

Chapter 20. Electromagnetic Forces

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4.5.3 Magnetic effect of a current

Core

- 1 Describe the pattern and direction of the magnetic field due to currents in straight wires and in solenoids
- 2 Describe an experiment to identify the pattern of the magnetic field (including direction) due to currents in straight wires and in solenoids
- 3 Describe how the magnetic effect of a current is used in relays and loudspeakers and give examples of their application

Supplement

- 4 State the qualitative variation of the strength of the magnetic field around straight wires and solenoids
- 5 Describe the effect on the magnetic field around straight wires and solenoids of changing the magnitude and direction of the current

4.5.4 Force on a current-carrying conductor

Core

- 1 Describe an experiment to show that a force acts on a current-carrying conductor in a magnetic field, including the effect of reversing:
 - (a) the current
 - (b) the direction of the field

Supplement

- 2 Recall and use the relative directions of force, magnetic field and current
- 3 Determine the direction of the force on beams of charged particles in a magnetic field

4.5.5 The d.c. motor

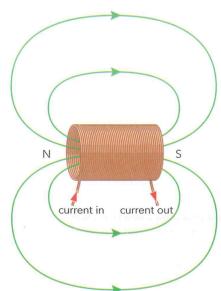
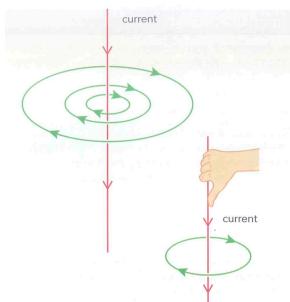
Core

- 1 Know that a current-carrying coil in a magnetic field may experience a turning effect and that the turning effect is increased by increasing:
 - (a) the number of turns on the coil
 - (b) the current
 - (c) the strength of the magnetic field

Supplement

- 2 Describe the operation of an electric motor, including the action of a split-ring commutator and brushes

20.1 The Magnetic Effect of a Current - Summary



Exercise:

Complete the following sentences

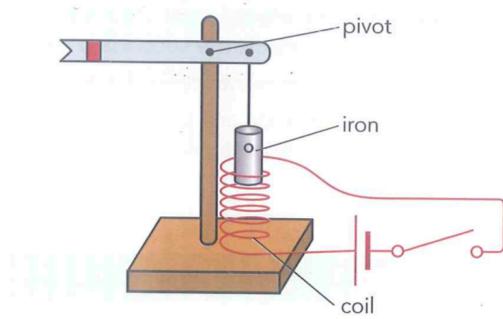
There is a magnetic field around a conductor when it carries

The field lines around a straight wire are

The direction of these field lines can be found using

The field around a solenoid is the same as that around a

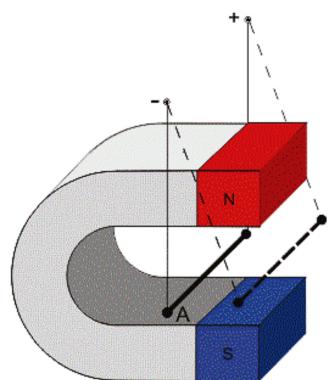
Explain what happens when the switch is closed, and then when it is re-opened?



20.2 Force on a Current - Carrying conductor

Motor effect: when a current-carrying wire is crossed with magnetic field lines, it will be moved.

Basic requirements for motor effect:

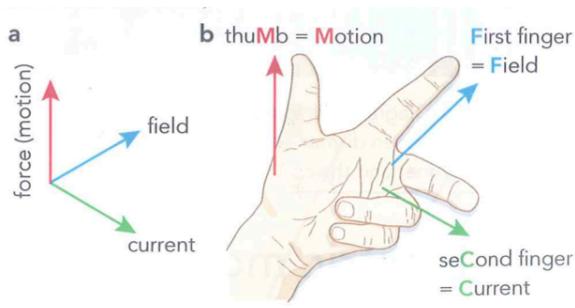


The direction of force can be reversed by:

Reversing the direction of the current

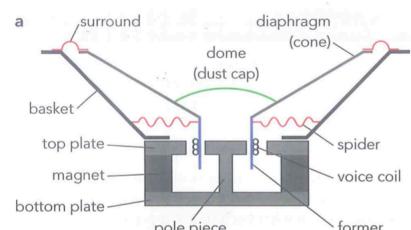
Reversing the direction of the field of the permanent magnet by turning it around

How do we determine the direction of force (Ampere's force)? => **Fleming's left-hand rule**



- the First finger is Field
- the seCond finger is Current
- the thuMb is force or Motion.

