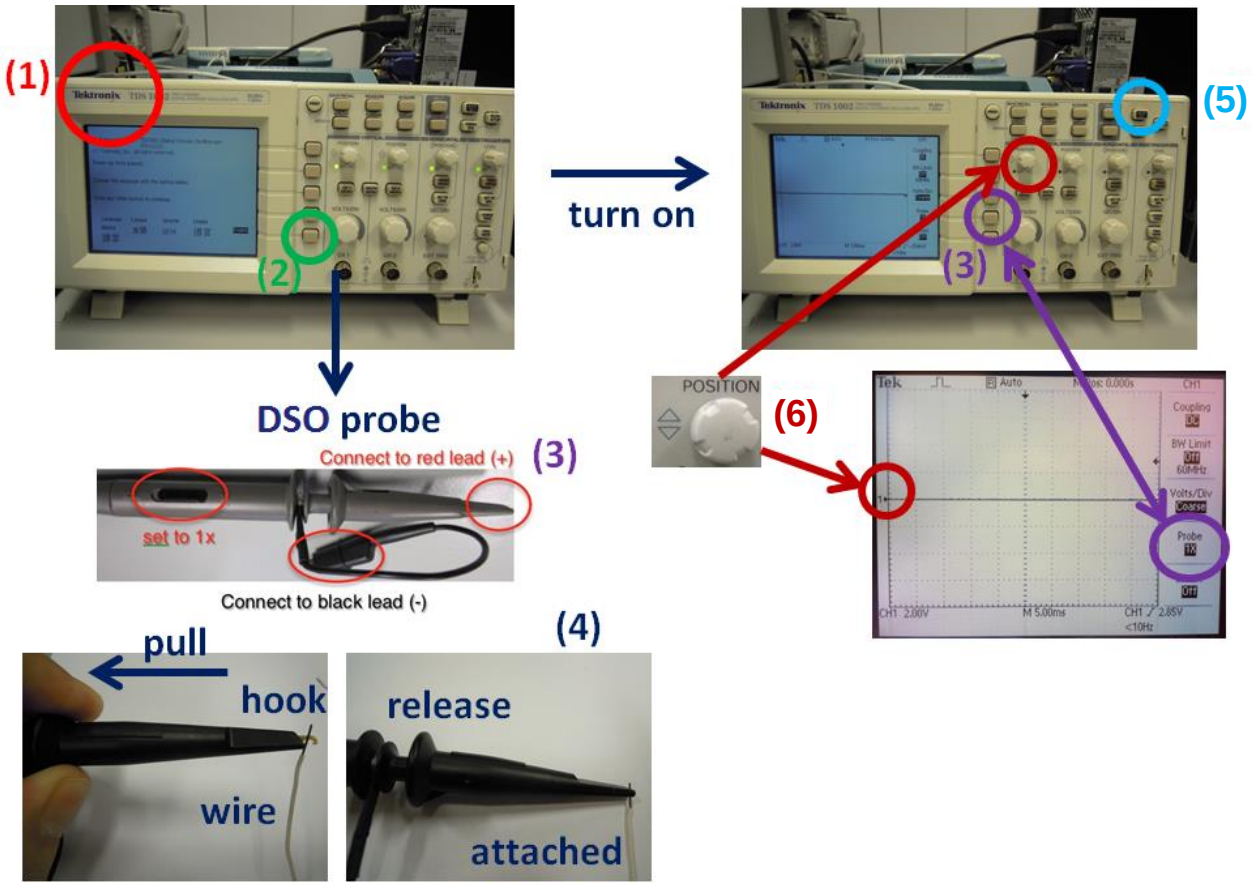
Part B

Step 1: Identify the DSO and turn it on.

Step 2: Change the language if necessary. If no change is needed, press any other button.

Step 3: Connect the DSO Probe head to the oscilloscope and set the probe to 1x as shown.

Step 4: Take two wires and cut 6mm openings on both ends. The probe-like structure is the positive terminal, while the small clip is the negative. Pull the cap of the positive terminal to expose the hook as shown. Take a wire and attach one end to the hook. Take second wire and clip it to the negative terminal. Connect the two unattached ends of the two wires to the Generator probe, positive to positive, negative to negative.



Step 5: Press **AUTO SET** button and read the signal displayed on the screen.

Step 6: Adjust the zero reference to the middle of the screen using the vertical **POSITION knob**

Q1: From the DSO (left bottom), what is the value of each division on the voltage axis?

Q2: From the DSO (middle bottom), what is the value of each division on the time axis?

