Magnetic Field Measurement Using a Smartphone

Duty – D1 D2 D3

Question 2

Download APP

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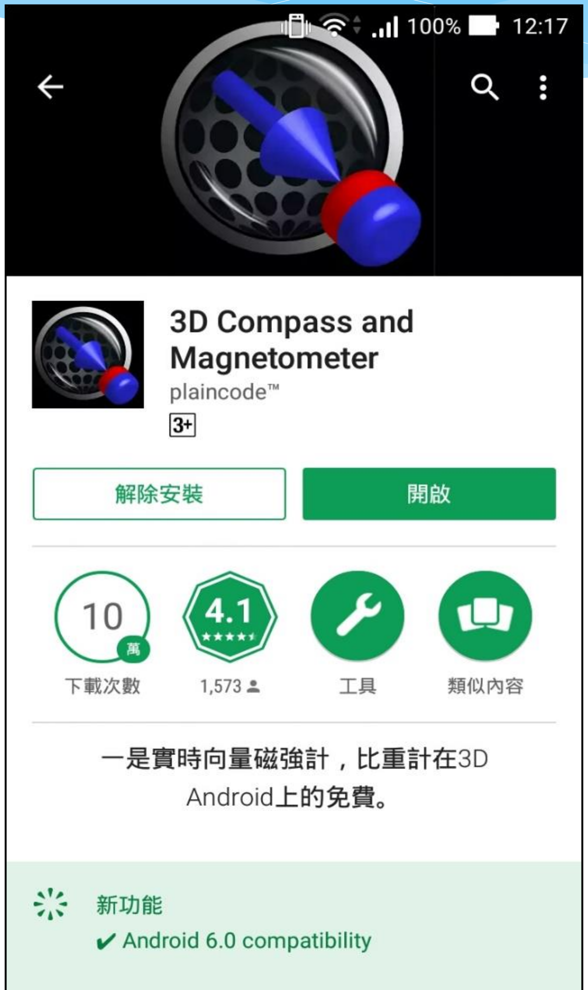


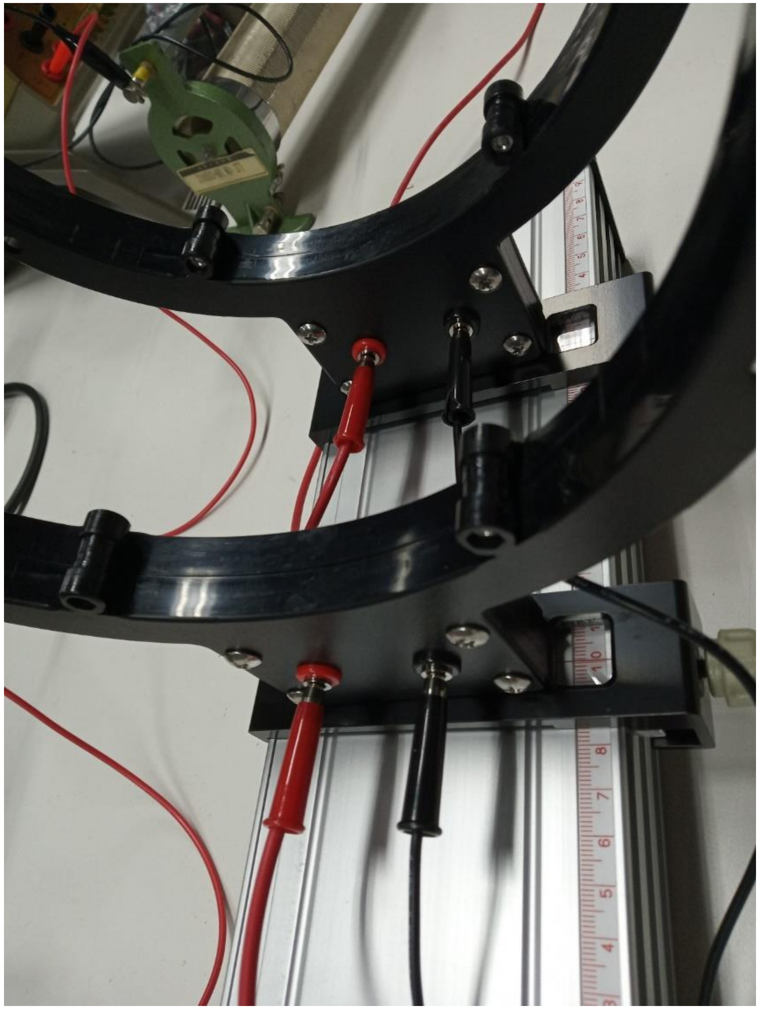
Locate the magnetic field sensor in a smartphone

Magnetic Field Mode

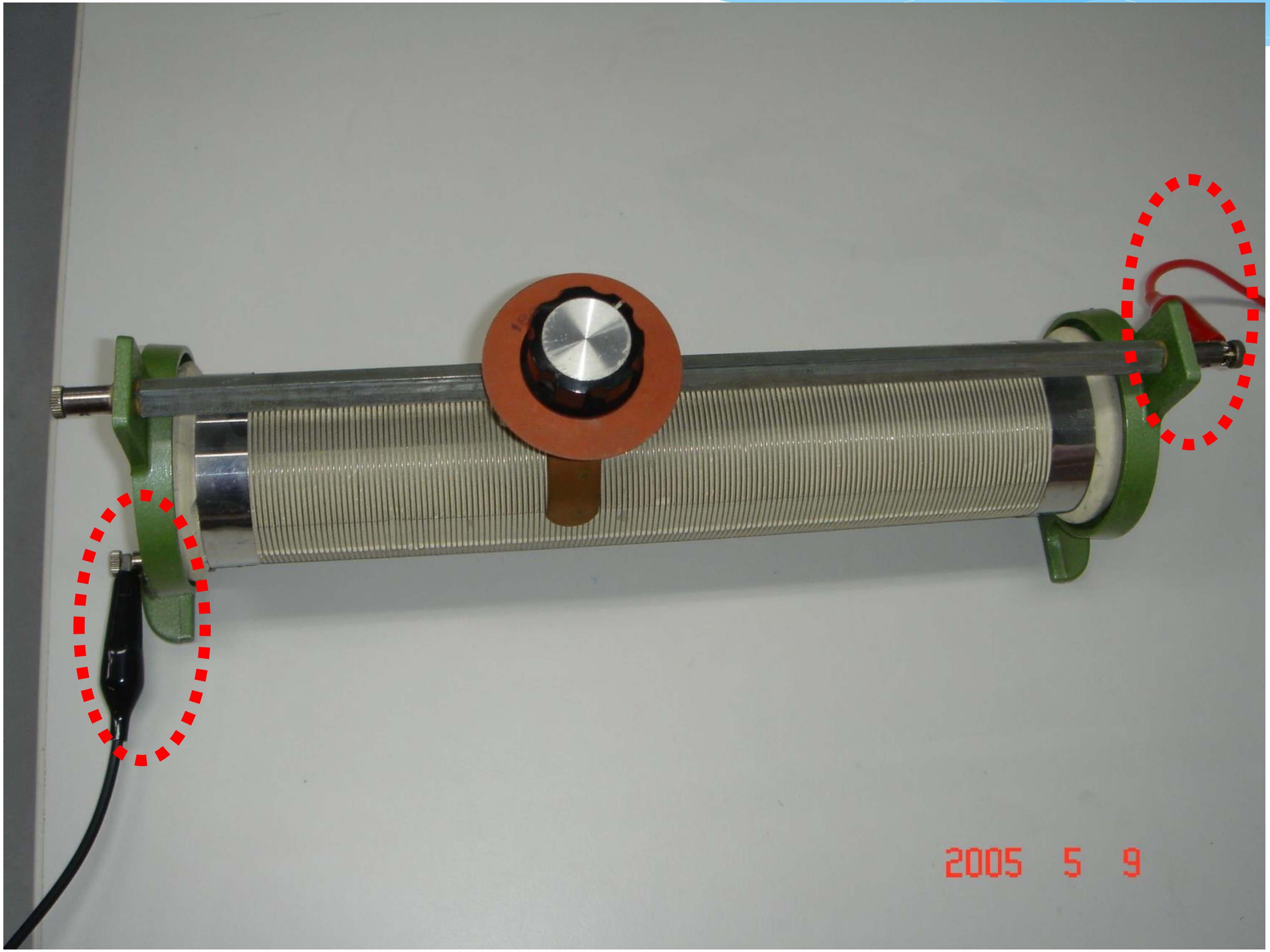
Use a magnet to find a point where the magnetic field reading was the highest

