

Tap 412-1: Forces on currents

These activities allow qualitative investigation of the forces on currents.

You will need:

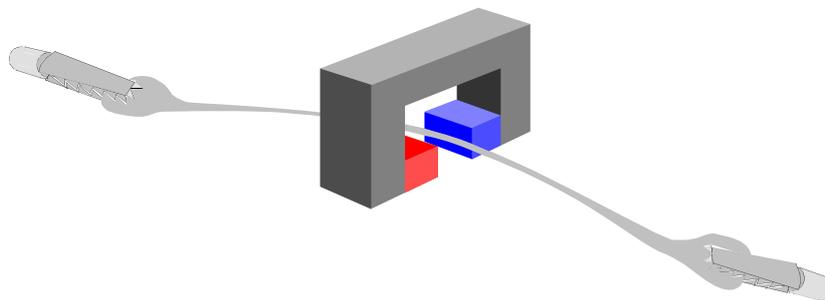
- ✓ aluminium foil
- ✓ scissors
- ✓ large horseshoe magnet
- ✓ two clip component holders
- ✓ four long 4 mm leads
- ✓ power supply, 0–12 V plus rheostat (4 A) (or Westminster Very Low Voltage power supply)

	Safety If the current is too large then the foil will get hot and the forces will be too large and tear the foil. When using two strips of foil be aware that if they touch sparking may occur. Care is needed, and the pd must remain modest
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You will be making some general observations about forces on currents. As force is a vector, you will be interested to see how large the force is and in what direction it acts. Systematic observations will be essential.

The force on a current in a magnetic field

The current passes through a strip of aluminium foil. The movement of this foil shows the size and direction of the force. The foil is placed in the magnetic field of a large permanent magnet and connected to the power supply.



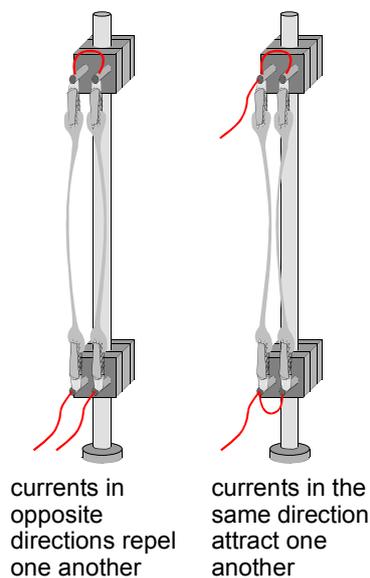
1. Set the power supply to 1 V, switch on, and observe what happens to the foil.
2. Increase the power supply to 2 V. What happens?
3. Now reverse the connection to the power supply. What happens?
4. Finally, reverse the magnet. What happens to the foil?

What you have seen

1. The size of the force on a current in a magnetic field depends on the size of the current.
2. The direction of the force depends on the direction of the current and the direction of the magnetic field.
3. The direction of the force is at right angles to the current and to the magnetic field. (Fleming's left-hand rule.)
4. You have not seen that the size of the force also depends on the size of the magnetic field. But you can show that the magnetic field is essential to the force by removing the magnet!

The force between two currents

Set up two strips of foil as shown in the diagram and connect the power supply.



1. First, arrange the connections so the current is passing down both strips of foil. Set the power supply to 1 V. Switch on and describe what happens.
2. Increase the power supply to 2 V. What happens now?
3. Arrange the connections so that the current is passing up both strips of foil. What happens?
4. Finally arrange the connections so the current is passing up one foil and down the other. What is the result?

What you have seen

1. The size of the force between currents depends on the size of the current.
2. The direction of the force depends on the current directions. If they are in the same direction they attract. If they are in opposite directions, they repel. Like currents attract, unlike currents repel.

Practical advice

The main point is that currents experience forces in a magnetic field, which can be due to either a permanent magnet or another current. The size of the force depends on the sizes of the current and the magnetic field. Depending on your circumstances this may well be revision of pre-16 level work. You might like to extend the tasks. How does the force between currents depend on distance? What happens when alternating current is put through the foil in the field? What has this got to do with a possible loudspeaker or microphone?

	<p style="text-align: center;">Safety</p> <p>If the current is too large then the foil will get hot and the forces will be too large and tear the foil. When using two strips of foil be aware that if they touch sparking may occur. Care is needed, and the pd must remain modest</p>
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Technician's note:

Westminster power supplies are ideal for the first two experiments. If these are not available it may be necessary to put a high-current rheostat in the circuit to prevent the cut-out operating.

Alternative approaches

The option is to select one activity and to demonstrate it, with class discussion, as a revision exercise.

External reference

This activity is taken from Advancing Physics chapter 15, 290E