Induction of Electricity

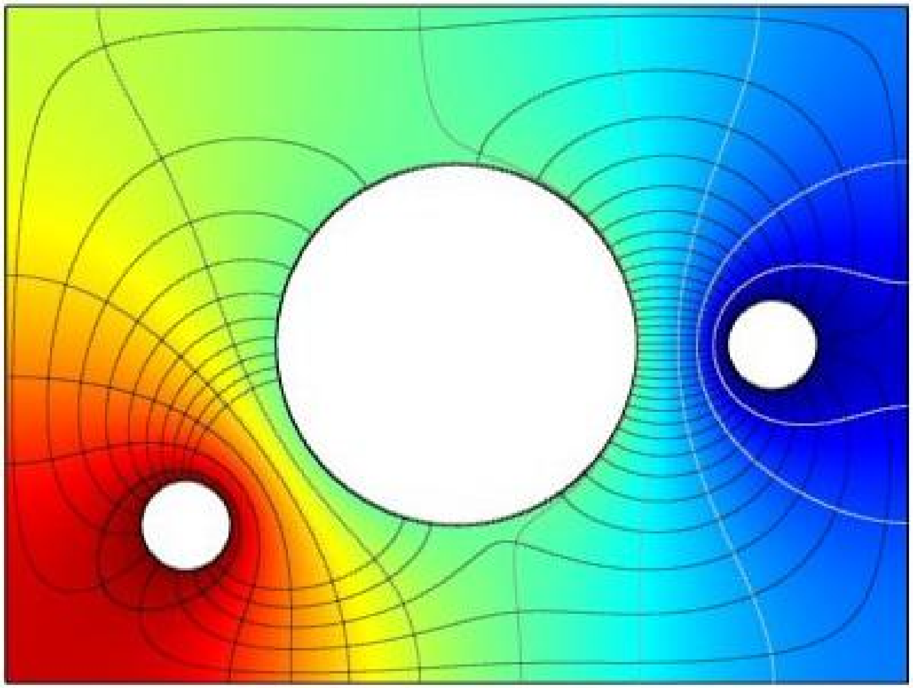
Manual

Aim and Apparatus
Experimental Procedues
1. Preparation
2. Measurements
3. Drawing

Aim

To find the electrical induction

on the surface of an isolated metal plate



Apparatus

- a steel plate,
- a transparent plastic sheet for isolation,
- a conducting rubber sheet (black),
- a chacopaper® (or a chalk paper, white),
- donut-shaped brass plates (A and B: small, C: large),
- some magnets,
- a digital multimeter (DMM) and its probes,
- a battery box (～2.6 V),
- some cables with alligator-alligator clips

1. Preparation

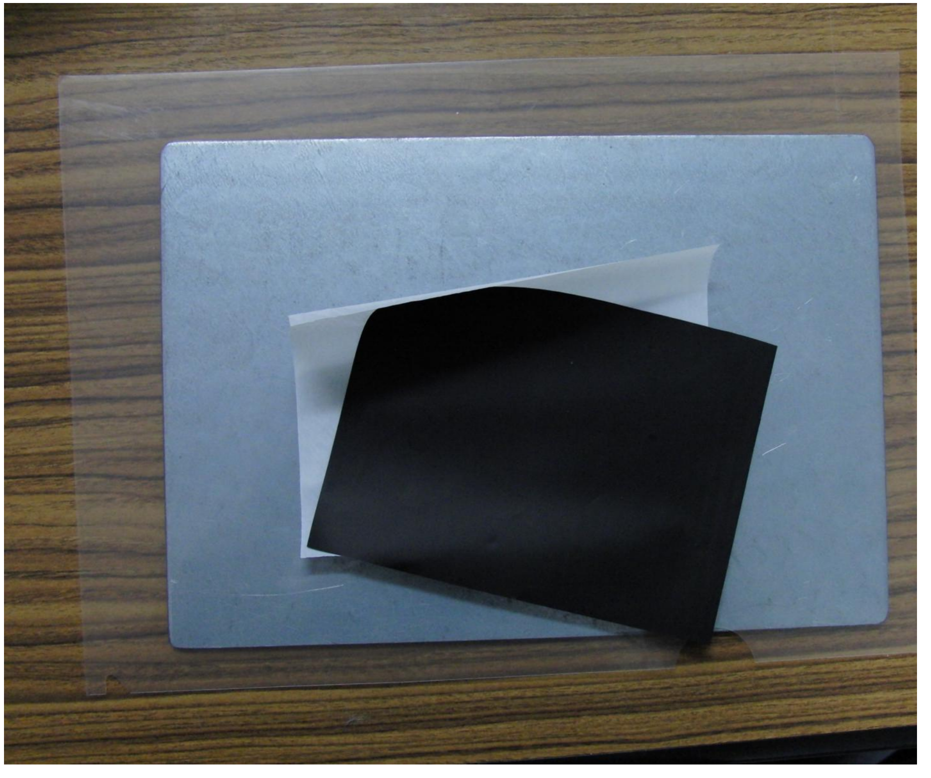
1.1 Place a steel base plate on the table.