Calibration

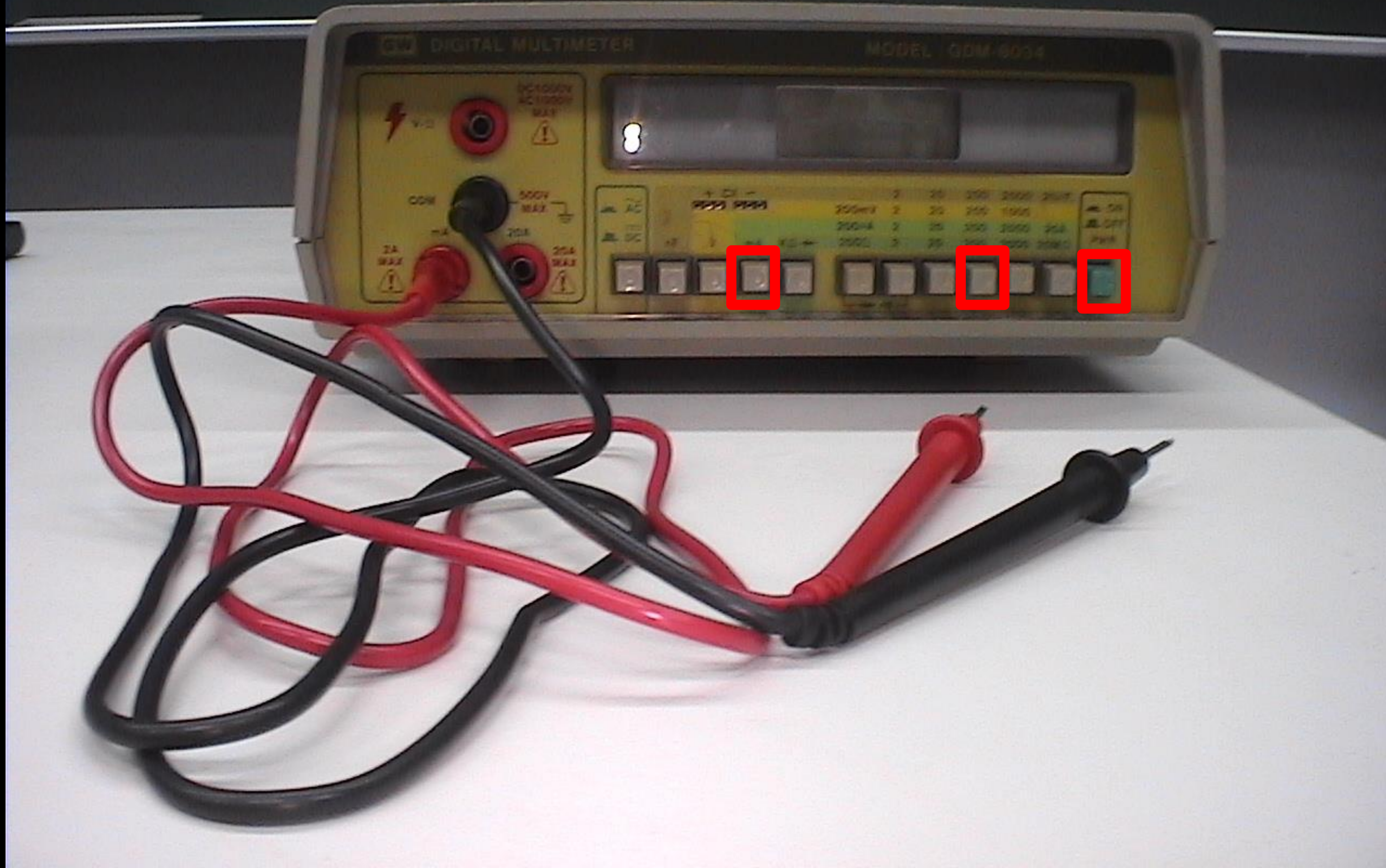
Coils



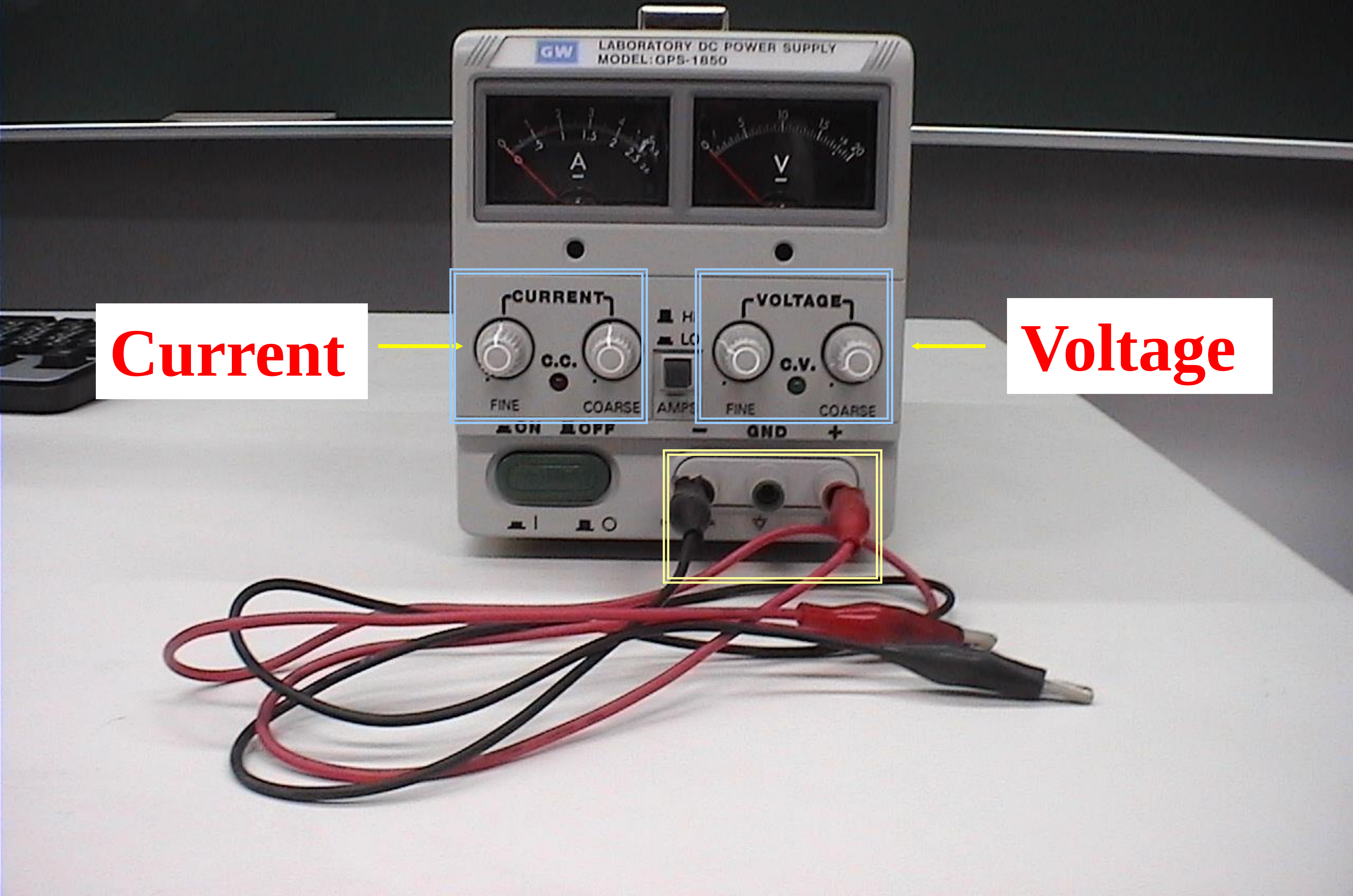
Variable Resistor



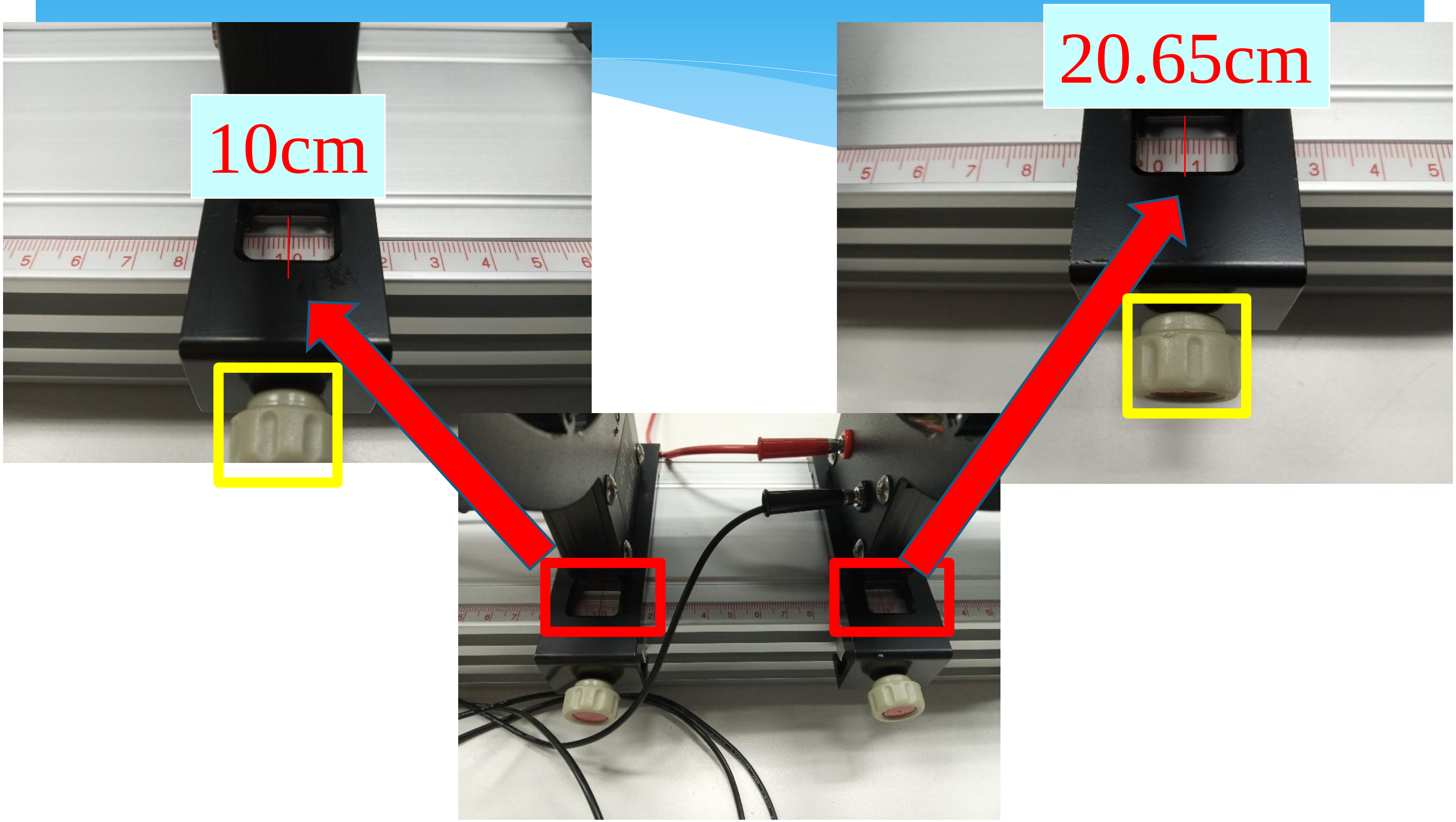
Current Measurement (< 2A)