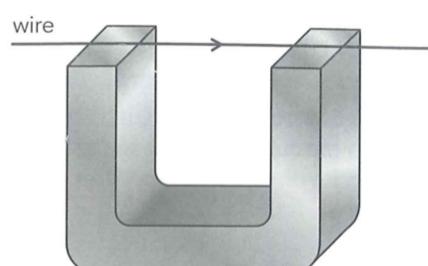
Ampere force = demo



Prove reversion of force



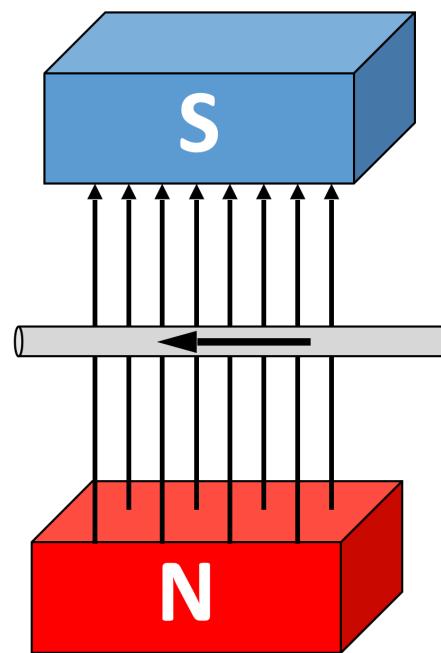
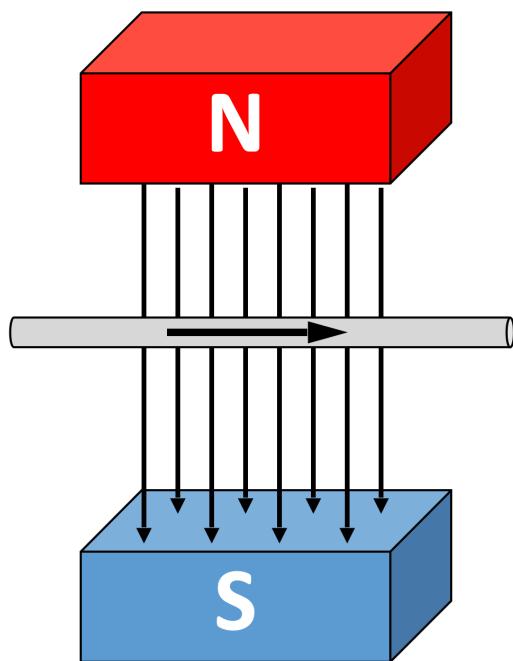
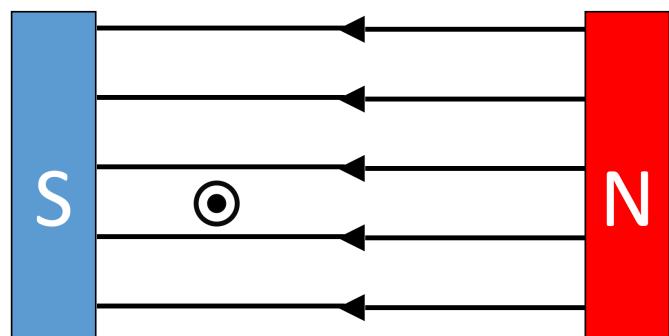
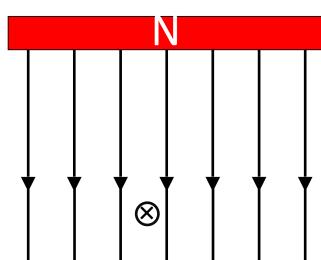
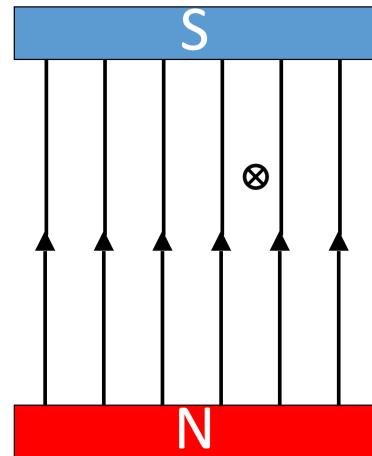
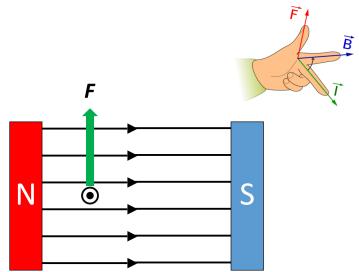
Motor effect application