1. Preparation

1.2 Place an insulation sheet (transparent) on the steel base plate.

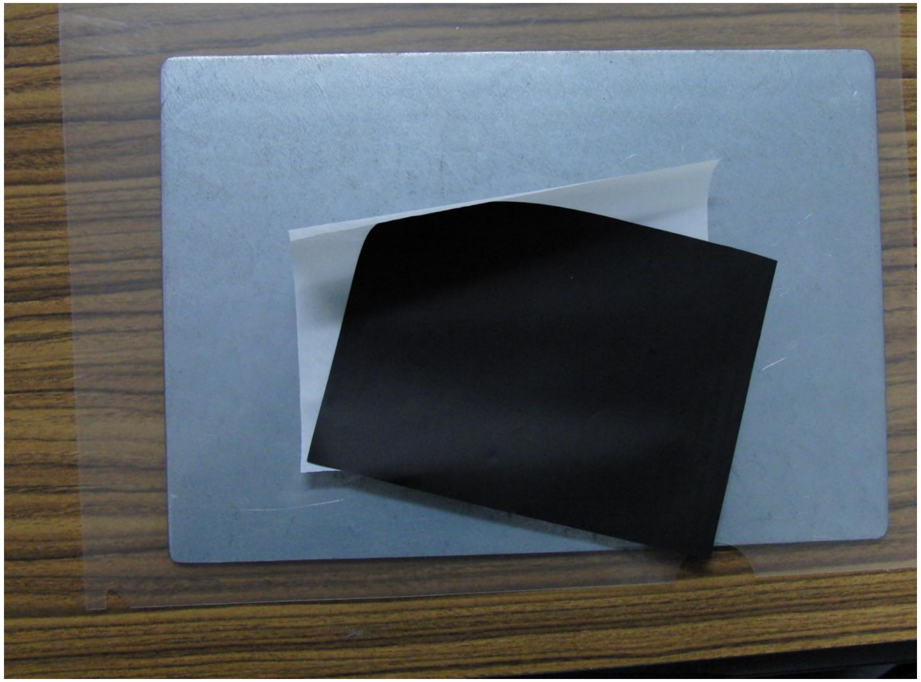
1. Preparation

1.3 Place a sheet of chacopaper® (white) and a conducting sheet (black) on the insulation sheet.



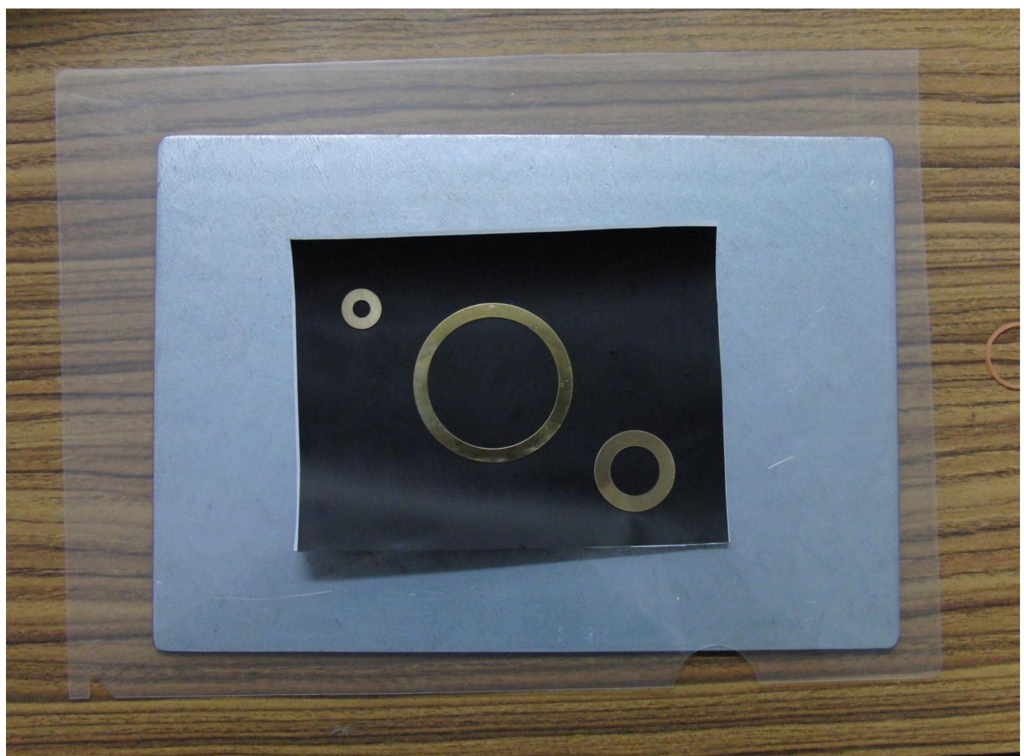
1. Preparation

1.3 The chacopaper® should be sandwiched between the black and transparent sheets, facing chalk surface to the black sheet.