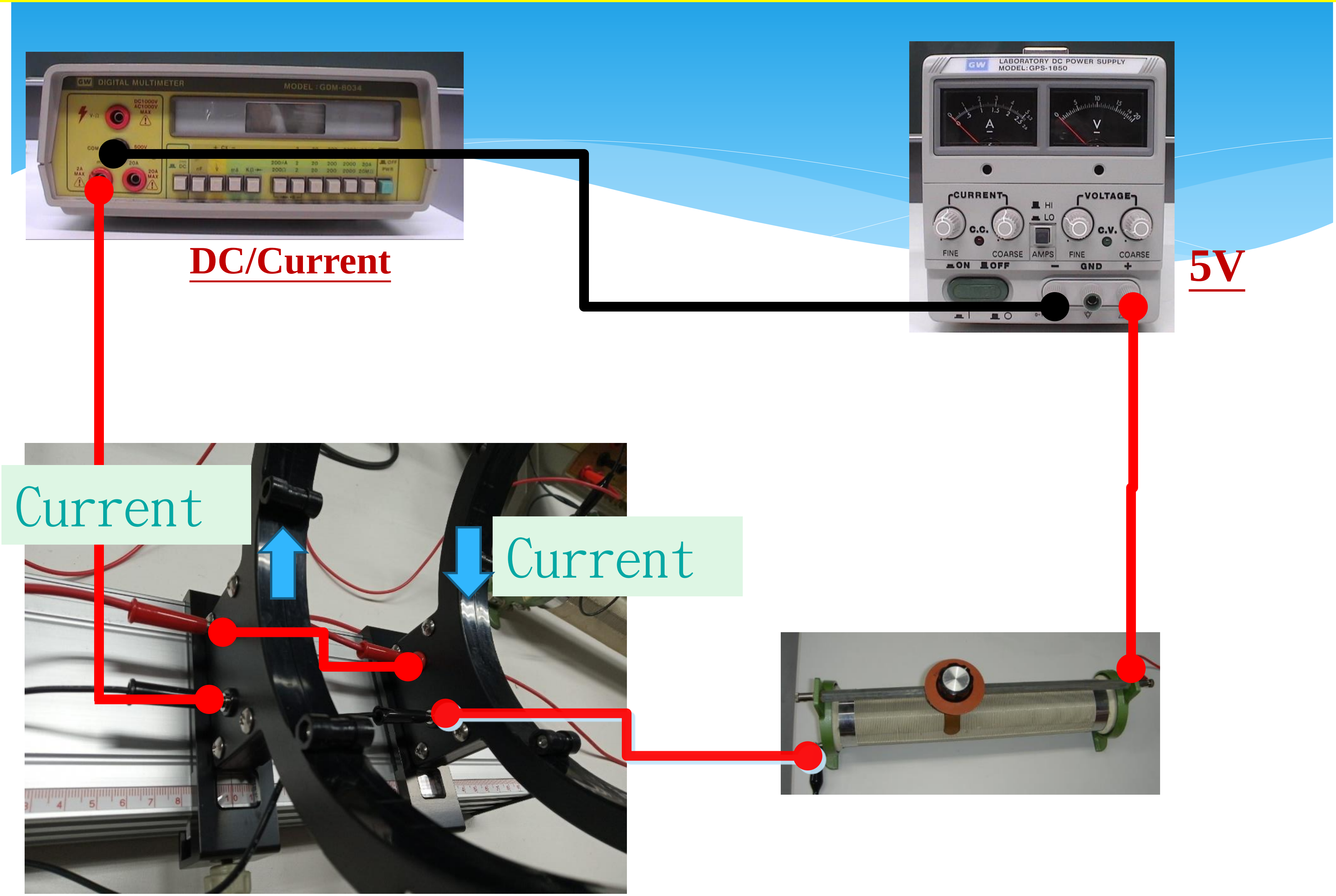
DC Power Supply



The distance should be 10.65 cm

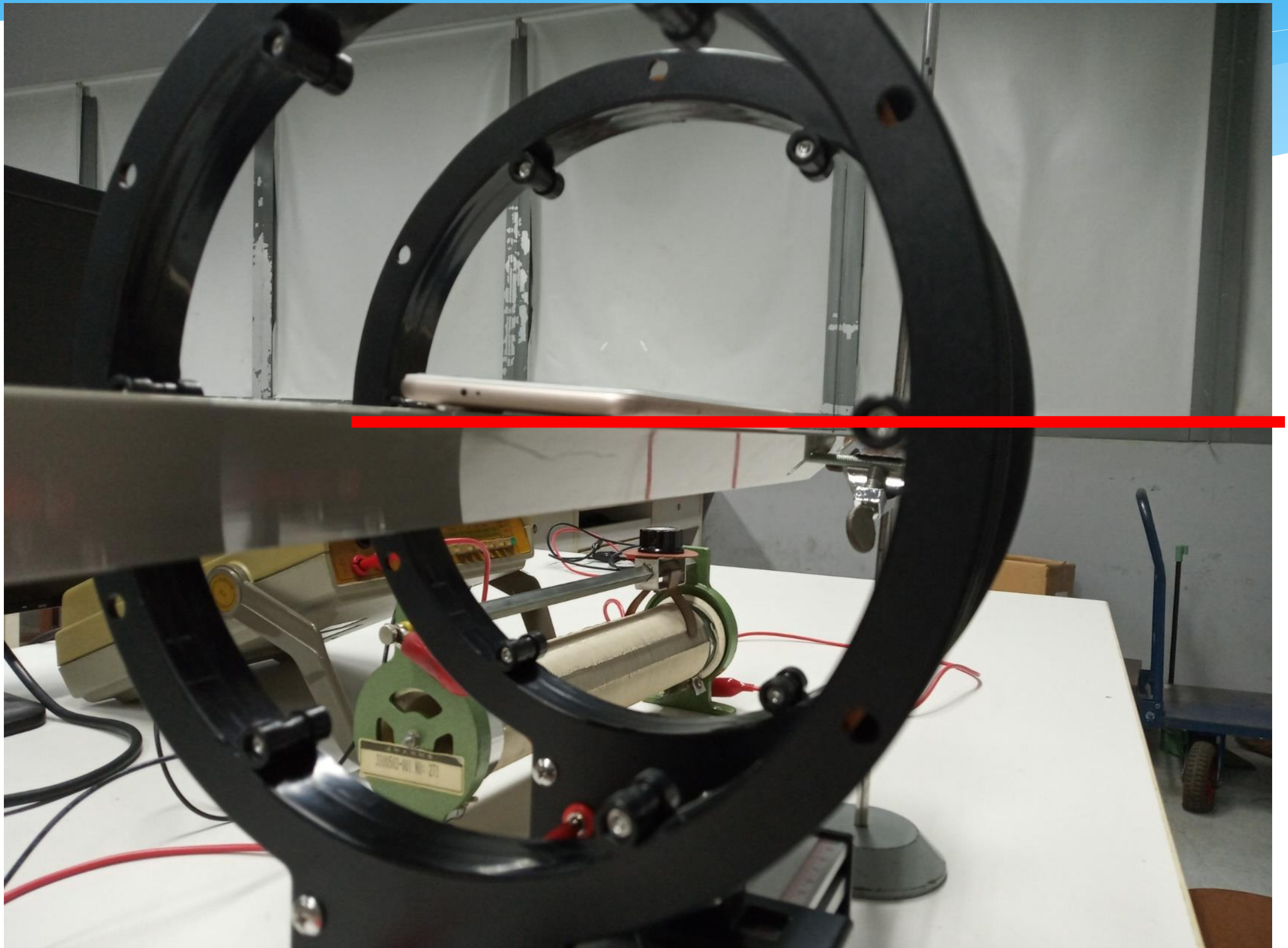


Make sure the current in each coil is in the opposite direction.



