Notes For Use

B8H26629 **Apparatus to Show Force on a Conductor in a Magnetic Field** **NFU332**

Purpose

This kit is designed to show a simple yet effective demonstration of the force experienced by a conductor in a magnetic field. It consists of two magnets on the ends of a U-shaped support to set up a linear magnetic field between them. There is also a pair of strong brass rails with 4mm plugs at the end, and a light brass axle which is free to roll along the brass rails, across which it completes the circuit.

Requirements

A power supply capable of supplying 2-3V d.c. across a short circuit for example:

Bench PSU H10453
500mm 4mm plug leads:
Red A59169
Black A59158

The force on a charge q moving with velocity v is defined by the Lorentz Force Law:

$F = qE + qv \times B$

With no electric field present and travelling perpendicular to a straight magnetic field, this becomes F = qvB.

With conventional current (positive to negative), the direction of the force can be determined using the left hand rule.

First **F**inger **F**ield
se**C**ond finger **C**urrent
thu**M**b **M**otion

version A48215.15.10

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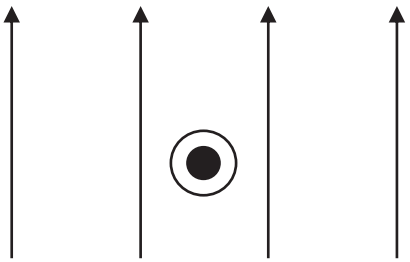
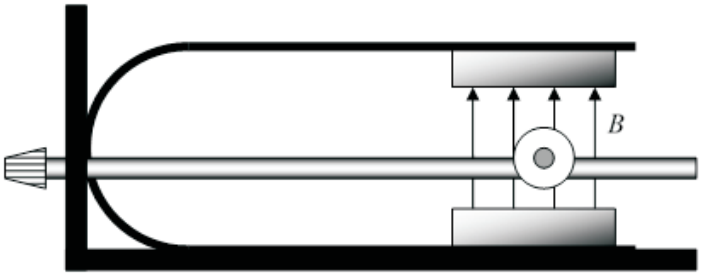


Consider this experiment

A conducting wire is perpendicular to a vertical magnetic field. The current is travelling towards you out of the page.
In which direction will the Lorentz force act?

Answer: Left

Experiment

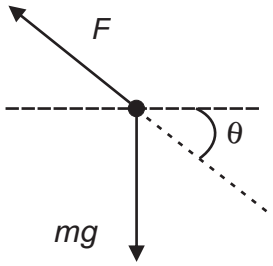


The most effective way to demonstrate the effect is to put everything in place before turning on the power. First, rest the axle across the rails, and roll it between the magnets.

Next, connect the apparatus to a power supply using two 4mm leads. The polarity of the current is important, so it may be worth using red and black wires to indicate this.

Before turning on the power, try to determine which direction you believe the axle will roll using the left hand rule. Turn on the power to see if you are correct. Try reversing the polarity of the current to demonstrate the effect this has on the force.

It's possible to determine the force exerted on the conductor using a protractor. Set up the apparatus as before, and set the power supply to 3V. Slowly lift the apparatus at one end, the axle should not roll down. Keep lifting slowly until the axle starts to roll and then stop lifting immediately. Use the protractor to measure the angle at which it began to roll.



By resolving the forces on the axle, it's quite easy to calculate the Lorentz force counteracting the weight:

F =mgcos?

Of course, you'll have to measure mass of the axle, which will be on the order of 4 grams.

CAUTION The axle gets very hot after a short time due to the high current flowing through it.
Minimize the amount of time that power is connected.

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Maintenance

Keep the surfaces of the rails and axle clean, to reduce both electrical resistance and friction between the surfaces.

Warranty, repairs and spare parts

The Apparatus to Show Force on a Conductor in a Magnetic Field is guaranteed for a period of one year from the date of delivery to the customer. This warranty does not apply to defects resulting from the action of a user such as misuse, improper wiring, any operations outside of its specification, improper maintenance or repair, or unauthorized modification.

Our liability is limited to repair or replacement of the product. Any failure during the warranty period should be referred to Customer Services.

In the event of a fault, apart from replacing the instrument fuse in the IEC socket, the Apparatus to Show Force on a Conductor should be referred to the Philip Harris recommended repair agent.

Please contact Customer Services or techsupport@philipharris.co.uk for advice.

Supplier details

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Orders and Information Tel: 0845 120 4521
Fax: 0800 138 8881
Repairs Tel: 0845 120 3211

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