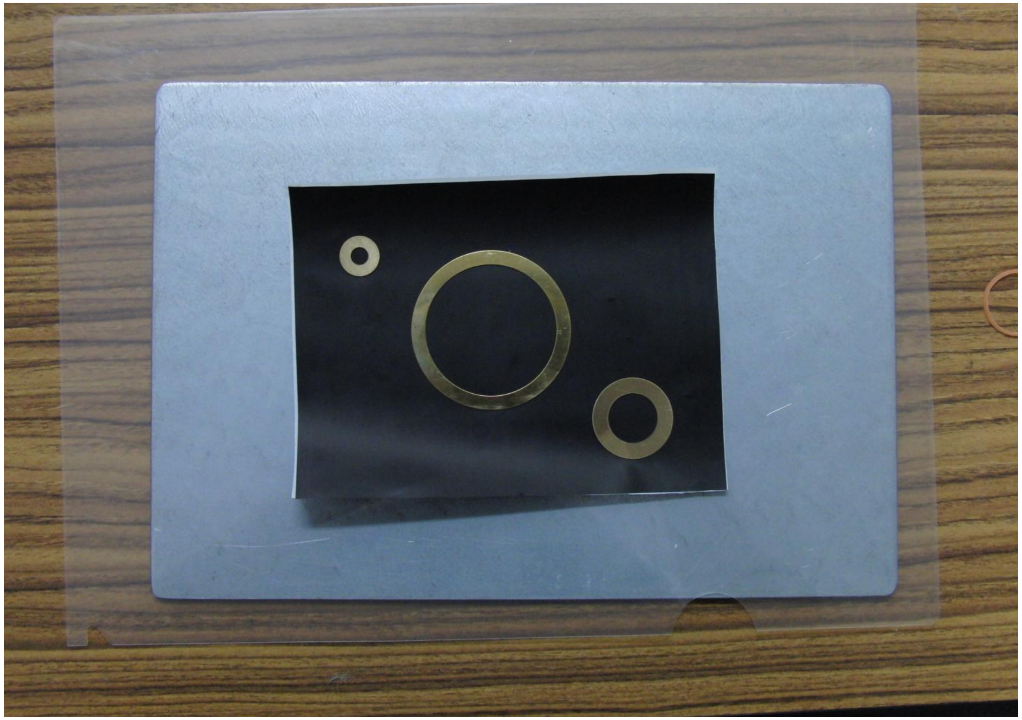
1. Preparation

1.4 Place two small brass plates A and B on a pile of those sheets.



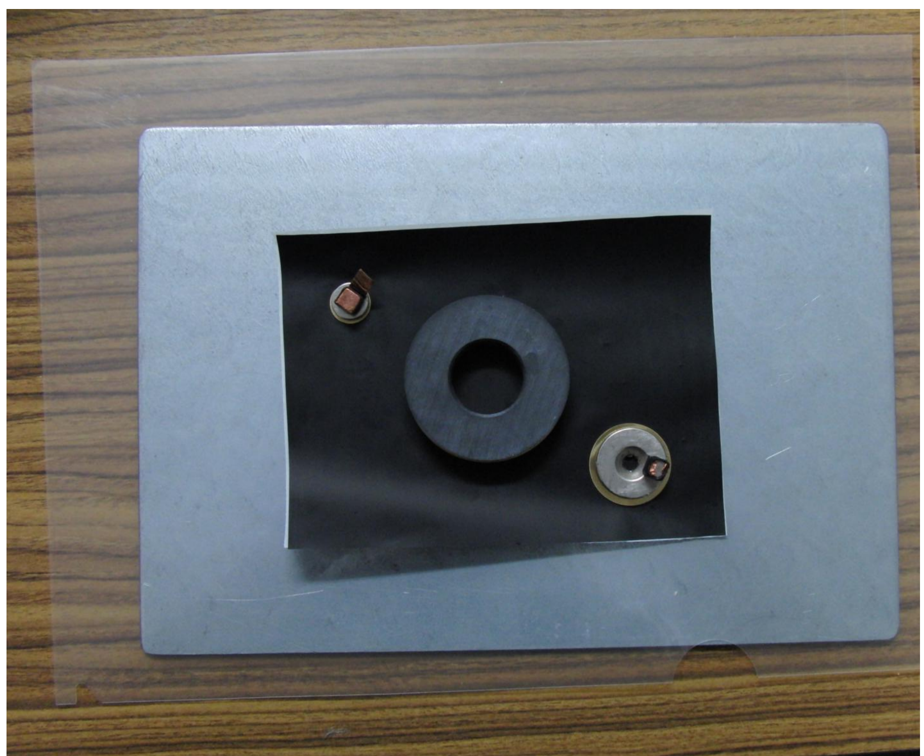
1. Preparation

1.4 Note that sufficient space for the measurements around an additional large brass plate should be reserved between them.



1. Preparation

1.5 Put two magnets on the brass plates to establish firm electrical contacts with the black sheet.

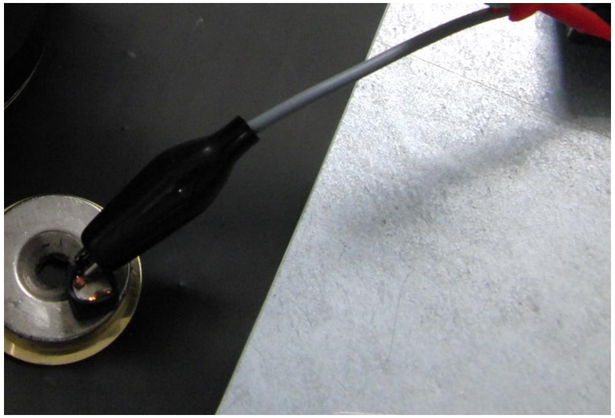


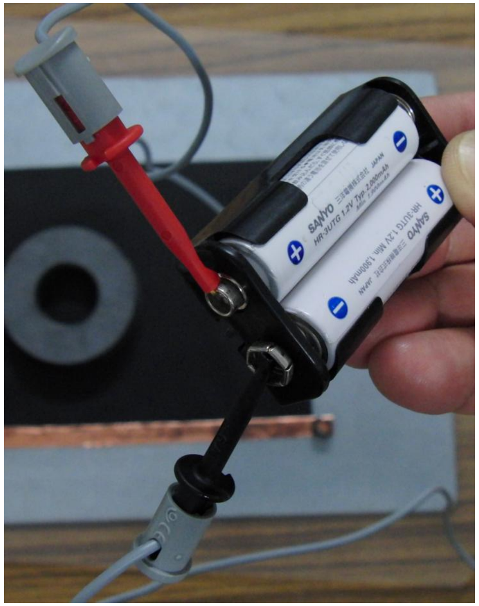
1. Preparation

1.6 Place a piece of copper foil on the magnet and mount a tiny cubic magnet on it to form an electrode. Make the other electrode similarly.

