INVESTIGATION OF THE FORCE ON A CURRENT IN A MAGNETIC FIELD

Specification reference: **A level Component 3.9 – Magnetic Fields**

Theory:

The force on a current carrying wire in a magnetic field is described by the relationship: $F = BIl\sin\theta$. In this practical arrangement, the value of $\theta = 90^0$ so the equation can be simplified to $F = BIl$. The value of F is determined by the weight of the magnet placed on a balance. In effect $F = \Delta mg$ where Δm is the apparent change in mass as F varies due to the magnitude of the current. The current can be varied and a graph of F against I can be plotted which should be linear. The length of the wire can be measured and the magnetic flux density of the magnet can be determined from the gradient of the graph and the value of length of wire within the pole pieces of the magnet.

Apparatus:

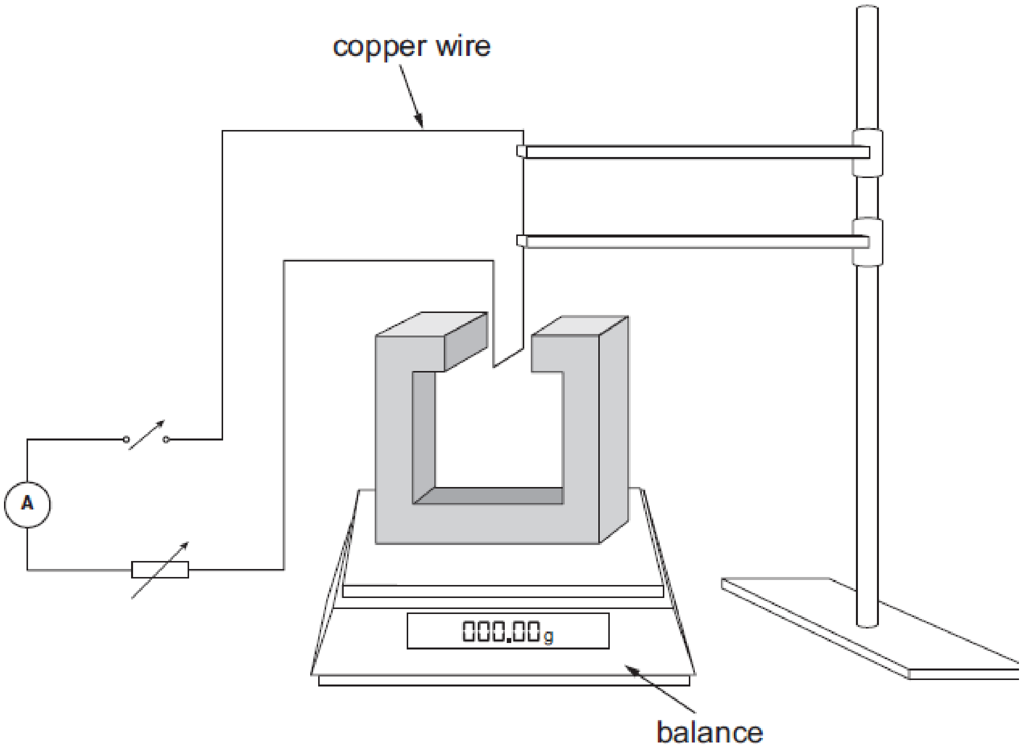
Electronic scales with resolution ± 0.001 g
Ammeter
Rheostat – value can be chosen so that the current can be varied in the range 0 to 3.00 A or 5.00 A
20 SWG copper wire
Ammeter or mutlimeter set to A range - ± 0.01 A
Variable d.c. power supply
U shaped soft iron section with ceramic pole pieces
Stand and clamp
Metre rule

Further Guidance for Technicians:

Electronic scales of resolution ± 0.01 g can also be used.

Experimental Method:

Set up the apparatus as shown in the diagram. Measure the length, l of the wire which is between the poles of the magnet. Use the rheostat to increase the current in steps from zero. For each chosen current value, record Δm, the apparent change in mass of the magnet (this can be an increase or decrease, depending upon the orientation of the current and the magnetic field). The force, F on the wire is calculated from $F = \Delta mg$ for each value of current I. A graph of F (y-axis) against I (x-axis) should be a straight line through the origin. The magnetic flux density, B of the magnet can be determined from: $B = \dfrac{\text{gradient}}{\text{length of wire}}$



Practical Techniques:

- Correctly construct circuits from circuit diagrams using d.c. power supplies, cells, and a range of circuit components, including those where polarity is important.
- Use ICT such as computer modelling, or data logger with a variety of sensors to collect data, or use of software to process data.