MAGNETISM DAY 6: LAB: FORCE ON A CURRENT-CARRYING WIRE

CED 12.3 · Skills 3.A/2.D · FRQ: ED · bounded investigation

RETRIEVAL — NO DEMO

For a fixed wire length perpendicular to a fixed magnetic field, current doubles. Predict F_B: **halves / stays the same / doubles / quadruples**. Sketch the expected F_B-versus-I graph.

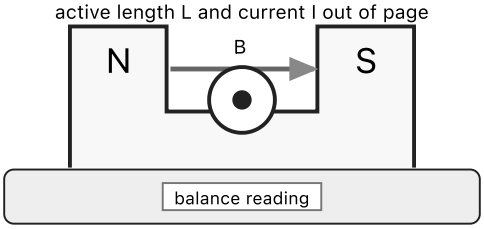
QUESTION AND MODEL

Question: How can the change in a balance reading determine the magnetic-field magnitude in the magnet gap?

$$F_B = BIL \quad (I \perp B) \qquad F_B = g|\Delta m|$$

WIRE-FORCE BALANCE ARRANGEMENT

Subtract the I = 0 baseline before converting balance change to force



PROCEDURE AND SAFETY

1. Measure the active wire length L in the field and record the $I = 0$ balance baseline.
2. Set a current, close the switch briefly, and record the current and balance reading.
3. Open the switch between trials. Repeat for the assigned current values.
4. Compute $\Delta m = m_I - m_0$. Convert grams to kilograms before multiplying by g.

Hot-wire limit: do not exceed the teacher's current or time limit. Switch power off before adjusting the wire or magnet.

I (A)	balance reading (g)	Δm (g)	$\lvert\Delta m\rvert$ (kg)	$F_B = g\lvert\Delta m\rvert$ (N)
0.0				
1.0				
2.0				
3.0				
4.0				

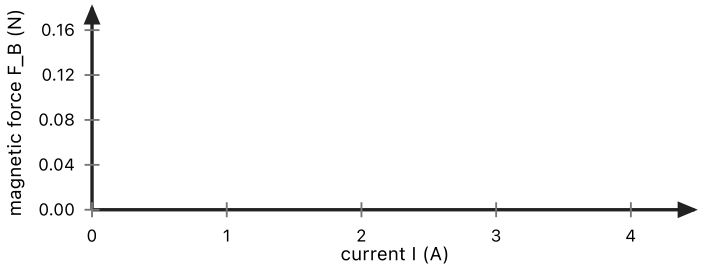
Control check: identify the quantities held fixed while current changes.

PROVIDED DATA AND GRAPH

If a balance rig is unavailable, analyze this dataset for $L = 0.120\,\text{m}$. The table already reports baseline-subtracted mass change.

I (A)	Δm (g)	F_B (N)
0.0	0.0	0.000
1.0	4.3	
2.0	8.6	
3.0	12.9	
4.0	17.1	

PLOT MAGNETIC FORCE VERSUS CURRENT



Graph calculation: determine the best-fit slope with units, then calculate $B = \text{slope}/L$.

ANALYSIS

1. State the relationship between F_B and I, using the graph as evidence.

2. Use the graph to predict F_B at $I = 5.0\ \text{A}$, without extending the apparatus beyond its safe current limit.

3. Explain why multiplying the entire zero-current balance reading by g would not give the magnetic force.

4. Identify one measurement limitation and state how it could affect the calculated field.

Required record: baseline, raw readings or provided data, converted forces, labeled graph, slope with units, field calculation, and evidence-based claim.