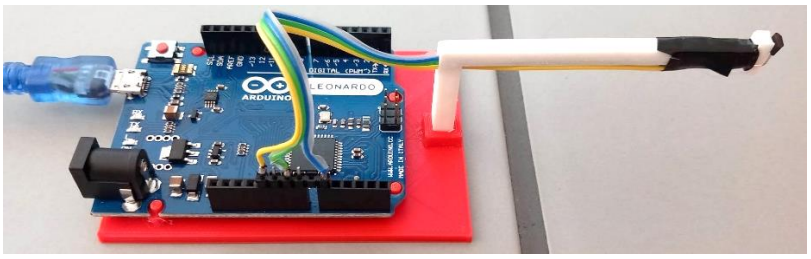
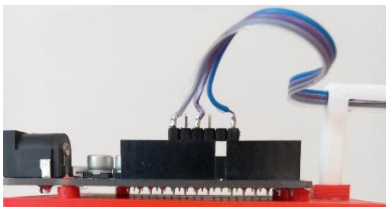
Magnetic field of a solenoid – classroom measurement using Arduino-controlled Hall-sensor

Experimental setup and the Arduino code

Create the circuit according to the pictures (OUT= A0 connector). Run and upload the code[1] to the Arduino - no current flowing through the coil - then check the values to make sure they are around 0 (mT).

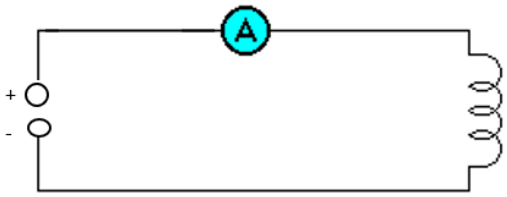


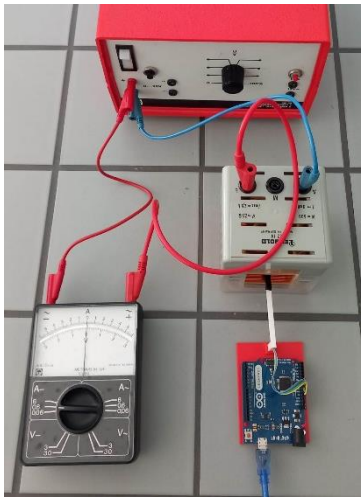


Questions and tasks

Build a circuit using the following equipment:

- Solenoid: N= 1000, l = 8cm
- Voltage source (0-20V)
- Ammeter





The current should never exceed 0.6 A!

a) First, set the current to 0.3 A. Place the Hall sensor in the middle of the coil. What is the effect on the measurement if we rotate or move the Hall sensor towards the end of the coil?

b) Place an iron core in front of the sensor. What change can we detect in the magnitude of the measured magnetic field? Let's explain what we experienced!

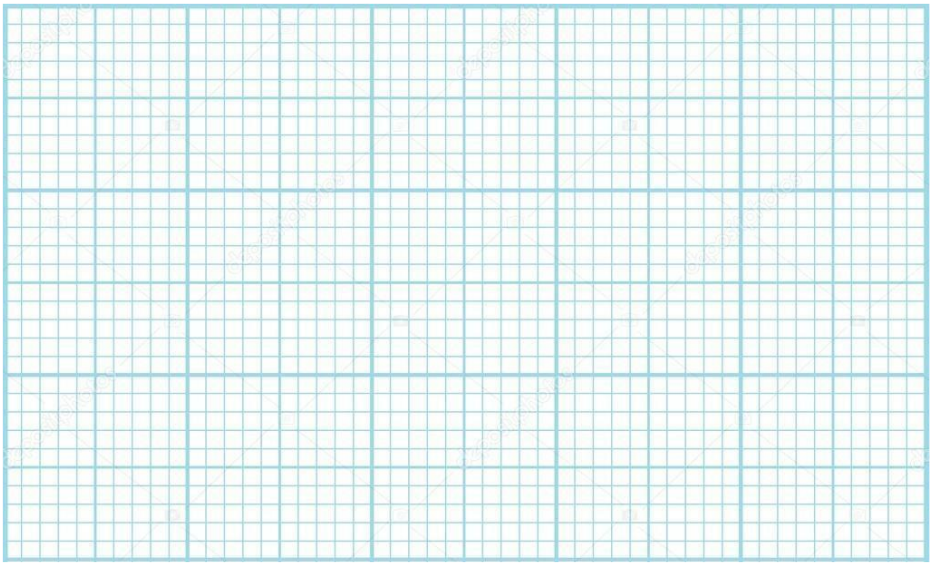
[1] https://schniderdorottya.com/arduino-kódok: MAGNETIC FIELD OF A SOLENOID - HALL-SENSOR

c) Put the Hall sensor in the centre of the coil. To begin with, do not turn on the power source, then start gradually increasing the voltage until you reach the maximum current.

Fill in the table.

I (A)	B (mT)
0	
0,1	
0,2	
0,3	
0,4	
0,5	
0,6	

f) Represent the data graphically. (x-axis: current intesity, y-axis: magnetic induction)



g) Qualitatively interpret the diagram. What is the relation between current intensity and magnetic induction?

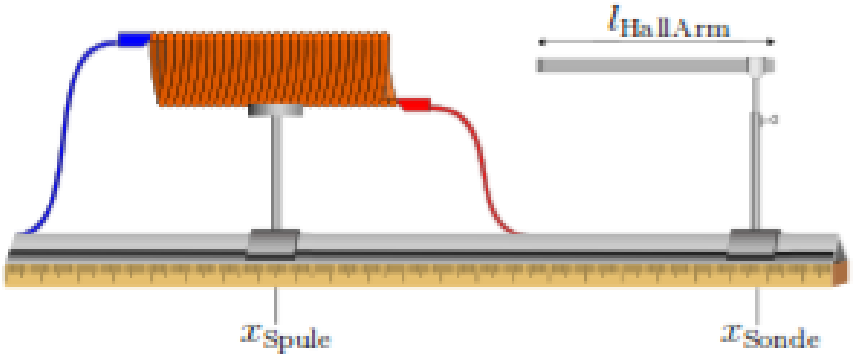
h) Represent the data graphically in Excel, too.

i) Identify possible sources of error.

*****: Bonus**

Set the current to a constant value: e.g. 600mA. Slowly move the Hall probe away from the center of the coil and determine the value of the magnetic induction as a function of distance. Always measure after increasing the distance by 1 cm.

Note: The center of the coild is x=0 cm, maximum distance: x=10 cm.



Represent data graphically and qualitatively explain the results.