Year 12 Physics Current Balance

Practical test part 2

ANSWERS 13 Marks

The aim of this experiment is to calculate a theoretical value for μ_0

The following data was collected from a current balance experiment.

Mass of wire = 1.45×10^{-5} kg

Length of loop (see saw balance) $\ell_{loop} = 3.00 \times 10^{-2}$ m

Number of coils (N) on the solenoid = 730

Length of solenoid $\ell_{soleniod} = 0.150$ m

1. Complete the table by calculating $B_{solenoid}$.

(3 marks)

Working space

$I\ell B = mg$

$B = mg/I_{loop}\,\ell_{loop}$

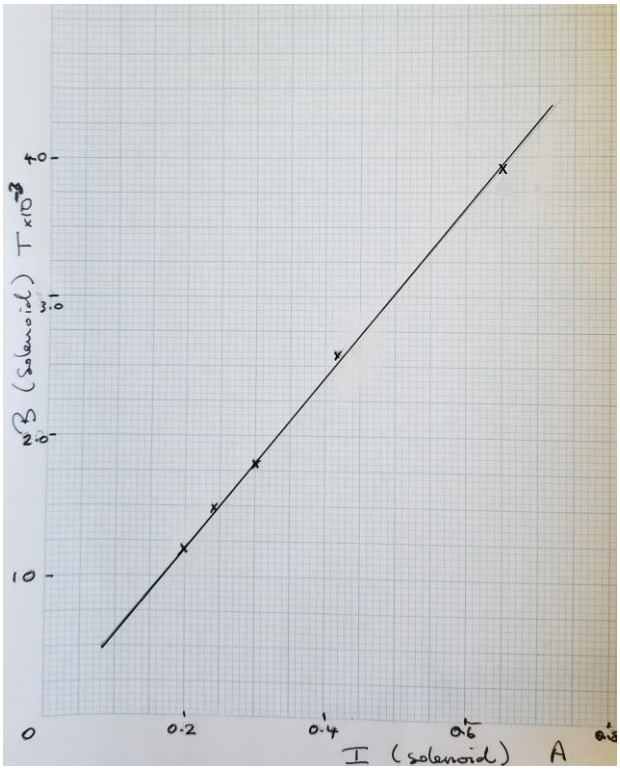
$= (1.45 \times 10^{-5} \times 9.8)/1.2 \times 0.03)$ $\quad (= 4.74 \times 10^{-3}/ I_{loop})$

$= 3.9 \times 10^{-3}$ T

-1 mark each error (eg using $I_{solenoid}$ or N=730 for loop) to max -2 marks

1 mark for 2 sig figs. (I_{loop} only has 2 sf)

$I_{solenoid}$ (A)	I_{loop} (A)	$B_{solenoid}$ (T)
0.65	1.2	3.9×10^{-3}
0.42	1.8	2.6×10^{-3}
0.30	2.6	1.8×10^{-3}
0.24	3.2	1.5×10^{-3}
0.20	4.0	1.2×10^{-3}



2. Use this data to draw a graph of $B_{solenoid}$ vs $I_{solenoid}$ (4 marks)
   1 data points, 1 LOBF, 1 Labels, 1 Correct current used

3. Calculate the gradient of this graph (4 marks)

   Eg: $m = (3.6 - 1.2) \times 10^{-3}/(0.60 - 0.2)$
   $= 6.0 \times 10^{-3}$ TA^{-1} (1) ANS

   Must show how gradient is calculated from graph (1)
   Units (1)
   2 sig fig (1) -1 if (0,0) used. (Since this is a point on LOBF it should be ok but not so for WACE!)

4. The relationship between the current in a solenoid and the field in the solenoid is

$$B_{solenoid} = \frac{\mu_0 N I_{solenoid}}{\ell_{solenoid}}$$

Use this relationship to find a value for μ_0 (2 marks)

$$\text{Slope} = \frac{\mu_0 N}{\ell_{solenoid}}$$

$$\mu_0 = \text{Slope} \times \ell_{solenoid} / N$$

$= 6.2 \times 10^{-3} \times (0.15/730)$ -1 if slope not used.
$= 1.2 \times 10^{-6}$ NA^{-2} (units and 2 sig fig not required).