Gavin Chen
Worked with Cole TerBush and Daniel Aronov

1 • Part 1

1.1 Data

Current in Solenoid (A)	Magnetic Field (T)
0.00	0.00
0.25	$3 \cdot 10^{-5}$
0.50	$6 \cdot 10^{-5}$
0.75	$7 \cdot 10^{-5}$
1.00	$9 \cdot 10^{-5}$
1.25	$1.1 \cdot 10^{-4}$
1.50	$1.4 \cdot 10^{-4}$
1.75	$1.8 \cdot 10^{-4}$
2.00	$2 \cdot 10^{-4}$

1.2 Analysis

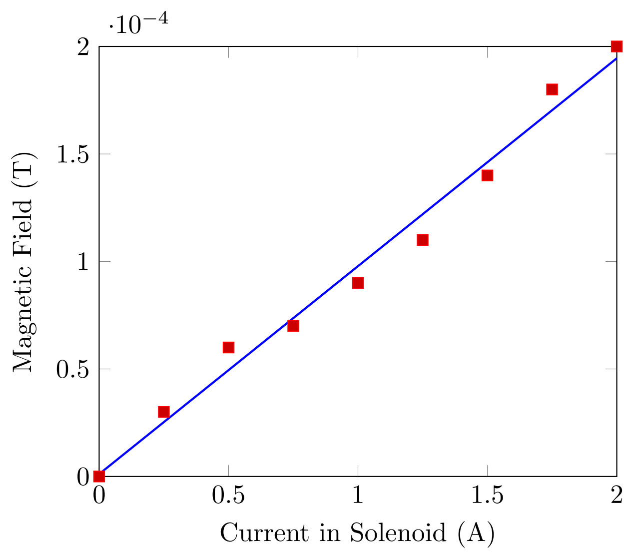

Figure 1: Magnetic field vs. current in solenoid, with a solenoid length of 1 m with 82 turns. The shape of the graph and the equation for magnetic field in a solenoid roughly agree with each other. The slope of the graph is the permeability constant μ_0 times the number of turns divided by the length of the solenoid, which here is $9.67 * 10^{-5} \frac{T}{A}$. Using the slope to calculate μ_0, we get $1.18 \cdot 10^{-6} \frac{kg \cdot m}{s^2 \cdot A^2}$, with a 6.16% error from the true value.

2 • Part 2

2.1 Data

Length (m)	Magnetic Field (T)	Turns Per Meter
0.25	$7.9 \cdot 10^{-4}$	328.00
0.50	$3.7 \cdot 10^{-4}$	164.00
0.75	$2.9 \cdot 10^{-4}$	109.00
1.00	$1.3 \cdot 10^{-4}$	82.00
1.25	$1.4 \cdot 10^{-4}$	66.00
1.50	$1.2 \cdot 10^{-4}$	55.00

2.2 Analysis

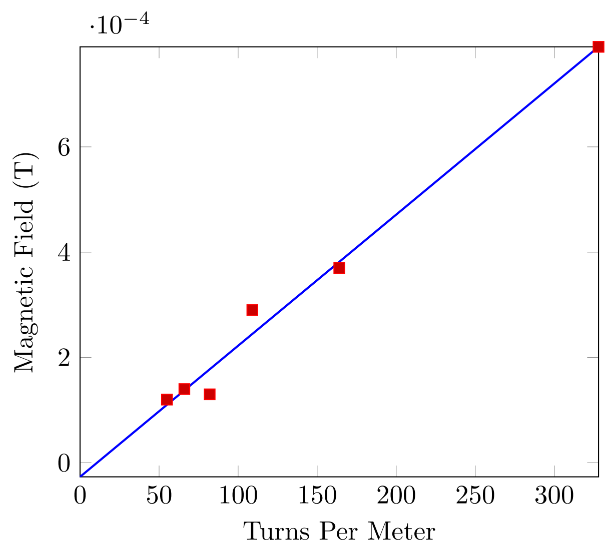

Figure 2: Magnetic field vs. turns per meter of a solenoid, with a solenoid with 82 turns with a current of $2A$ running through it. The shape of the graph and the equation for magnetic field in a solenoid roughly agree with each other. The slope of the graph is the permeability constant μ_0 times the current through the solenoid, which here is $2.49 * 10^{-6} \frac{T \cdot m}{turns}$. Using the slope to calculate μ_0, we get $1.25 \cdot 10^{-6} \frac{kg \cdot m}{s^2 \cdot A^2}$, with a 0.53% error from the true value.

3 • Analysis

The average value of μ_0 is $1.21 \cdot 10^{-6} \frac{kg \cdot m}{s^2 \cdot A^2}$, with a 3.54% error.