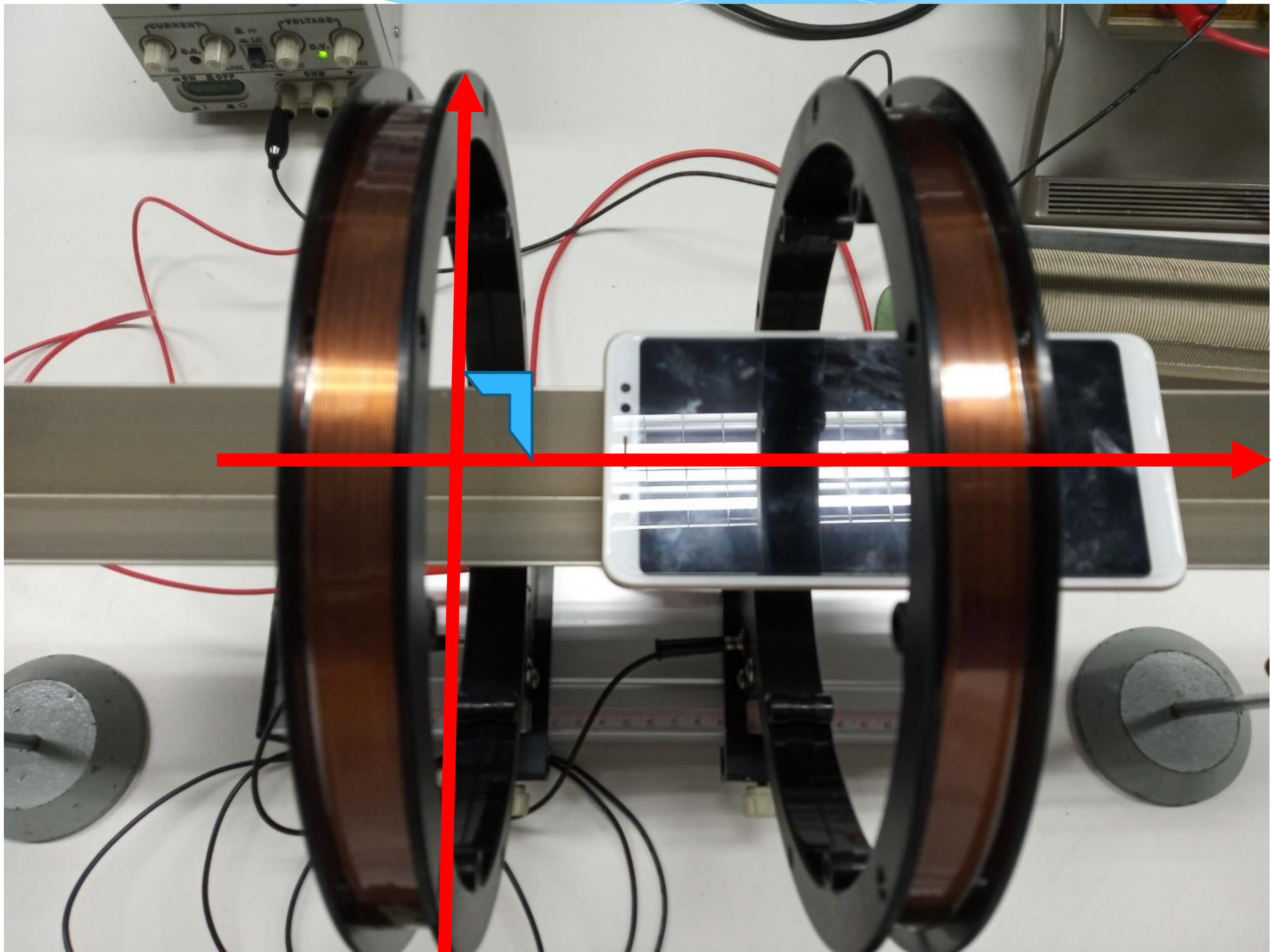
Set the platform height

1、



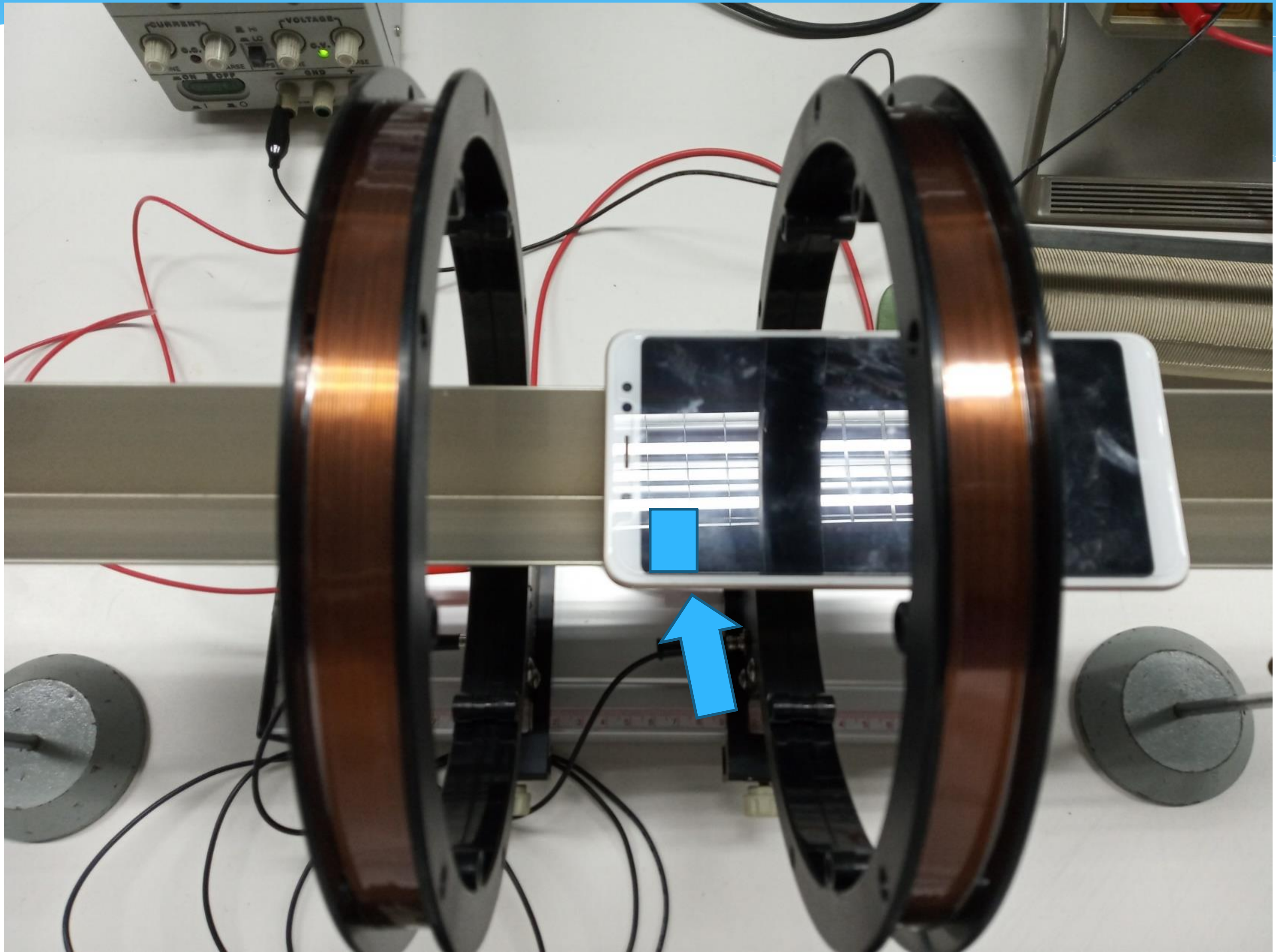
Alignment between the sensor and the surface of the coil

