Basic Elec. Engr. Lab

ECS 204

Asst. Prof. Dr. Prapun Suksompong

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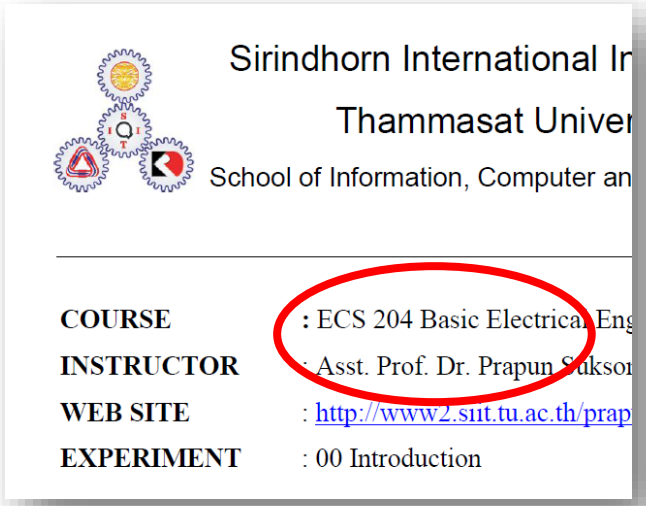
Announcements

- Your bench # are posted on the door.
- Lab manuals for Lab 0 and Lab 1 are available
  - at the **copy center**.
    - There are *many* basic EE labs! Make sure that you buy the right one:
      "***ECS 204 by Dr.Prapun***"
  - on the course web site



Course Organization

- **Course Web Site: http://www2.siit.tu.ac.th/prapun/ecs204**
- Lab manuals will be posted there.
  - You can **download** the manuals and **print** them out (even in color) if you don't want to **buy** it at the copy center.
    - You can also view it on your computer/tablet/phone. **Still need to print some pages for recording results**.
  - For each week, make sure that you also have the lab manual for the subsequent week.
    - For example, today, we will work on Lab 0.
    - Before coming to the lab next week, make sure that you come well-prepared for lab 1 by reading the manual for Lab 1.

Getting Info About This Course

- The **syllabus** contains tentative information.
- I will announce **in class** and on the **web site** if there is any change.
  - **Slides** will be posted on the web site after the lab.
- You are responsible for making sure that you obtain this information.
- Come to lab on time and listen carefully for announcement.

Schedule

Date	Experiments
January 12, 2015	L0: Introduction
January 19, 2015	L1: DC Measurements
January 26, 2015	L2: Network Theorems I
February 2, 2015	L3: Network Theorems II
February 9, 2015	P1: Practice Session
February 16, 2015	E1: Midterm Exam (In Lab)
February 23, 2015	L4: AC Measurement
March 2, 2015	Mid-term Examination Period (No Lab)
March 9, 2015	Mid-term Examination Period (No Lab)
March 16, 2015	L5: Resonance RLC Circuits
March 23, 2015	L6: Diodes and Rectifiers
March 30, 2015	L7: Operational Amplifiers I
April 6, 2015	No Lab
April 13, 2015	No Lab
April 20, 2015	L8: Operational Amplifiers II
April 27, 2015	P2: Practice Session
May 4, 2015	E2: Final Exam (In Lab)

If you can't attend any of the experiments or exams, withdraw now!

Me?

- Ph.D. from **Cornell** University, USA
- In Electrical and Computer Engineering
- Minor: Mathematics (Probability Theory)
- Ph.D. Research: Neuro-Information Theory
- Current Research:
  Wireless Communications
- 2009 and 2013 SIIT Best Teaching Awards
- 2011 SIIT Research Award
- 2013 TU Outstanding Young Researcher Award

prapun.com

Class Goals

- Have fun in the lab.
- Obtain some appreciation for the theorems that you have studied:
  - You will **verify many theorems**.
  - You will see that they actually work!
  - You will see that nature (at least in our controlled environment) can be described and analyzed by simple formulas.
- Enhance **problem solving skill** and **debugging skill**.
- Increase eagerness to ask question IN ENGLISH.

Grading

Contents	Percentage
1. Quizzes	**10 %**
2. Lab reports (L1-L8)	**30 %**
3. In-lab participation/performance	**10 %**
4. Midterm examination (E1)	**25 %**
5. Final examination (E2)	**25 %**
Total	100 %

Lab Report: 30%

- **1 copy per group**
  - Submit at the **beginning** of the subsequent lab
- It **must be neatly PRINTED on clean A4 sheets.**
- Guideline/template is posted on the class web site.
  - Will talk more about this next time.
- Units are important.
- For student who copies ***any part*** of the report, a zero score will be given to ***the whole*** corresponding experiment.

Warning

Copying (even partially) = 0

From peers' reports,
previous year reports, etc.

Quiz: 10%

- To make sure that you come well-prepared for the lab, there will be ***at least* one quiz almost every week**.
  - Work **alone** on the quiz (not with your lab partner).
- Start at the **beginning** of the lab.
- There can be a couple more ***pop quizzes***.
- Points are generally based on your entire solution, not your final answer.
  - You may get full credit even when you have the wrong final answer.
  - You may get **zero** even when you write down a correct answer without justification.

Quiz: 10%

- For lab 1, make sure that you know
  - How to read resistor color code
    - Explained in the appendix of the manual for Lab 0
    - For example,
      Green, blue, red = 5.6kΩ
  - Ohm's law, KVL, KCL, Voltage/Current Divider
- A sample of the quiz is posted on the web and included with your lab manual.