Q3: From the DSO, what is the period (time for the signal to repeat) of the signal?

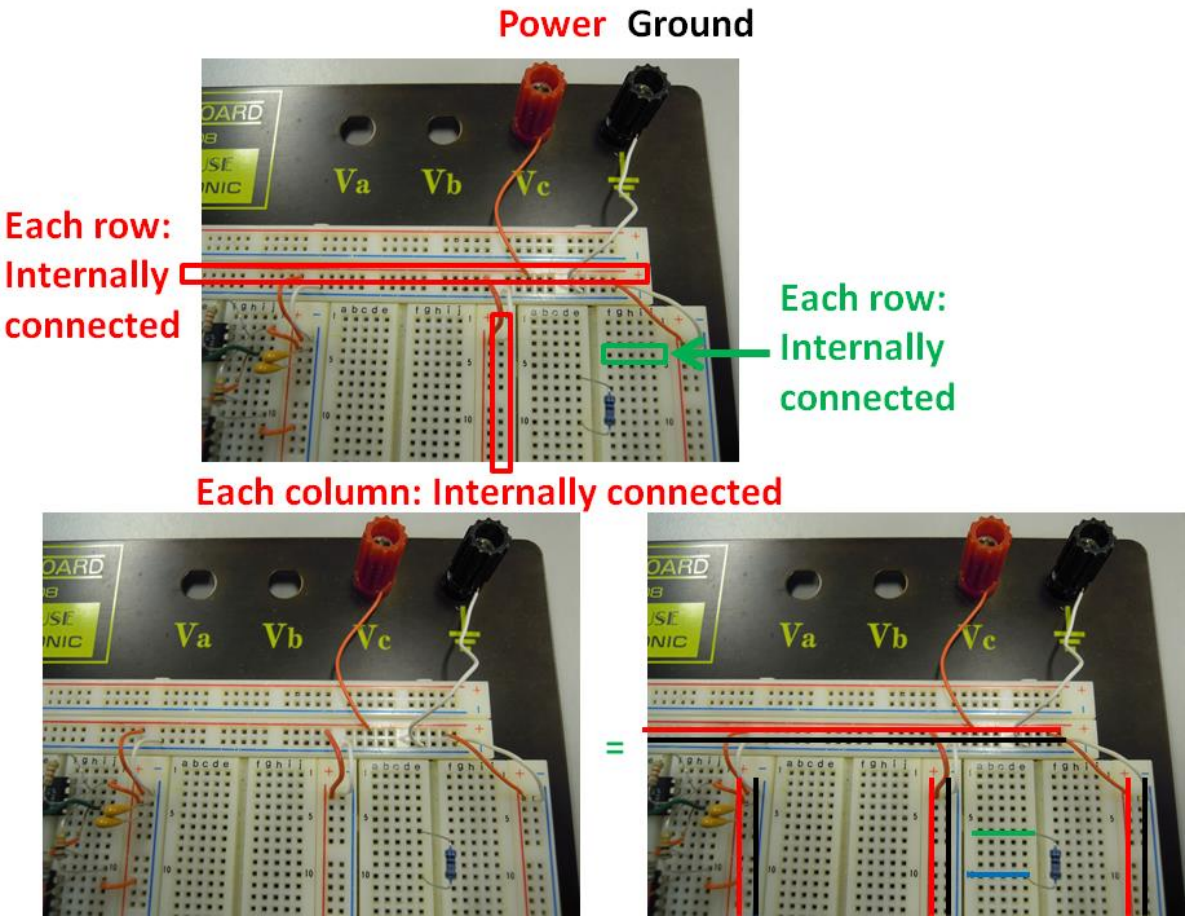
Demo to your TA and obtain his/her signature.

Experiment 4: Preparing the breadboard and measuring a voltage (~30 mins)