The sensor should be perpendicular to the surface of the coil



Place the sensor in the center of Helmholtz coil

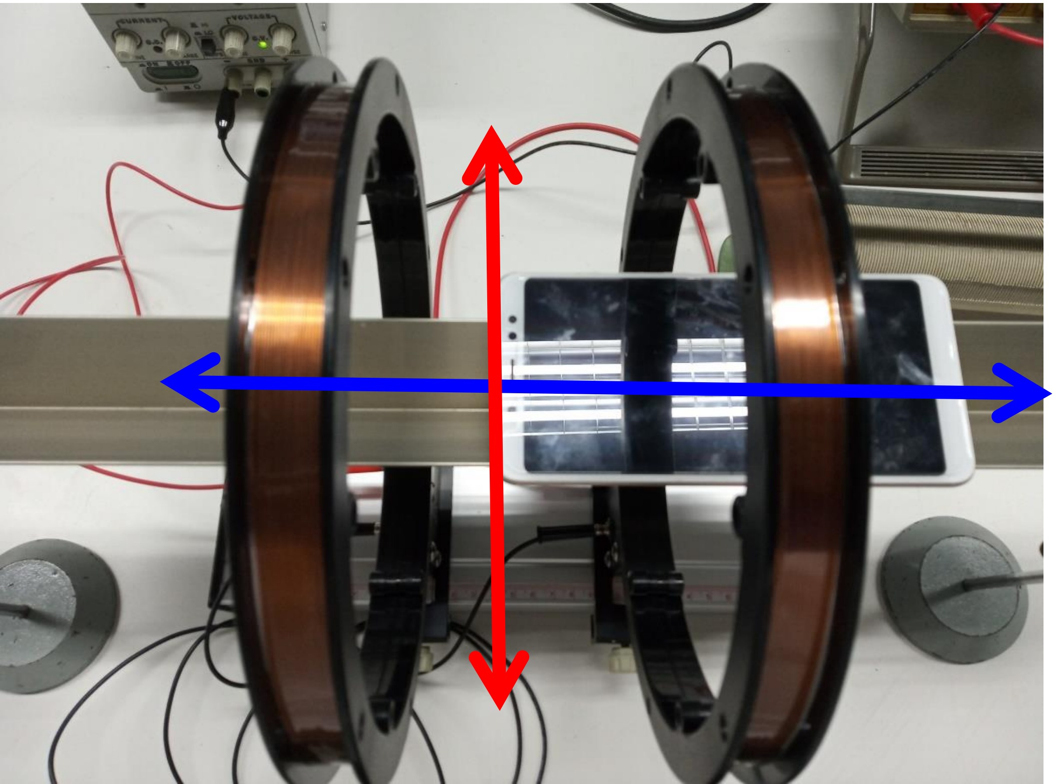
2、



Place the sensor in the center of Helmholtz coil

3、

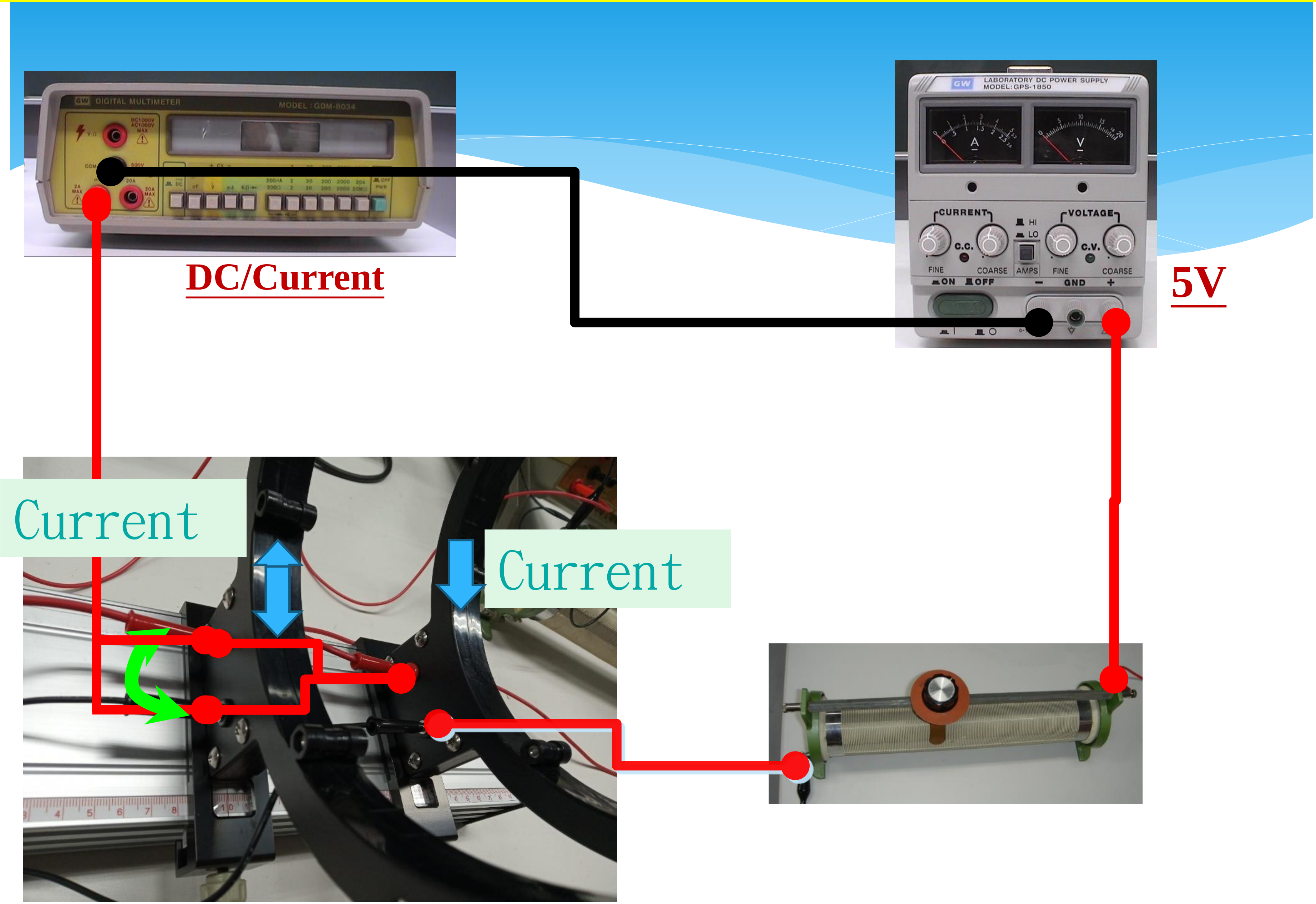
Each coil carries an equal electric current in the opposite direction(180mA). Find a point where the magnetic field reading was the lowest



Relative Mode

Zero out background noise

Swap connectors and make sure the current in each coil is in the same direction.



Measure the magnetic field in the center of Helmholtz coil

Turn off the power.

Zero out the background noise

then turn on the power.

Each coil carries an equal electric current

in the same direction.

Measure and record the magnetic field

With different current.

Relative Mode

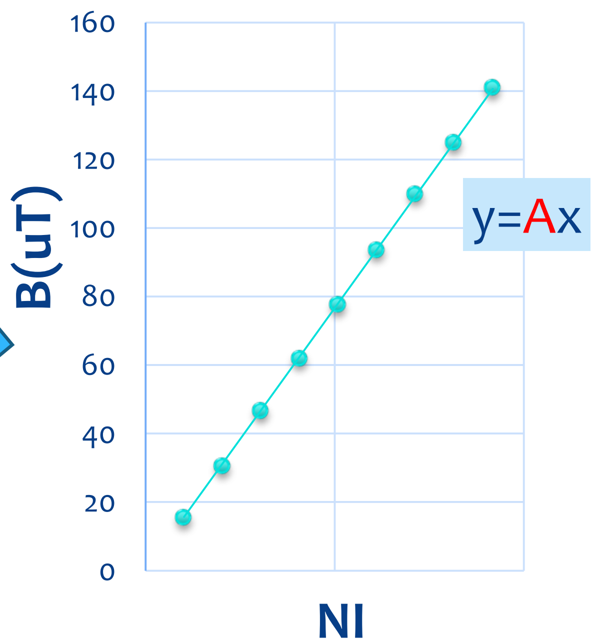
Zero out background noise

Calibration Coefficient of Your Smartphone

I(A)	N	NI	B_h(uT)
0.02	200	4	
0.04	200	8	
0.06	200	12	
0.08	200	16	
0.10	200	20	
0.12	200	24	
0.14	200	28	
0.16	200	32	
0.18	200	36	