Two Exams: 50%

- Hands-on exams
  - Similar to what you have already played with in the experiments.
- 25% **Midterm**
- 25% **Final**
- Final exam is cumulative (covers all material, including those before the midterm.)
- Two practice sessions.

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Lab Performance: 10%

- NOT entirely the same as lab attendance!
- However, coming to the lab **on time** is one of the factors.
- Pay attention to the **briefing** of the lab at the start of each lab.
  - The TAs will help me on this.
- Correctly and carefully **follow** the lab manuals and guideline provided by the instructor/TAs.
- Quickly **notify** the instructor if you find error in the manuals or if the equipment is broken or damaged.
- After the lab, **clean/organize** items on your desk
  - Put all the components (R, L, C, chips, cables, DMM) back to their places.

In-Lab Regulations

- T-shirt, slippers, sandals, and bare feet are **NOT** allowed in the laboratory.
- Food and drink are **NOT** allowed.
- **Do not enter/use the lab when there is no instructor/TAs**.
- 15 minutes late = absent.
- Absent from two labs = "**F**".
- Students are financially responsible for the loss or damage of instrument in the laboratory.
  - Recall that, for each student, a deposit of 5,000 Baht has already been collected for damaged equipment and non-returned library books. This deposit, after reduction of damages caused by the student, is returned to the student when he/she graduates or leaves SIIT.

Question?


ANALAB
G 18

Lab 0

- Work on Section IV (starting from page 11) of the manual.
- Pages 1-10 contain information on how to use many of the tools in our lab.
  - I will show you the necessary steps now so that you can work on the experiment in Section IV.
  - Refer to pages 1-10 for more information during the lab.
    - Read them carefully at home.

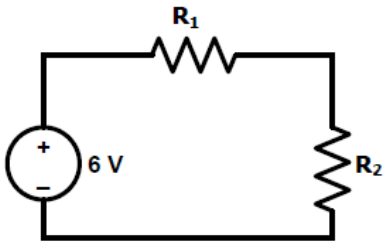


Figure 12: The circuit for Part A.

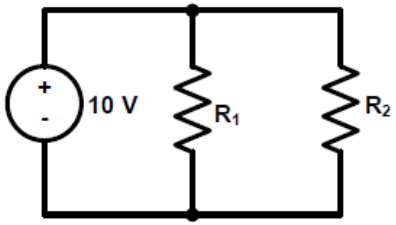


Figure 13: The circuit for Part B.

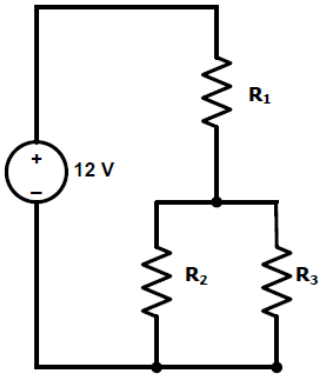
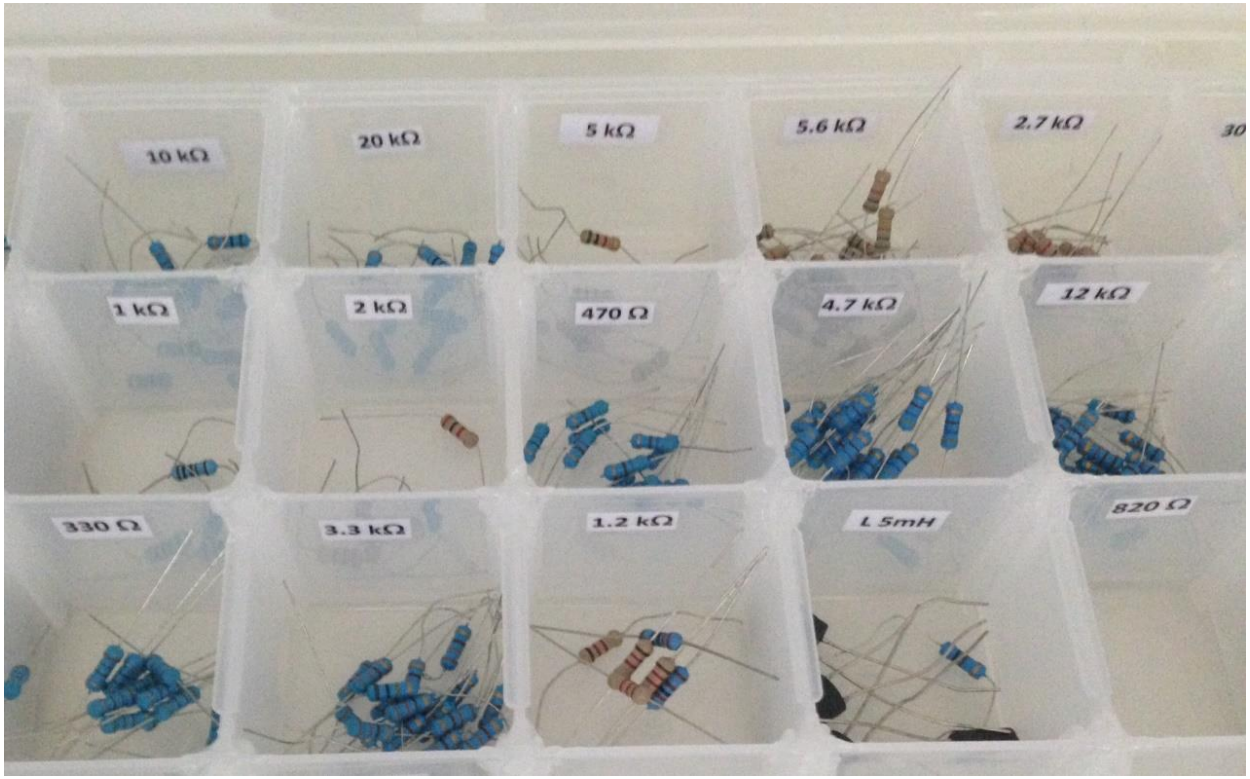


Figure 14: The circuit for Part C.