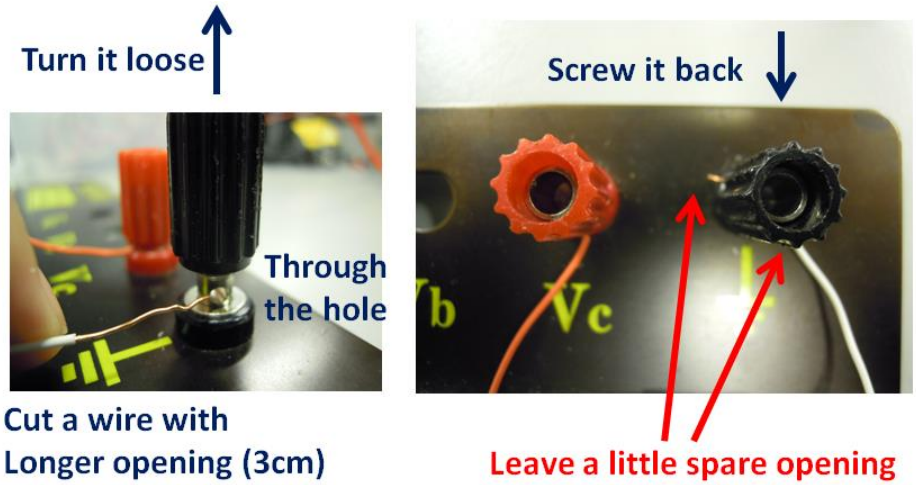
In this experiment, we learn how to use the breadboard.

Part A

Step 1: Study the figure below to understand the internal connection of the breadboard.



Step 2: Connect wire for power and ground as shown below.



Part B

Step 1: Pick up an arbitrary resistor.

Step 2: Turn on the digital multimeter and select "Ω" by pressing the button.

Step 3: Connect the probe leads from the digital multimeter to the two ends of the resistor (resistor has no polarity). Read the value displayed on the screen.

Q4: What is the resistance value as displayed on the screen of the digital multimeter?

Demo to your TA and obtain his/her signature.

Part C

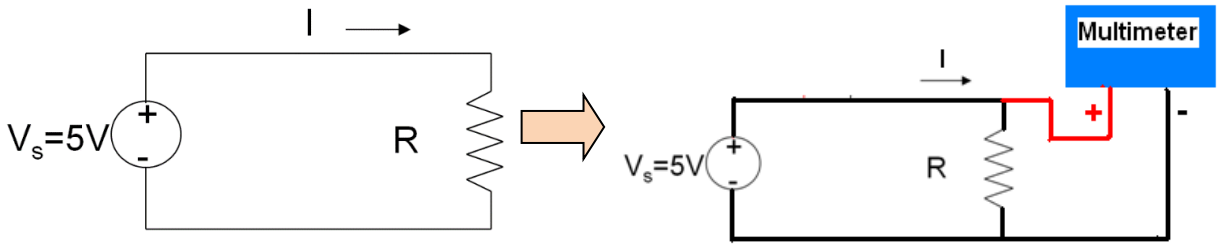
Step 1: Generate 5V from the power supply (refer to Experiment 2) and connect it to the breadboard.

Step 2: Construct the circuit below using the breadboard. Use the resistor you picked at Part B as the R.

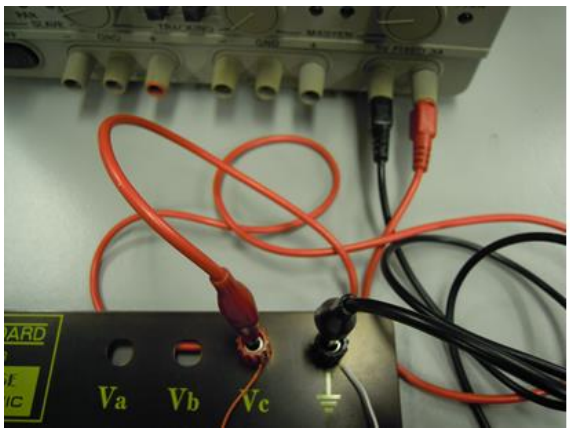
Step 3: Switch on digital multimeter (if not) and press "**DCV**" for DC voltage measurement. As shown below, connect the probe leads from the digital multimeter to the two ends of the resistor.

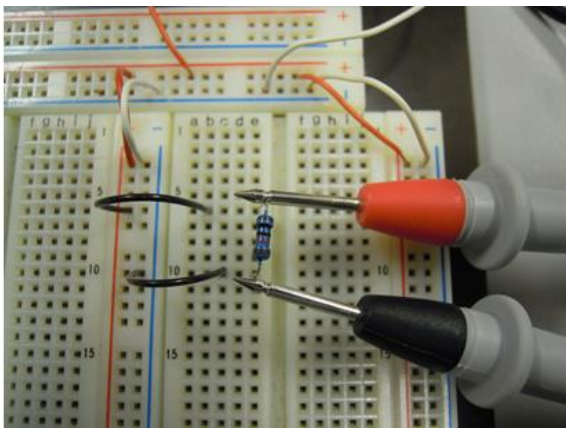
Q5: What is the voltage as displayed on the screen of the digital multimeter?