1. Preparation

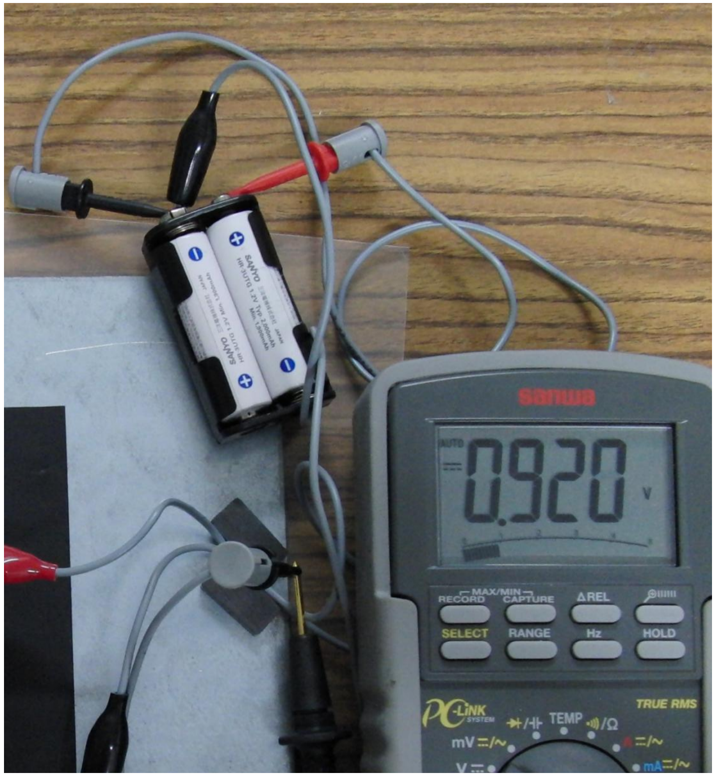
1.7 Connect those electrodes to positive and negative poles of the battery box using alligator-alligator cables.