Theoretical value

$$\frac{B_h}{NI} = \frac{8\mu_0}{\sqrt{125}R} = 8.443$$



Coefficient K=8.443/A

Page 1

(1) Calibration

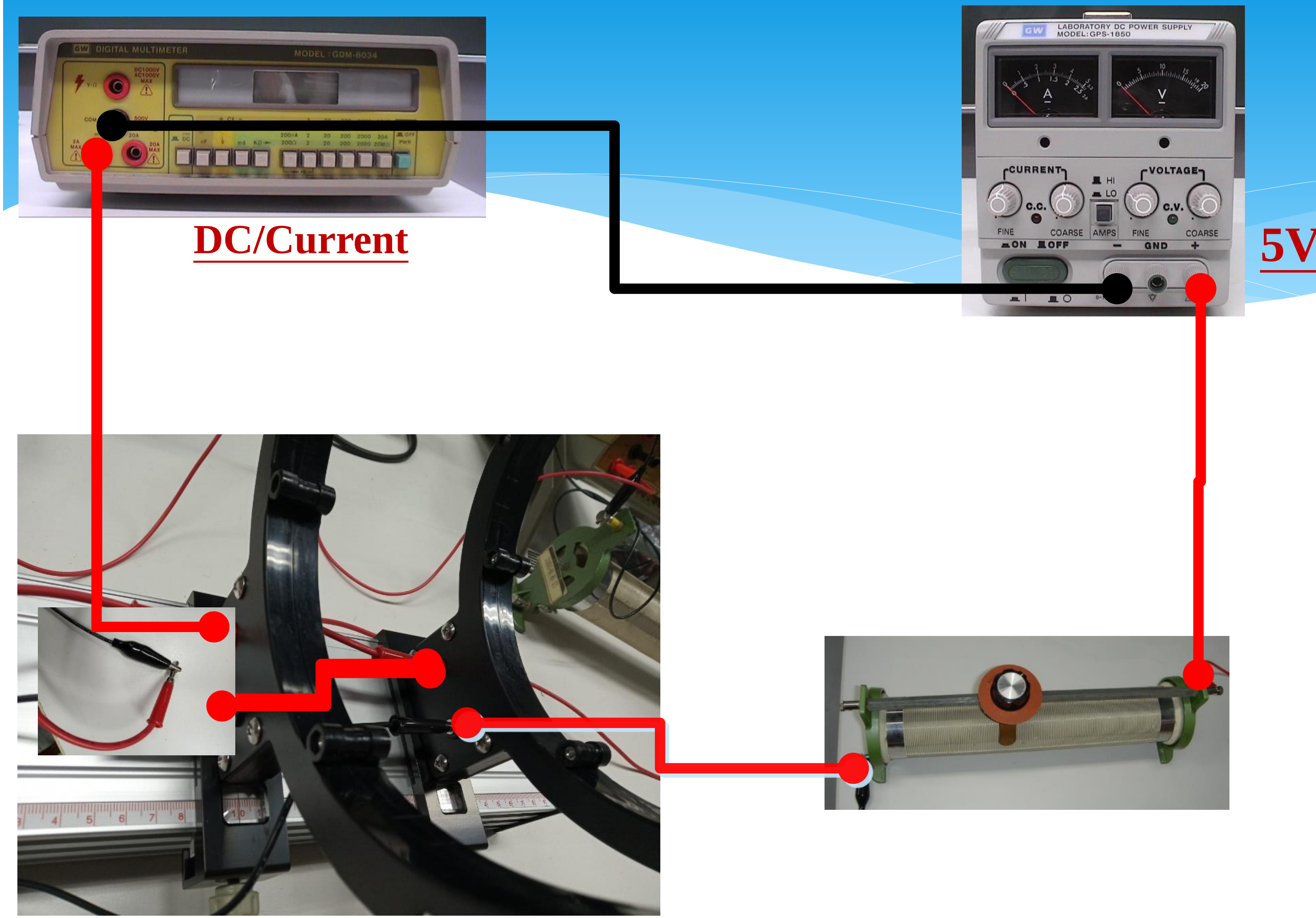
Radius R=0.1065 m

Current I	Turns N	N*I	B_h	$\frac{B_h}{NI}$ experimental value
0.02	200		Measurement	
0.04	200			
0.06	200			
0.08	200			Slope
0.10	200			
0.12	200			
0.14	200			
0.16	200			
0.18	200			

$\frac{B_h}{NI}$ theoretical value : $\frac{8\mu_0}{\sqrt{125}R} =$ 8.443