Demo to your TA and obtain his/her signature.



Using multimeter to measure a voltage

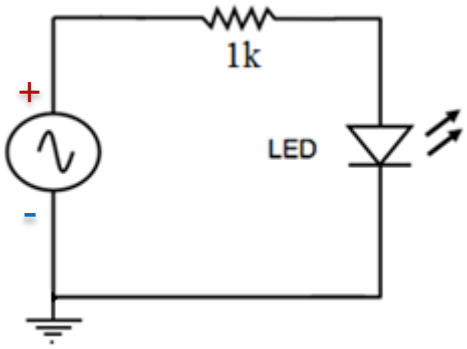




Experiment 5: Circuit construction on a breadboard (~30 mins)

Step 1: Use the signal generator to produce a "square wave"  (refer to Experiment 3). Set the amplitude of the wave to be 5V ($10V_{pp}$) and the frequency to 1kHz.

Step 2: Construct the following circuit on breadboard.



Step 3: Now you should see the LED light up. Demo to your TA and obtain his/her signature.

Q6: What is the purpose of the resistor in the circuit?

Step 4: Gradually reduce the frequency of the signal so that you can just see the LED starts blinking.

Q7: What is the lowest frequency that you need to use to avoid the LED from blinking? (Just give a rough number)

Step 5: Set the frequency to what you record in Q7. Now notice that the oscilloscope (DSO) has two inputs, Ch1 and Ch2. Insert two DSO probes to Ch1 and Ch2 of the oscilloscope. Remember to set both to 1x.

Step 6: Connect Ch1 to measure the output of the signal generator (through wires if necessary). Connect Ch2 to measure the voltage on the LED. Notice the polarity, make sure that positive to positive, negative to ground.

Q8: Sketch what you see on the scope (Ch1 & Ch2, including the scales).

Q9: What is the period of the waveform displayed on the screen?

Q10: What is the voltage drop at the resistor as shown from the oscilloscope?

Remember to clean up your bench! A messy table will cost 3 points!

ELEC 1100 Laboratory 1: Summary Sheet

Group Number: _____

Name: _____ Lab Partner: _____

Student ID: | | | | | | | | | Student ID: | | | | | | | | |

Experimental Part

Experiment 1: Cutting Wires

TA's Signature: _____

Experiment 2: Generate a specific constant voltage

TA's Signature: _____

Experiment 3: Generate and measure an AC voltage with an oscilloscope

TA's Signature: _____

Q1: From the scope (left bottom), what is the value of each division on the voltage axis?

_____

Q2: From the scope (middle bottom), what is the value of each division on the time axis?

_____

Q3: From the scope, what is the period (time for the signal to repeat) of the signal?

_____

Experiment 4: Preparing the breadboard and measuring a voltage

Q4: What is the resistance value as displayed on the digital multimeter? _____

TA's Signature: _____

Q5: What is the voltage as displayed on the screen of the digital multimeter? _____

TA's Signature: _____

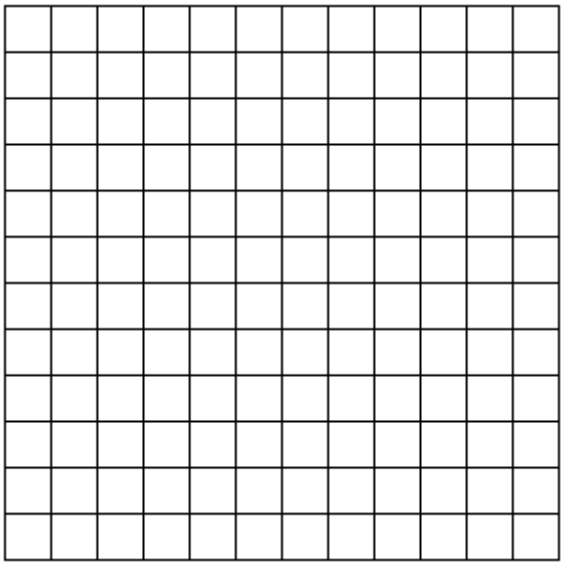
Experiment 5: Circuit construction using a breadboard

TA's Signature: _____

Q6: What is the purpose of the resistor in the circuit? _____

Q7: What is the lowest frequency you need to use to avoid the LED from blinking? _____

Q8: Sketch what you see on the scope (Ch1 & Ch2, including the scales).



Q9: What is the period of the waveform displayed on the screen? _____

Q10: What is the voltage drop at the resistor as shown from the oscilloscope? _____