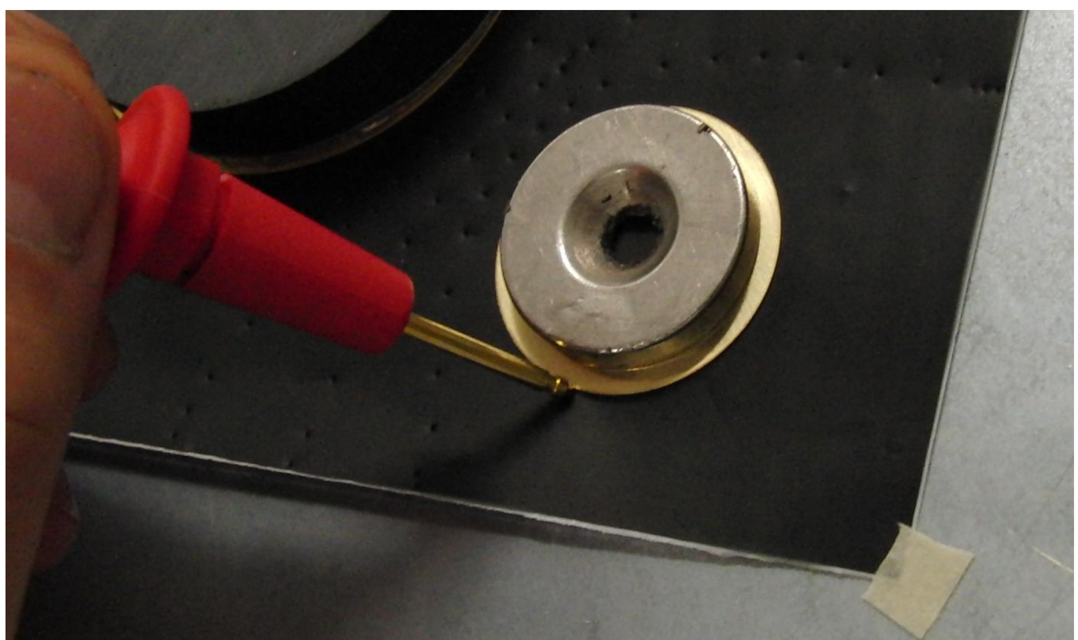
1. Preparation

1.8 Connect the negative pole of the battery box to a black probe of DMM using an additional alligator-alligator cable.



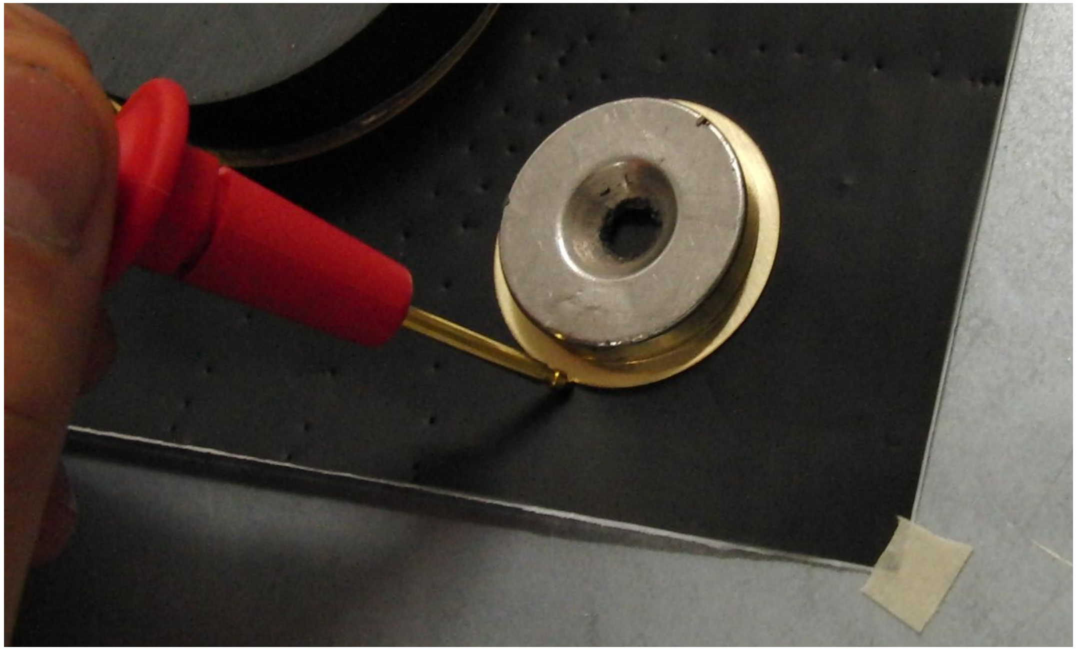
1. Preparation

1.9 Touch the red probe of DMM on the individual brass plates (A and B) and read the direct-current voltages on DMM.



1. Preparation

1.9 Write down those values.

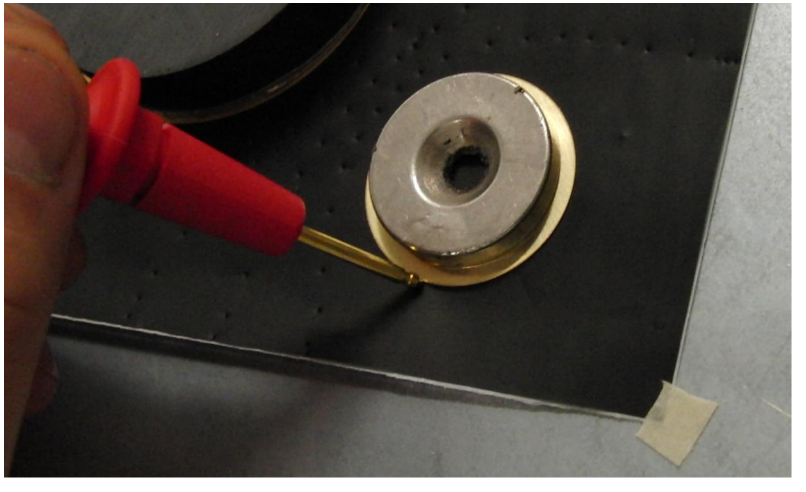


1. Preparation

1.10 Place a large brass plate C between two electrodes and put a large magnet on it.

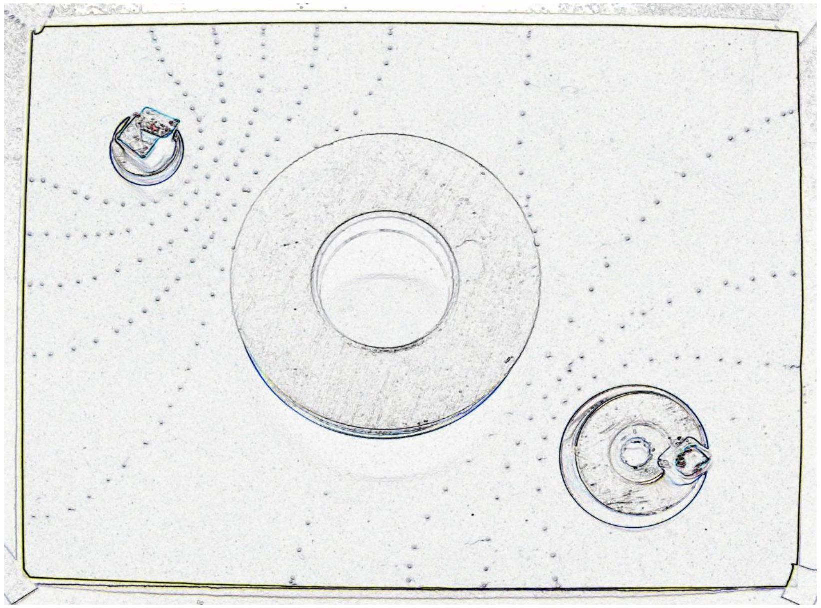
1. Preparation

1.10 Touch the probe of DMM on the brass plate C and read the value, and note it. Be sure that the voltages of two electrodes (brass plates A and B) are unchanged.



