OCR A Physics A-Level

PAG 11.3

Determining the uniform magnetic flux density between the poles of a magnet using a current-carrying wire and digital balance

Equipment
- Wire
- 2 stands with clamps
- 2 identical magnadur magnets (magnetised along long face)
- Mass balance
- Ammeter
- Power pack
- Ruler

Method
1. Set up the wire so it is between the faces of the magnets and both the wire and magnets are on top of the balance, the ammeter and power pack should be part of the complete circuit.
2. With no current flowing, zero the balance.
3. Change the supply voltage so that the current, measured on the ammeter, flowing through the wire is 6.0 A.
4. Record the reading on the mass balance.
5. Repeat the steps and readings for I = 5.0 A, 4.0 A, 3.0 A, 2.0 A and 1.0 .
6. Find a second set of results by repeating the experiment.
7. Using a ruler measure the length of the magnadur magnets, L, in metres. (This is the length of wire in the magnetic field).

Calculations
- Find the mean reading on the mass balance (m) for each current (I)
- Plot a graph of the mean m against I.
- Draw a line of best fit through the points forming a straight line graph through the origin and calculate the gradient.
  - The force on the wire is F = BIL (B is the magnetic flux density in Tesla).
  - This is equal to the force found from the balance reading (m) where F = mg/1000
  - (converting m into kg and with g = 9.81Nkg^{-1}).
  - Hence BIL = mg/1000
  - Make B the subject $B = \frac{mg}{IL \times 1000}$
  - The gradient of the graph is m/I so $B = gradient \times \frac{g}{L \times 1000}$

Safety
- When using magnets, students with pacemakers should not be near the magnets as they can interfere with their pacemaker's function.