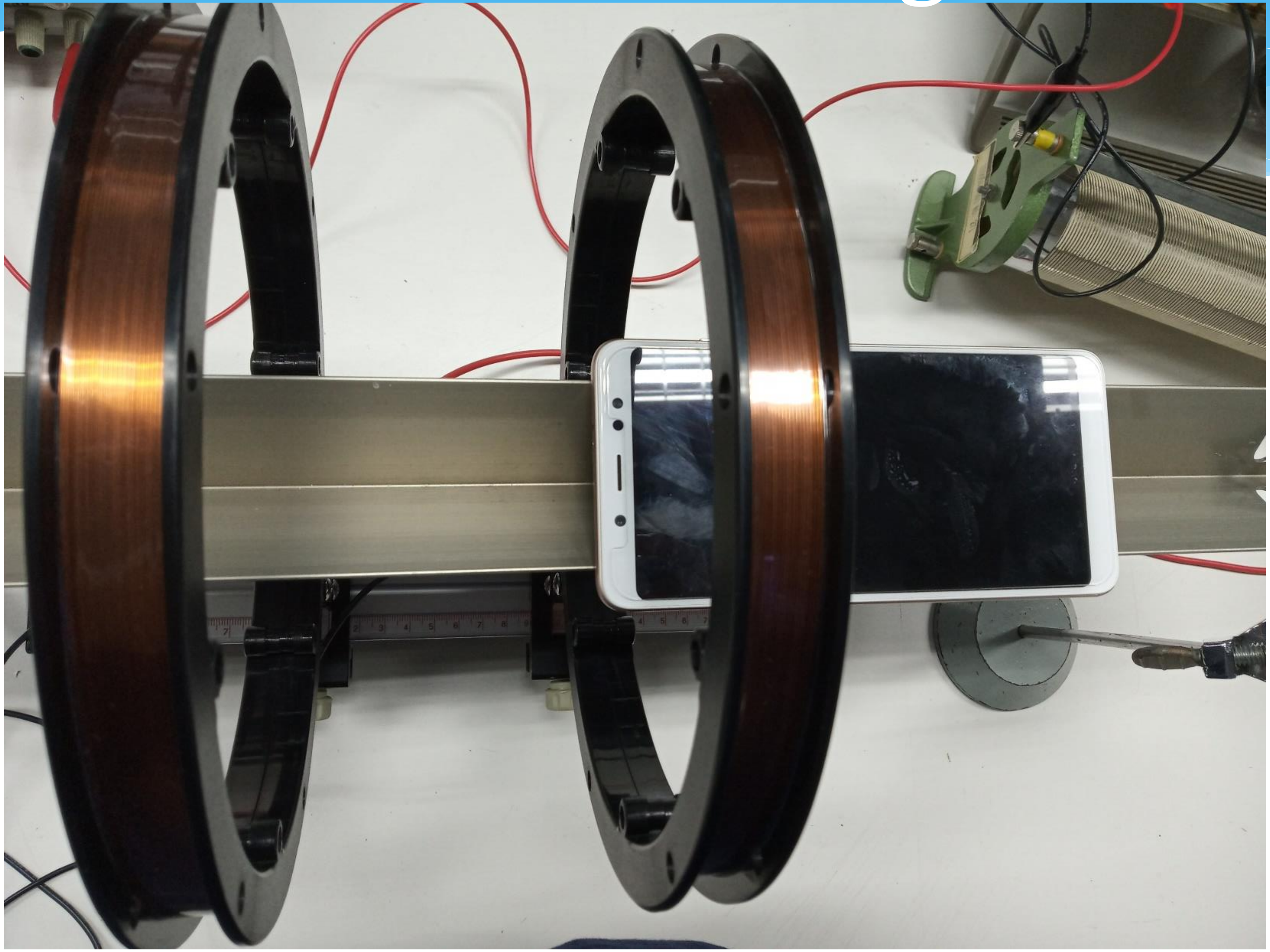
calibration coefficient K ($\frac{\frac{B_h}{NI}\text{ theoretical value}}{\frac{B_h}{NI}\textit{ experimental value}}$) = ________

Measurement 1


DC/Current
5V
DIGITAL MULTIMETER
MODEL : GDM-8034
LABORATORY DC POWER SUPPLY
MODEL:GPS-1850
CURRENT
VOLTAGE
C.C.
C.V.
FINE
COARSE
AMPS
ON
OFF
GND

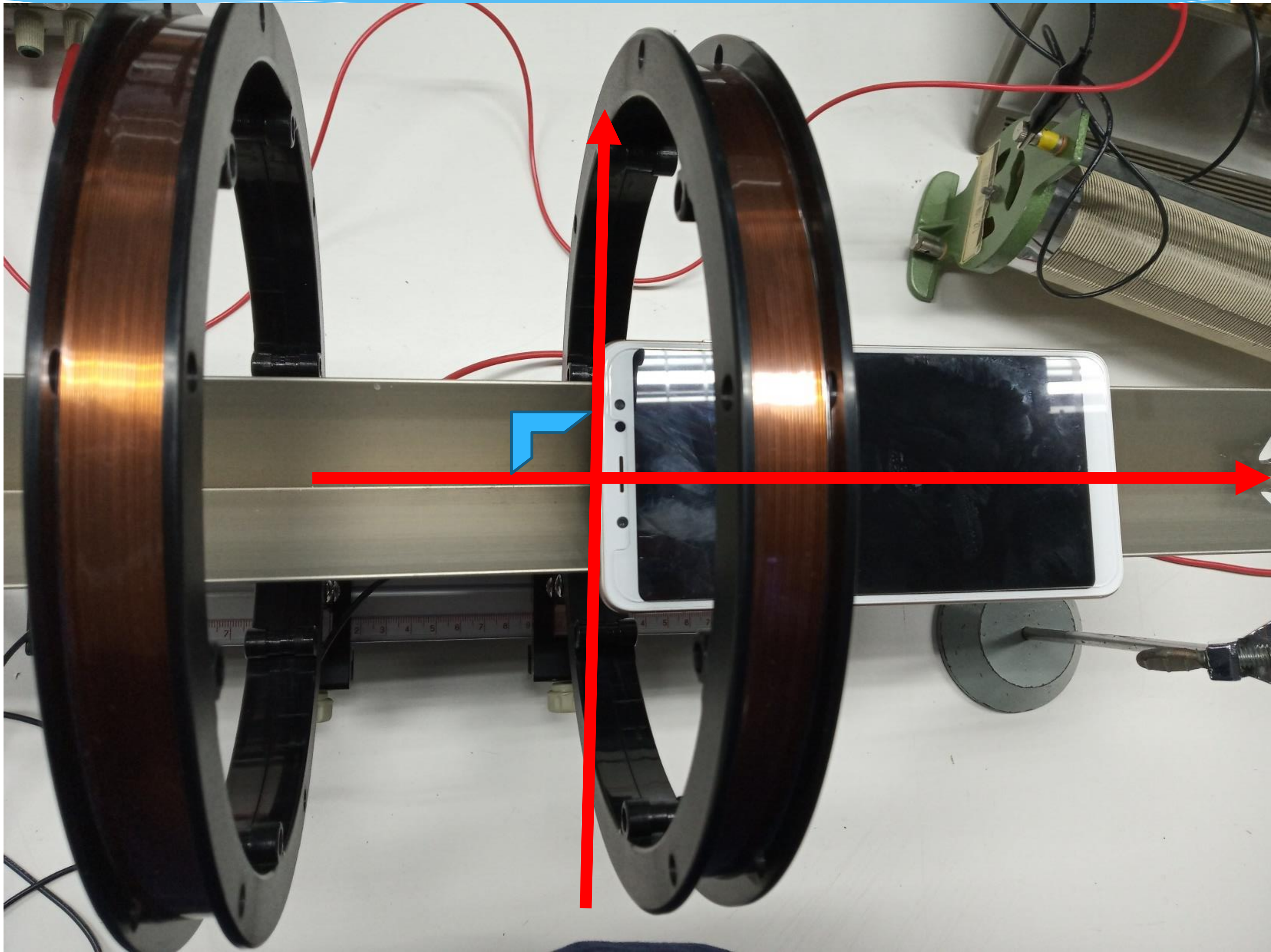
Place the sensor in the center of a single coil