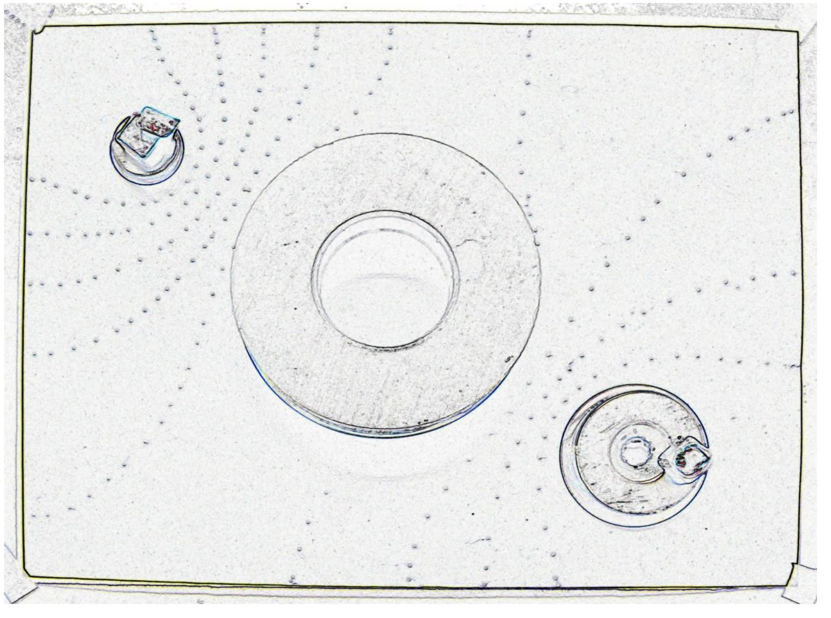
1. Preparation

1.11 Sketch the alignment of the brass plates A, B and C on another piece of paper.



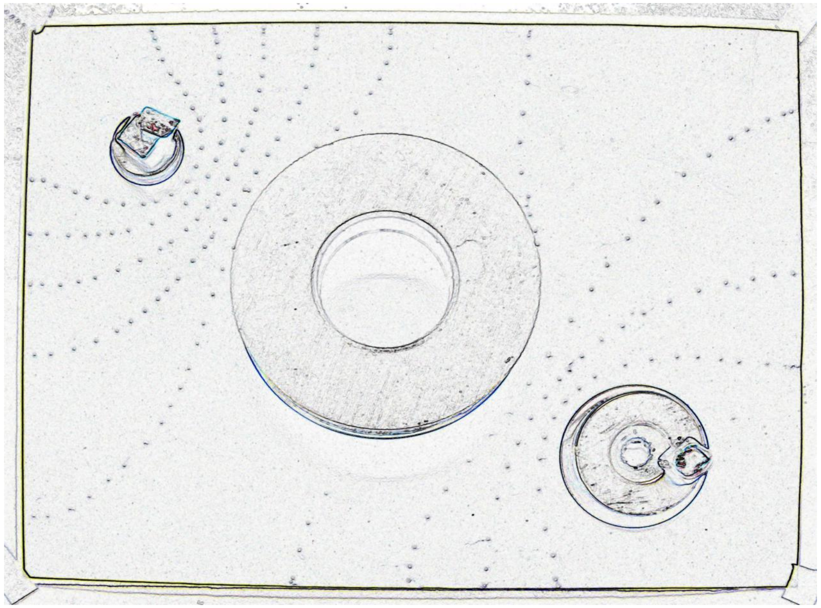
1. Preparation

1.11 Consider the lines of flowing currents and draw the lines on this paper. Then, draw expected equipotential lines, which should be normal to the current lines.



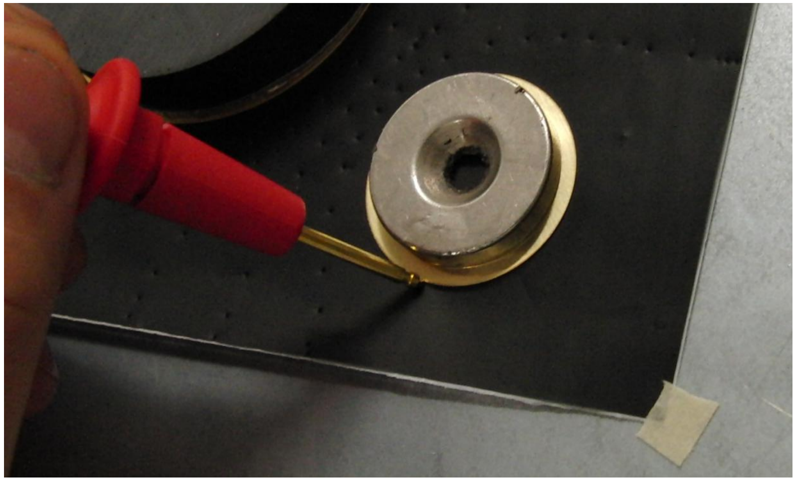
1. Preparation

1.12 Now let's have discussion time.



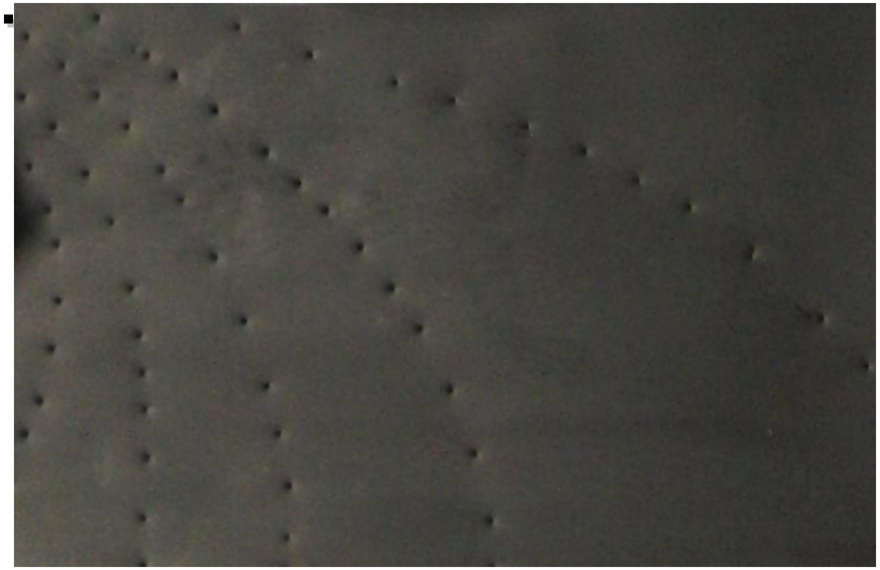
2. Measurements

2.1 Set up the red probe of DMM vertically and gently touch a place on the black sheet with a peak of the probe. Read DMM.