Resistors

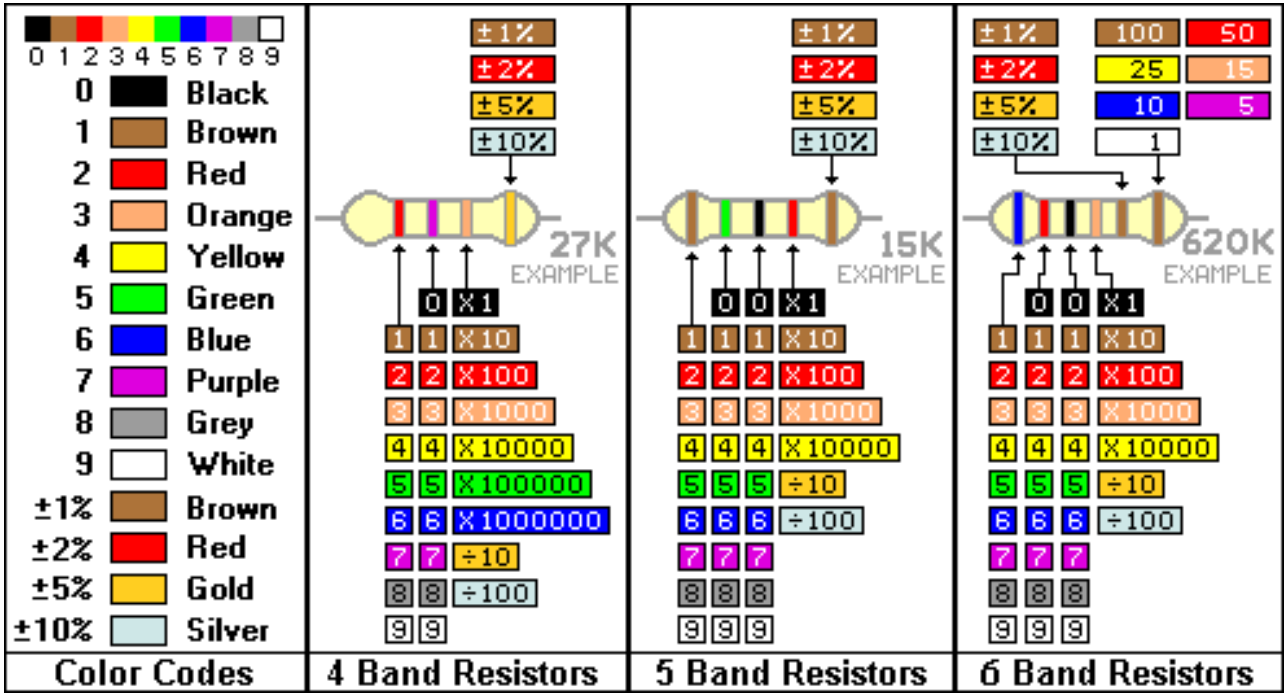
Brown Black Green = $10 \times 10^5\ \Omega = 1\ M\Omega$

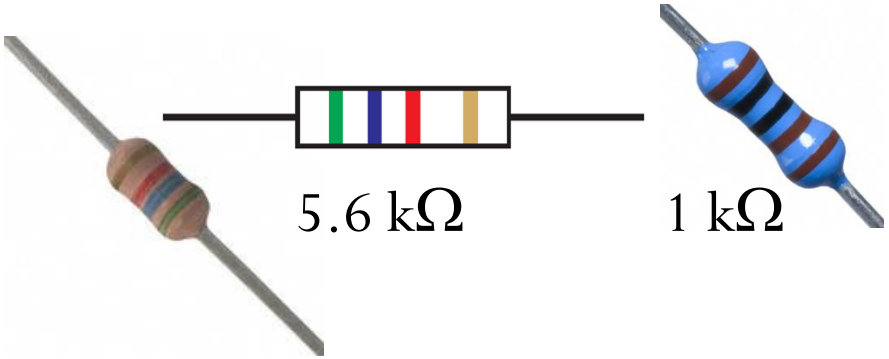


When you finish the lab, make sure that you put the resistors back in their appropriate boxes.

Measure the resistance of each of the resistors that you will use.

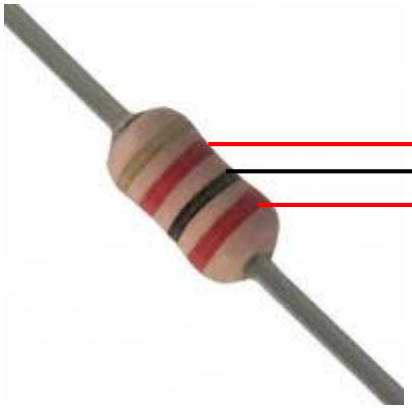
Resistor Color Code





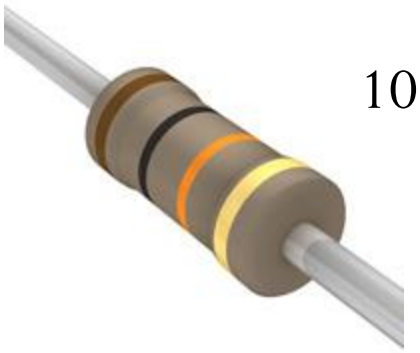
Check these web sites for more examples:
http://samengstrom.com/nxl/3660/4_band_resistor_color_code_page.en.html
http://www.hobby-hour.com/electronics/1k-8k2-resistors.php