1、



Alignment between the sensor and the surface of the coil

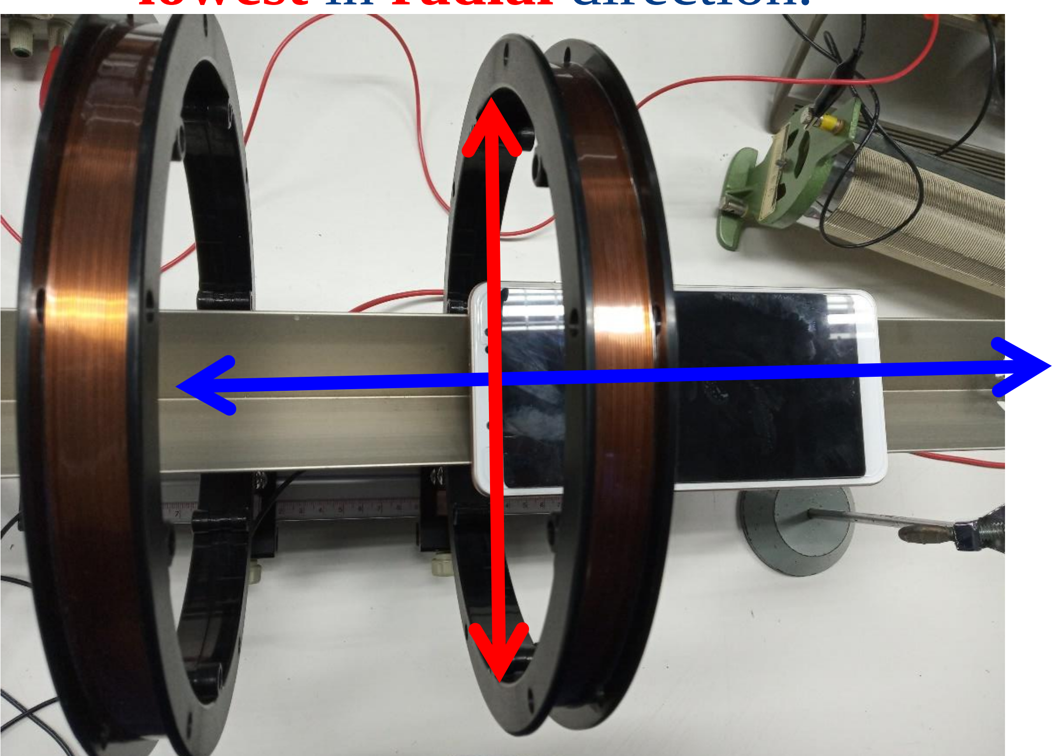
The sensor should be perpendicular to the surface of the coil



Place the sensor in the center of a single coil

2、

Zero out background noise. Turn on the power. Find a point where the magnetic field reading was the **highest** in **axial** direction and **lowest** in **radial** direction.



Zero out background noise

Relative Mode

Measure the magnetic field in the center of a single coil

Relative Mode

Turn off the power.

Zero out the background noise

then turn on the power.

Measure and record the magnetic field

With different current.

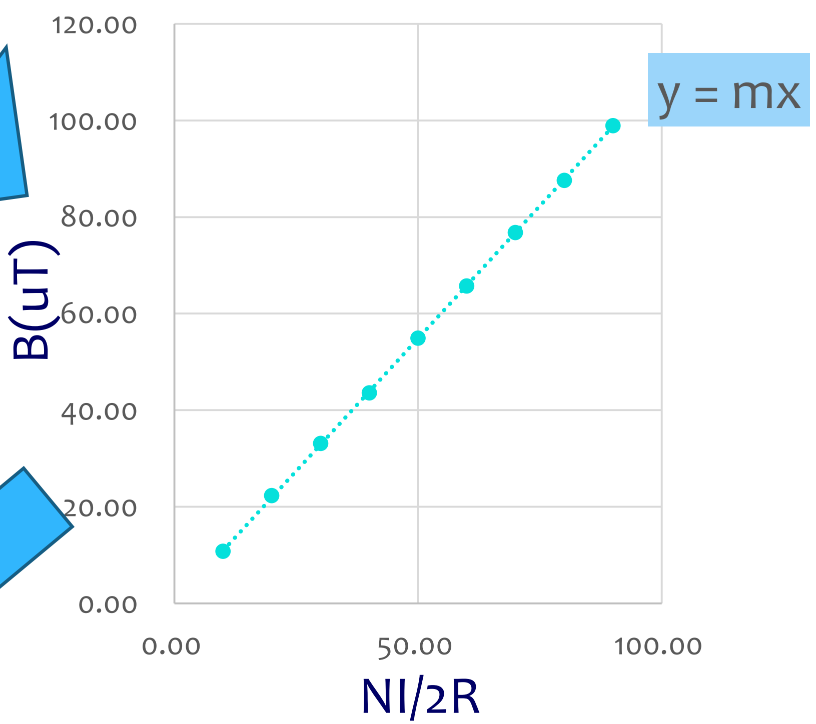
Zero out background noise

Get μ_o and calculate percent error

I(A)	N	NI/2R	B(uT)
0.02	200	18.78	
0.04	200	37.56	
0.06	200	56.34	
0.08	200	75.12	
0.10	200	93.90	
0.12	200	112.68	
0.14	200	131.46	
0.16	200	150.23	
0.18	200	169.01	

μ_0 experimental value

$K \cdot m$



μ_0 experimental value	μ_0 theoretical value	percent error
K·m	1.2566×10^{-6}	

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(2) Measurement 1 – circular coil

Radius R=0.1065 m

Current I	Turns N	NI/2R	B	Slope m	μ_0=m*k experimental value	Percent error
0.02	200					
0.04	200					
0.06	200					
0.08	200					
0.10	200					
0.12	200					
0.14	200					
0.16	200					
0.18	200					

$\mu_0$theoretical value : $4\pi \times 10^{-7}$ $(T \cdot m/A)$

Measurement 2

Measure the Earth Magnetic Field

Find a place without background noise.

Measure and record the magnetic field.

Magnetic Field Mode

B_e	$K \cdot B_e$	theoretical value	Percent error
		45.13	

Unit - uT