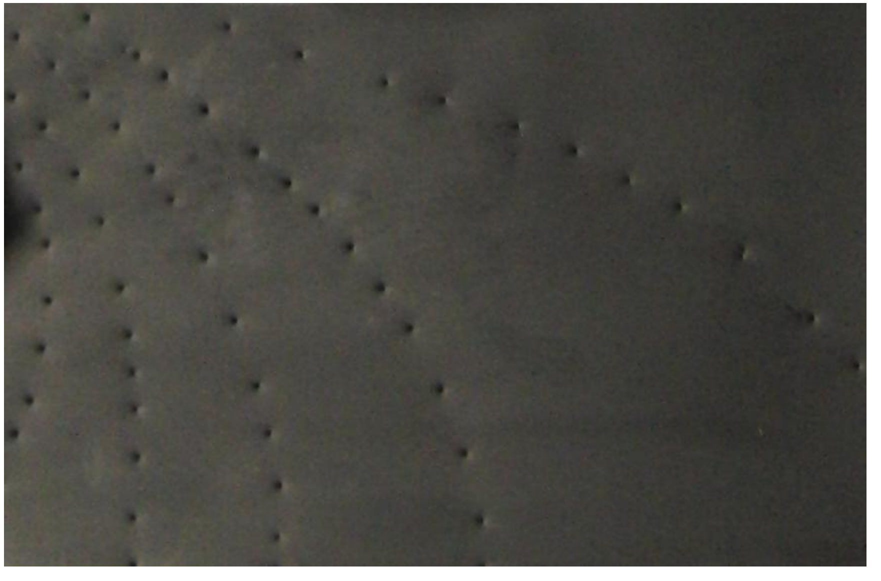
2. Measurements

2.1 Search for a place where the value is V = 1.000 V±0.002 V. When you find such a place, push the probe on the sheet and make a firm but small dip on it.