Examples



$20 \times 10^2\ \Omega = 2\ \text{k}$

RES 2.0K OHM CARBON FILM 1/4W 5%



$10 \times 10^3\ \Omega = 10\ \text{k}$

RES 10K OHM 1/4W 5% CARBFILM T/R

DC Power Supply

- Two variable voltage sources

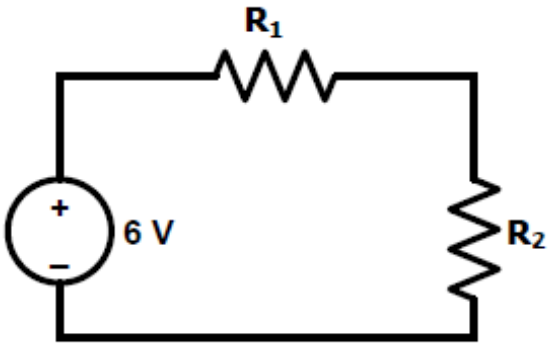
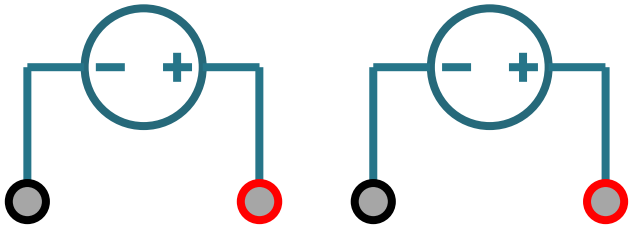


Figure 12: The circuit for Part A.



DC Power Supply

- Floating
- Current limit
  - Limit the maximum amount of current supplied by the device.
  - In our experiment, the current is small (mA).
    - So, we set the current limit to be small.
  - There is no further need to adjust these knobs in any experiment except to make sure that the red mark on the knob is located at the white mark.
- The **red light** should be off if you connect the circuit correctly.
  - Turn the power supply off immediately when you see red light. Fix your circuit before you turn the power supply on again.

Digital Multi-Meter (DMM)

- Use the **dial** to select the quantity you want to measure.
- Can measure
  - voltage across an element (voltmeter)
  - current passing through an element (amp-meter)
  - resistance (ohm-meter)
- Check three places before making measurement
  1. The rotary switch (the dial)
  2. The terminals
  3. Screen: DC or AC
     - Use the SELECT button to select **DC** or **AC** type of the measurements.

Low battery

- When the DMM has low battery, it can not make accurate measurement.
- Symptoms
  - Battery discharge warning display
  - Screen starts to fade away.
  - Resistance measurement gives wrong value.

Continuity Test

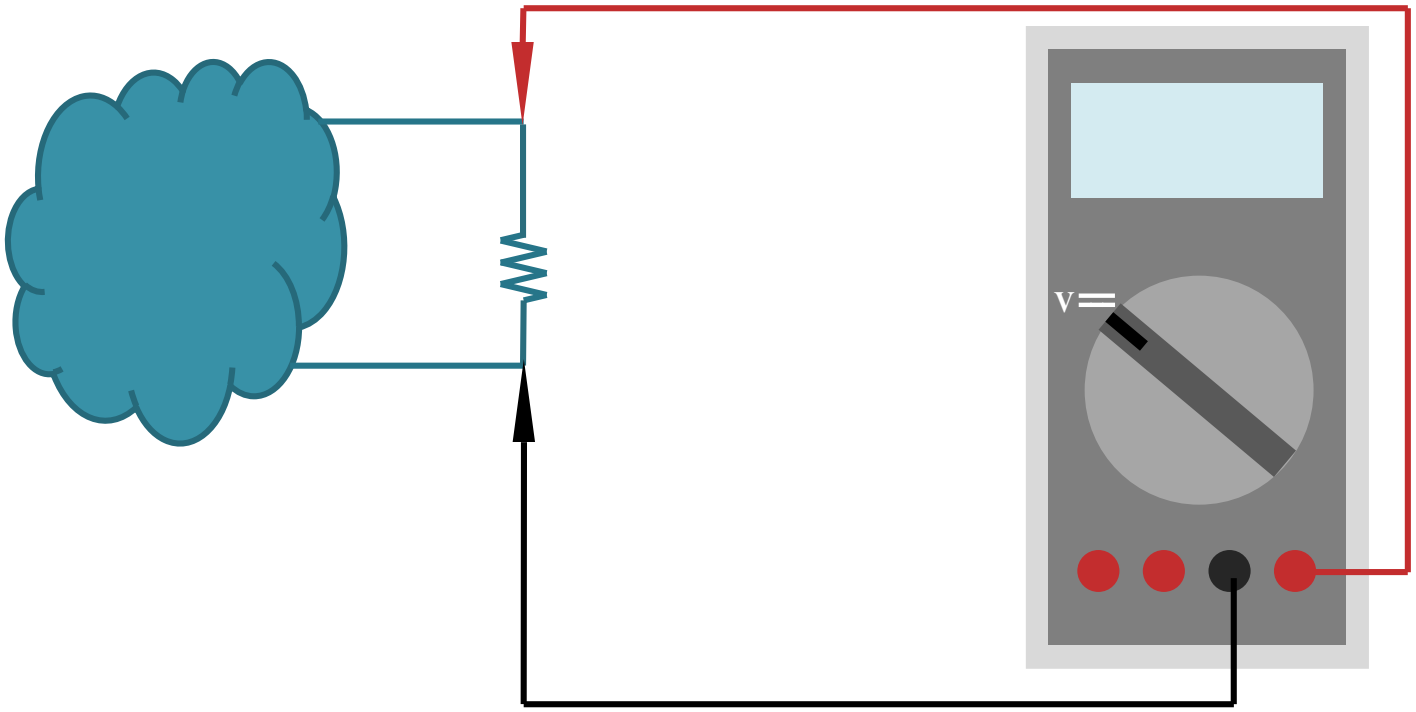
- It is very easy to check for broken wire using DMM.
- In the **ohmmeter mode**, press the **SELECT** button so that the speaker symbol appear on your screen.
  - Checking continuity display (speaker symbol)
  - DMM **beeps** = there is good continuity, or a good path that allows current to flow.
  - If there is no continuity, the DMM won't beep.
- Do not forget to press the **SELECT** button again (the speaker symbol should disappear) when you want to measure the resistance value.

Resistance Measurement

- This should be done **before** you connect that resistor into the circuit.
- After the circuit has been constructed, in general, to measure the resistance value of a resistor, separate it from the circuit first.
  - Disconnecting one end of the resistor will make sure that any adjacent component won't interfere with the reading.
- Do not measure the resistance value when the resistor is still fully connected in the circuit.

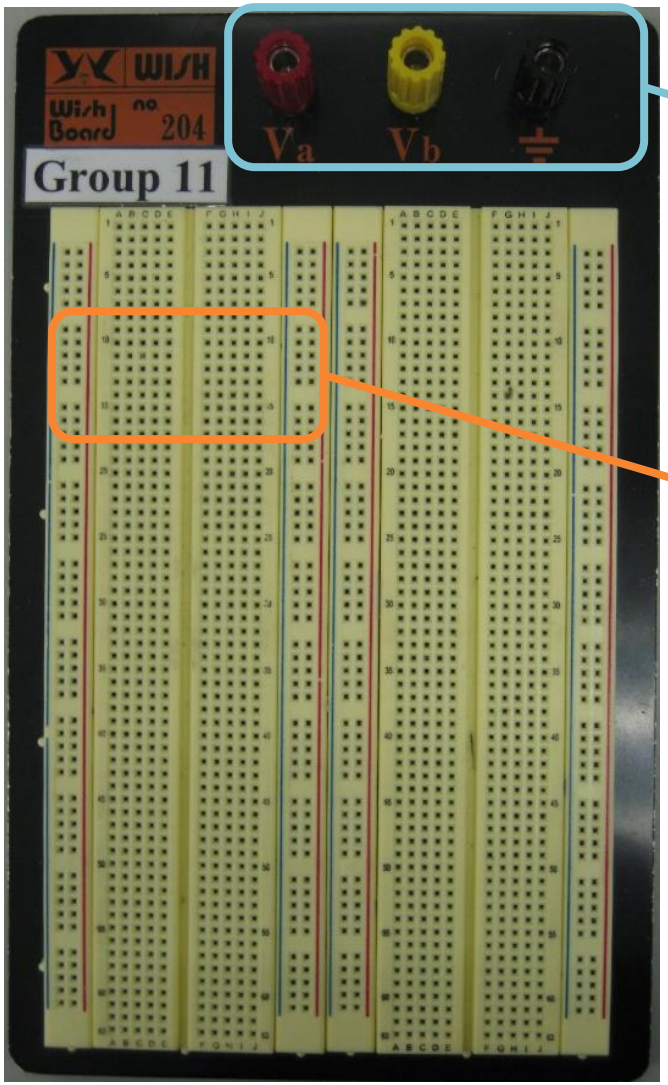
Demos

- Resistance Measurement
- Voltage Measurement
  - Measuring the output voltage of the power supply

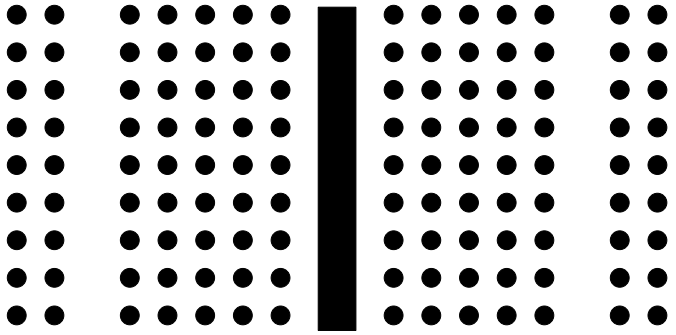


(Solderless)

Breadboard (Protoboard)



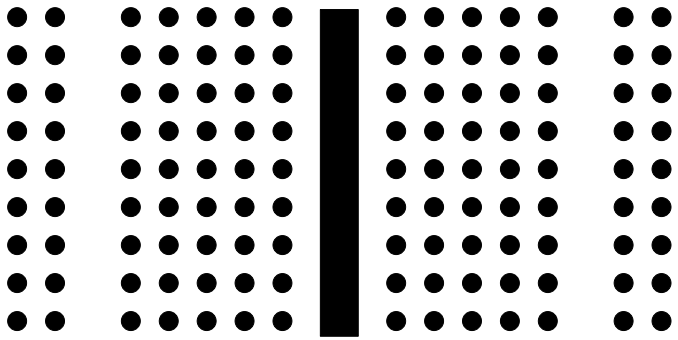
Nothing is connected to these internally.