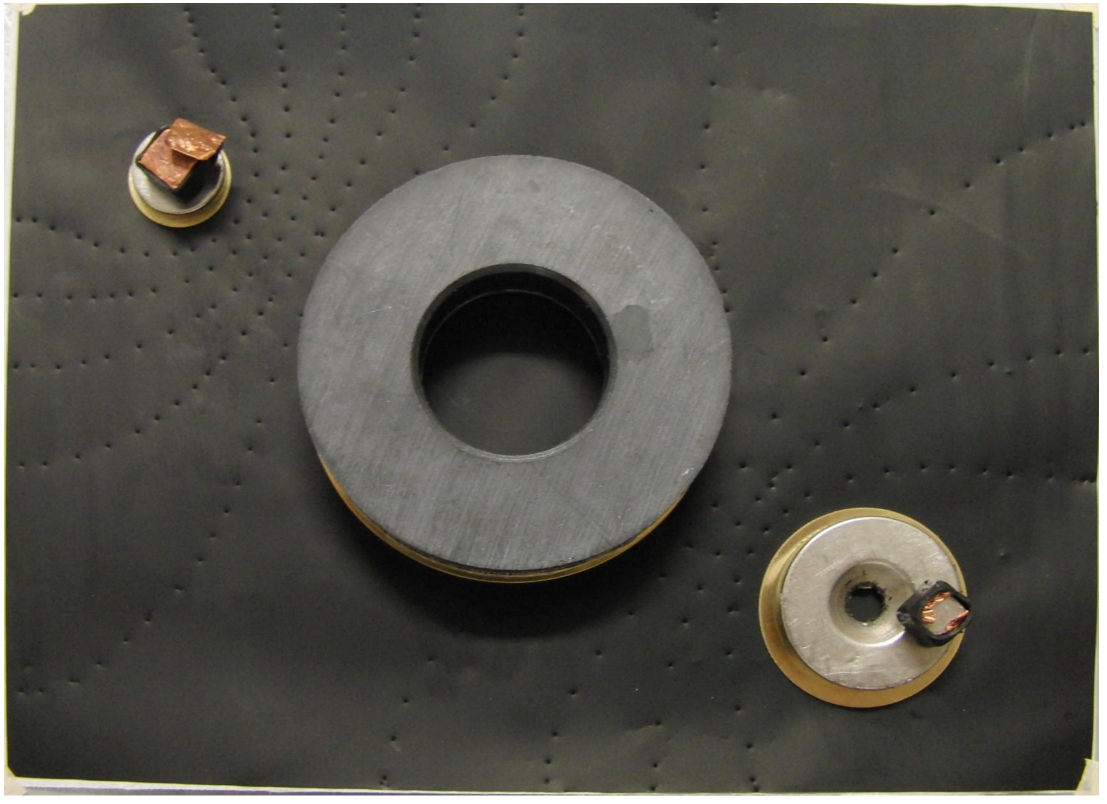
2. Measurements

2.2 Find other points for the same DMM values and make dips. A number of dips will make an equipotential line.



2. Measurements

2.2 This line should be closed, or have a couple of breaks at the edge of the black sheet.

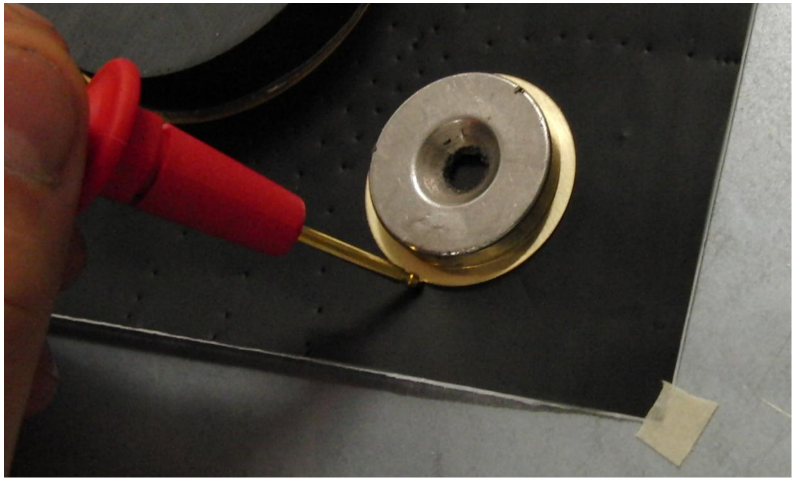


2. Measurements

2.3 Repeat making lines for *V* = 0.25, 0.5, 0.75, 1.25, 1.5, 1.75, 2.0, 2.25 and 2.5 V in the same precision.

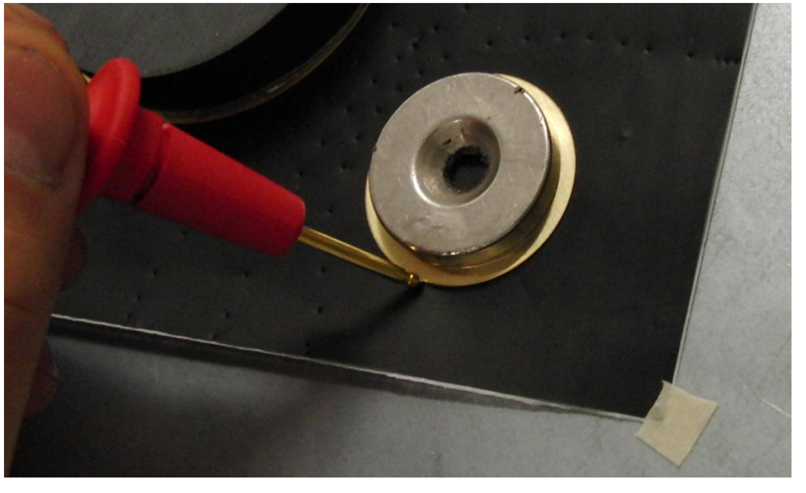
2. Measurements

2.4 Trace the rims of brass plates A, B and C fully and firmly with a ballpoint pen to make marks on the black sheet.



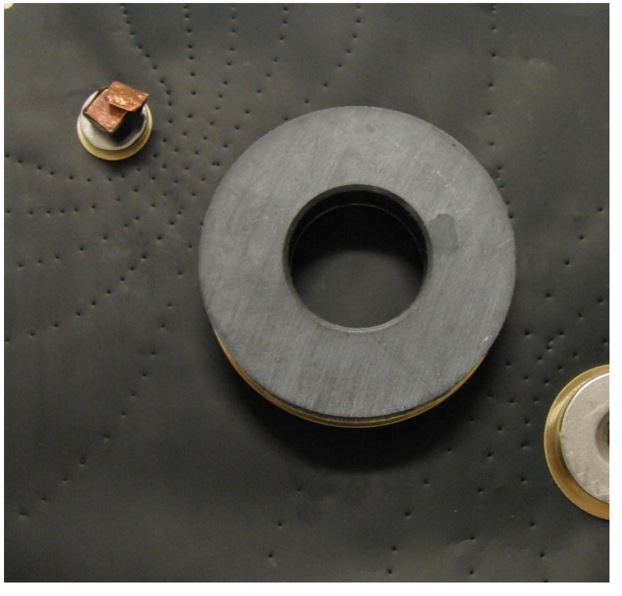
2. Measurements

2.4 Those marks are very important for the later procedure so you should confirm them.



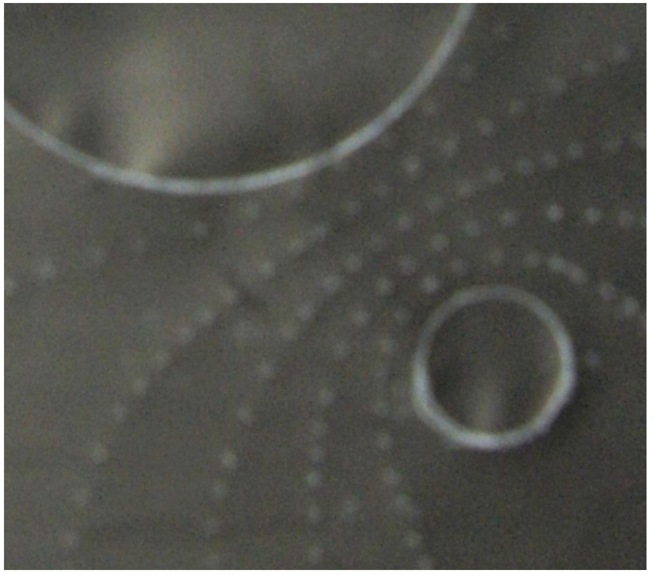
3. Drawing

3.1 Remove the cables, magnets, and brass plates. When you remove the magnets, you should be careful not to stretch or to scratch the black sheet.



3. Drawing

3.2 Turn over the black sheet. If you find some dips do not have enough white color, you should add white on the dips by using of a white pen.



3. Drawing

3.3 Copy the sheet using a copy machine (or a tracing paper).

3.4 Connect the lines of dips smoothly to draw the equipotential lines.

3. Drawing

3.5 Draw some short lines normal to the equipotential lines.

3.6 Draw current lines.

3.7 Find out the place where positive and negative poles are induced on the brass plate C.