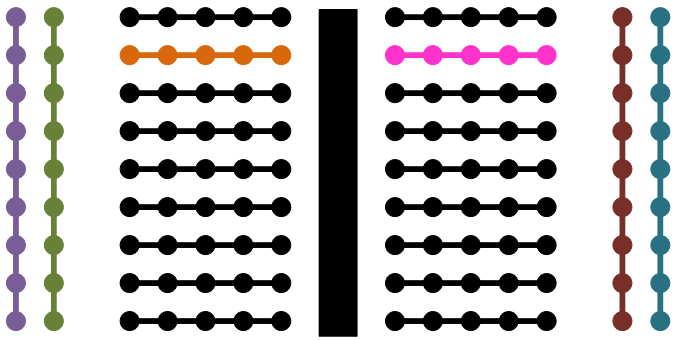


Some of these holes are connected internally.

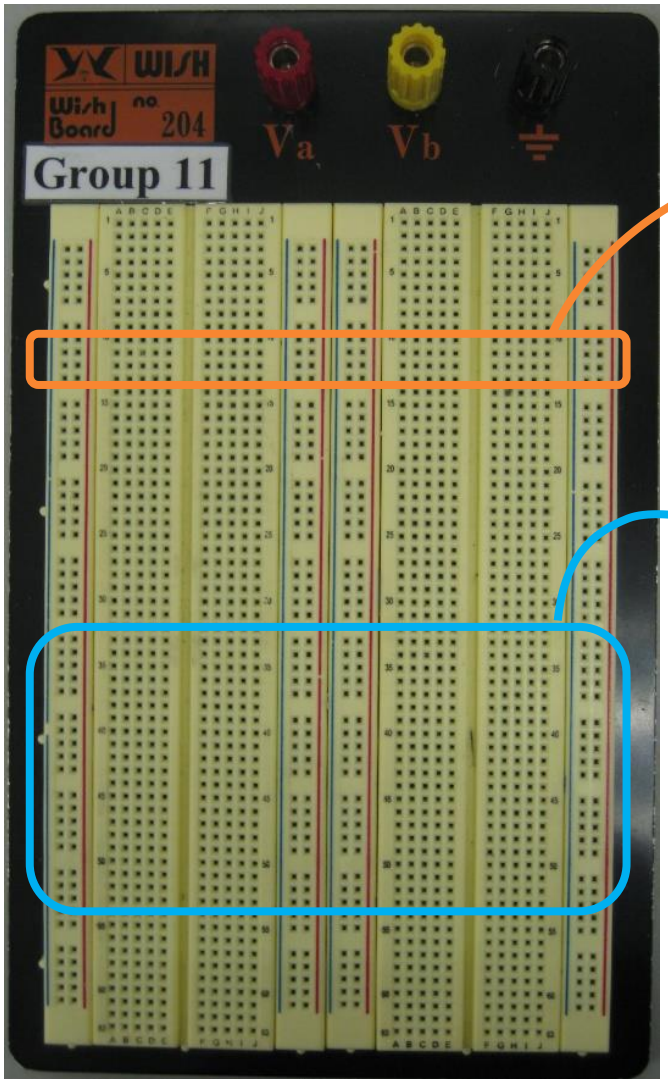
Breadboard (Protoboard)

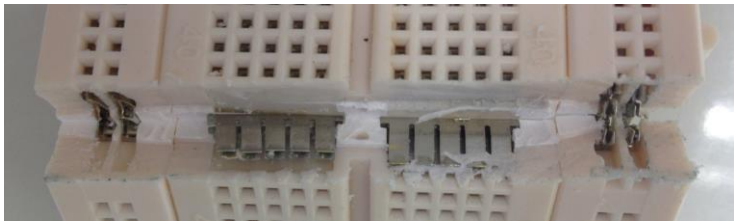
- Sets of sockets are arranged in rows and columns, and are connected together internally.
- **Each set** of holes can be used as **a node** in the actual circuit since they are short-circuited together.
- Components connected to the same node in a circuit can be pushed into the same set of holes on the protoboard.



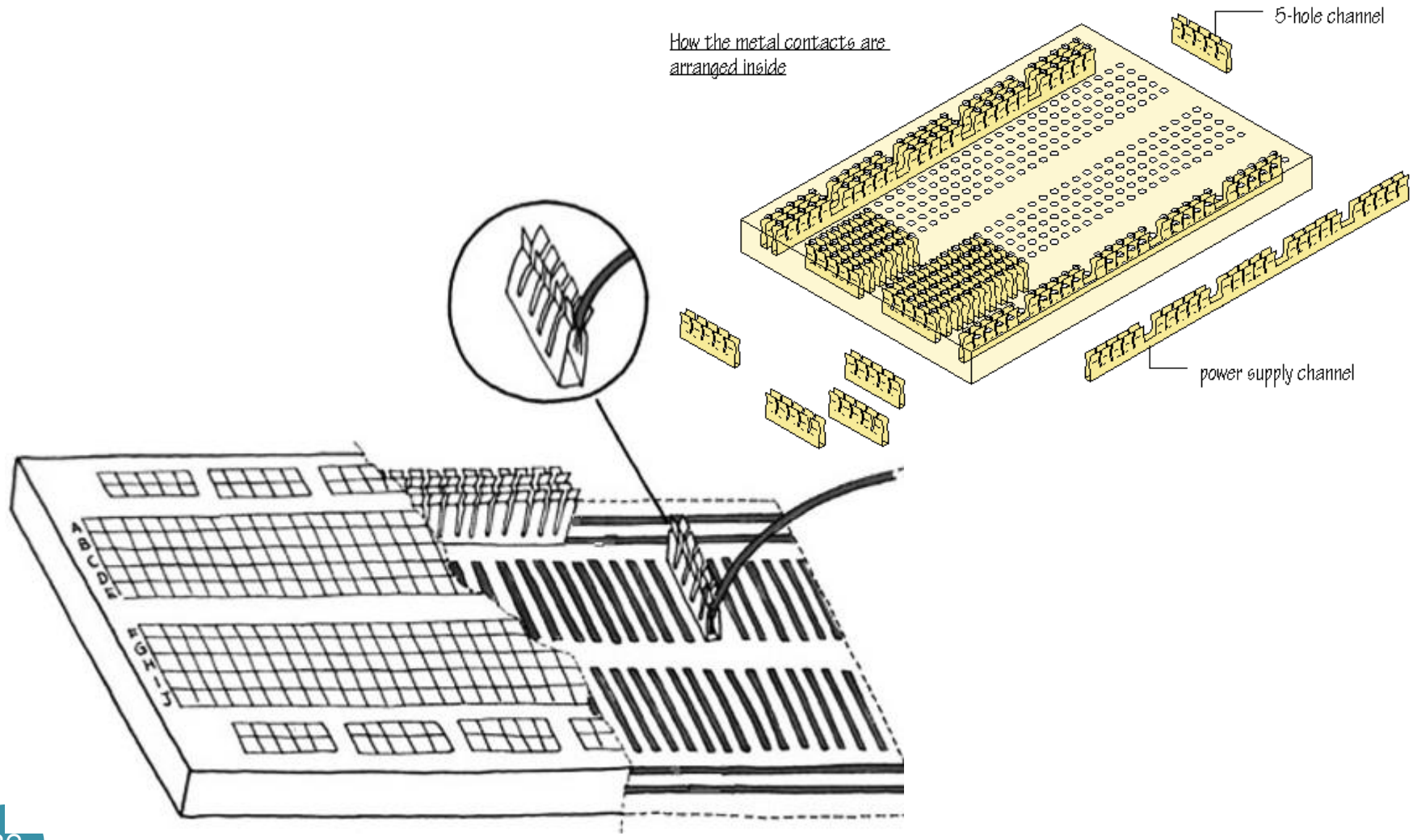


Breadboard (Protoboard)





Breadboard (Protoboard)

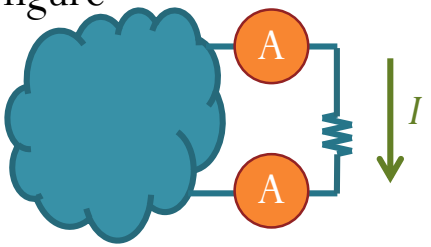


Demo

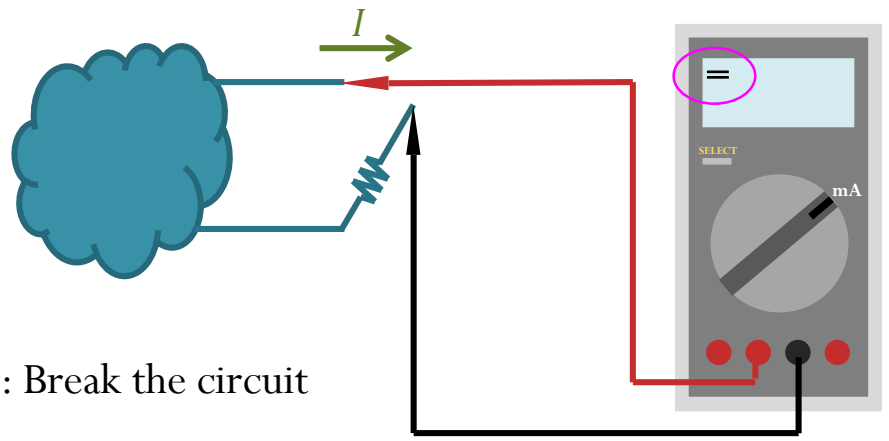
- Current Measurement

Make sure that the DC symbol is displayed on the screen

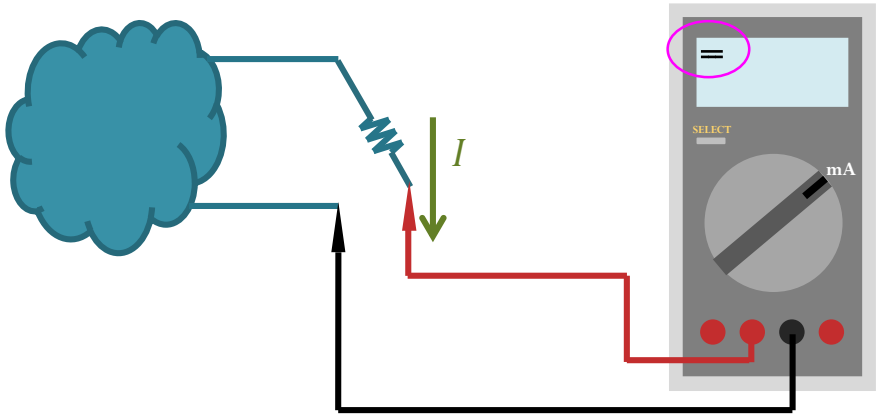
Step 1: Draw the ammeter in the figure



Step 2: Break the circuit

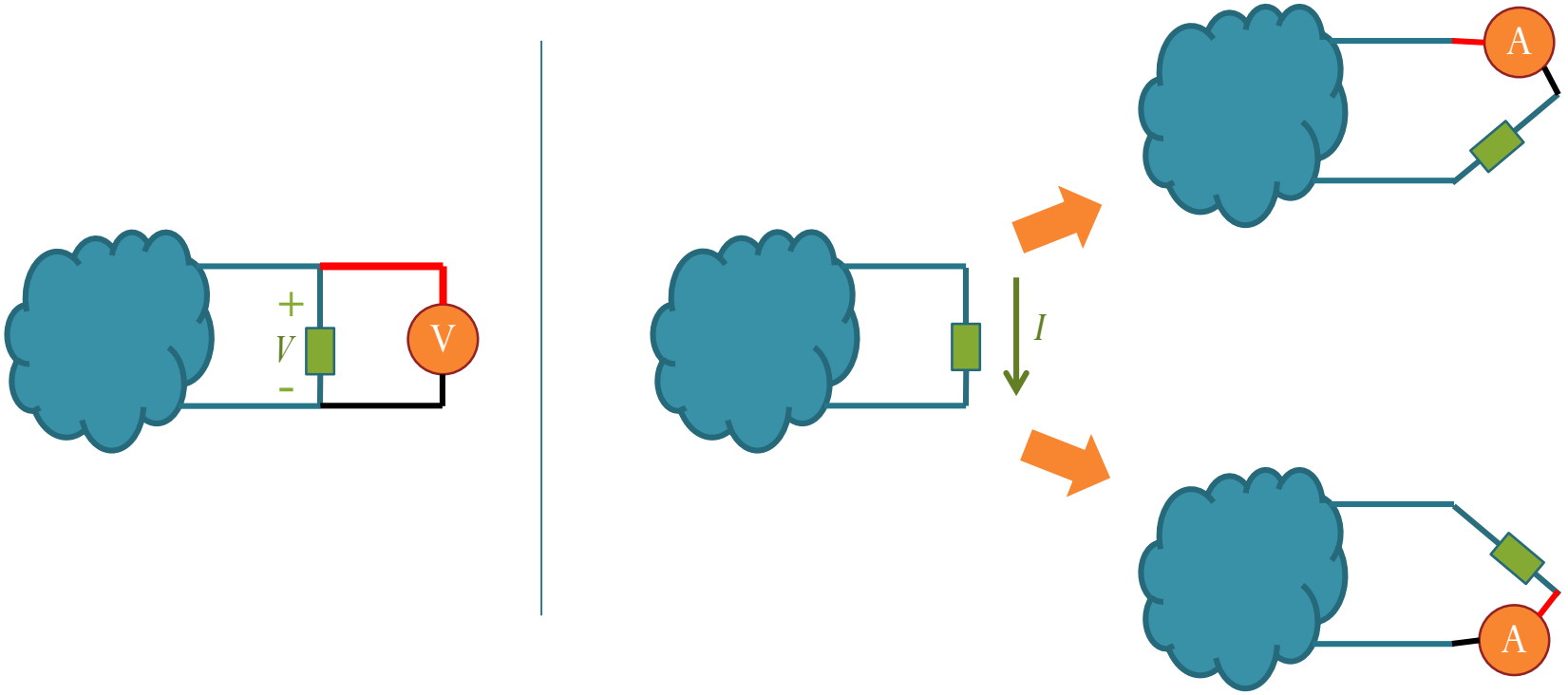


Step 3: Insert the ammeter



Tip: One way to see how to connect the ammeter is to draw it in the figure.

Voltage vs. Current Measurements



Signs are not important (yet) in this experiment.
They will be crucial in subsequent experiments.

What you need to do?

Table 3

	Part A		Part B		Part C		
	R_1	R_2	R_1	R_2	R_1	R_2	R_3
Resistance (Ω)							
Voltage (V)							
Current (A)							

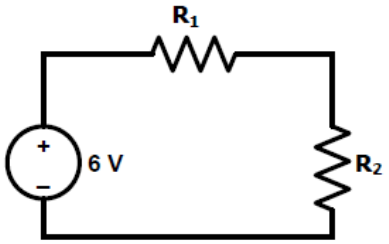


Figure 12: The circuit for Part A.

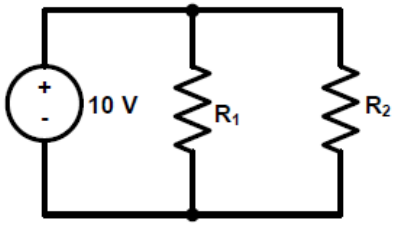


Figure 13: The circuit for Part B.

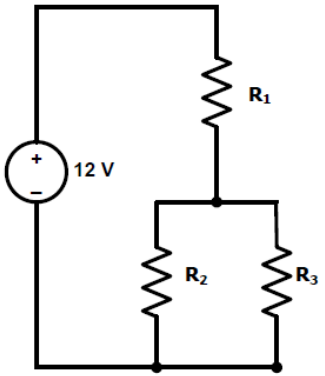


Figure 14: The circuit for Part C.

Good Laboratory Habits

- Use common sense.
- Do not eat, drink, smoke or apply makeup.
- Keep your bench space clean and tidy at all times. Make sure to clean it before you leave.
- Never work alone in the laboratory.
- Do not invite or receive visitors in the laboratory.
- Do not rush. Do not run. Do not push.
- Turn off the power supply when you modify your circuit. Don't forget to turn it back on when you are ready to make new measurement.

Final remarks

- When you work on each of the experiments, carefully follow the steps provided.
- If the way (places/orientation of resistors) you connect the circuit matches with the figure in the manual, it will be easier to debug for both you and the TAs).
- You will usually need a **calculator** and a **digital camera**.
  - Not needed today.
  - Next week, make sure that you have one.
  - In general, smartphone's cameras and calculator are OK
- Don't forget to prepare for the quiz next week.