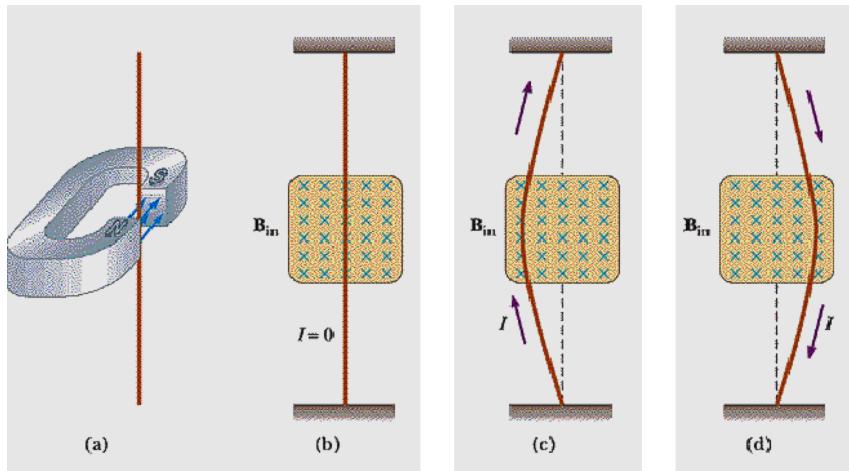
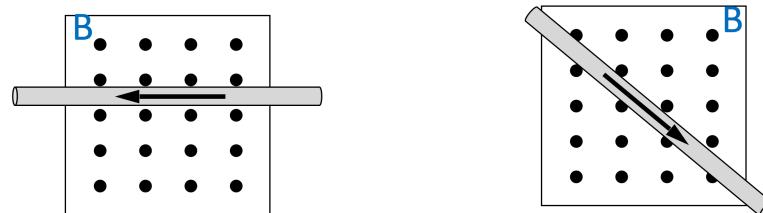
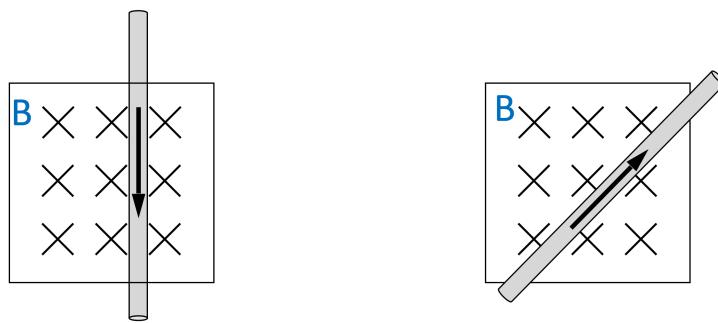


Exercise
explain why the wire will not move

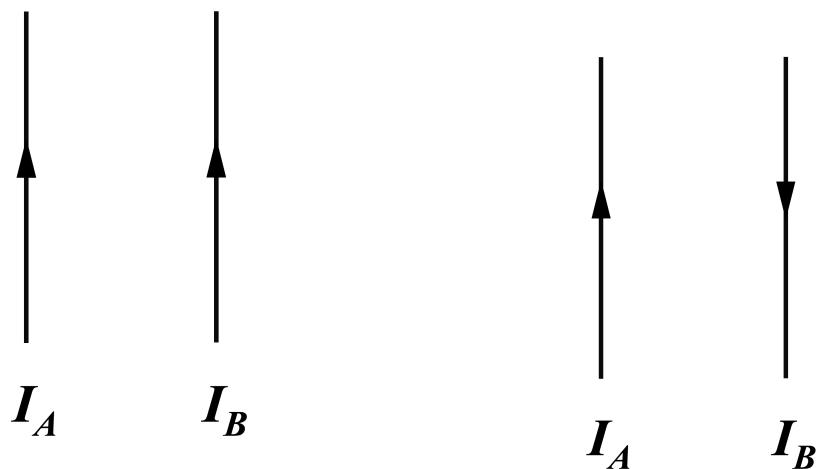
exercise:

Can you determine the direction of force that the wire experience in the following settings?
First one is done for you as an example.

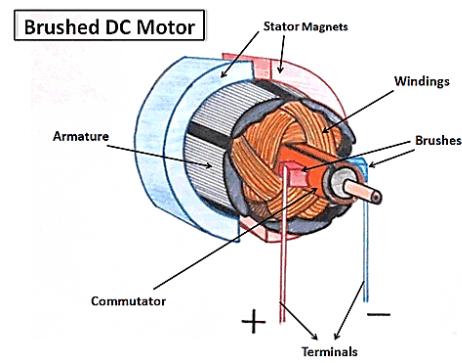




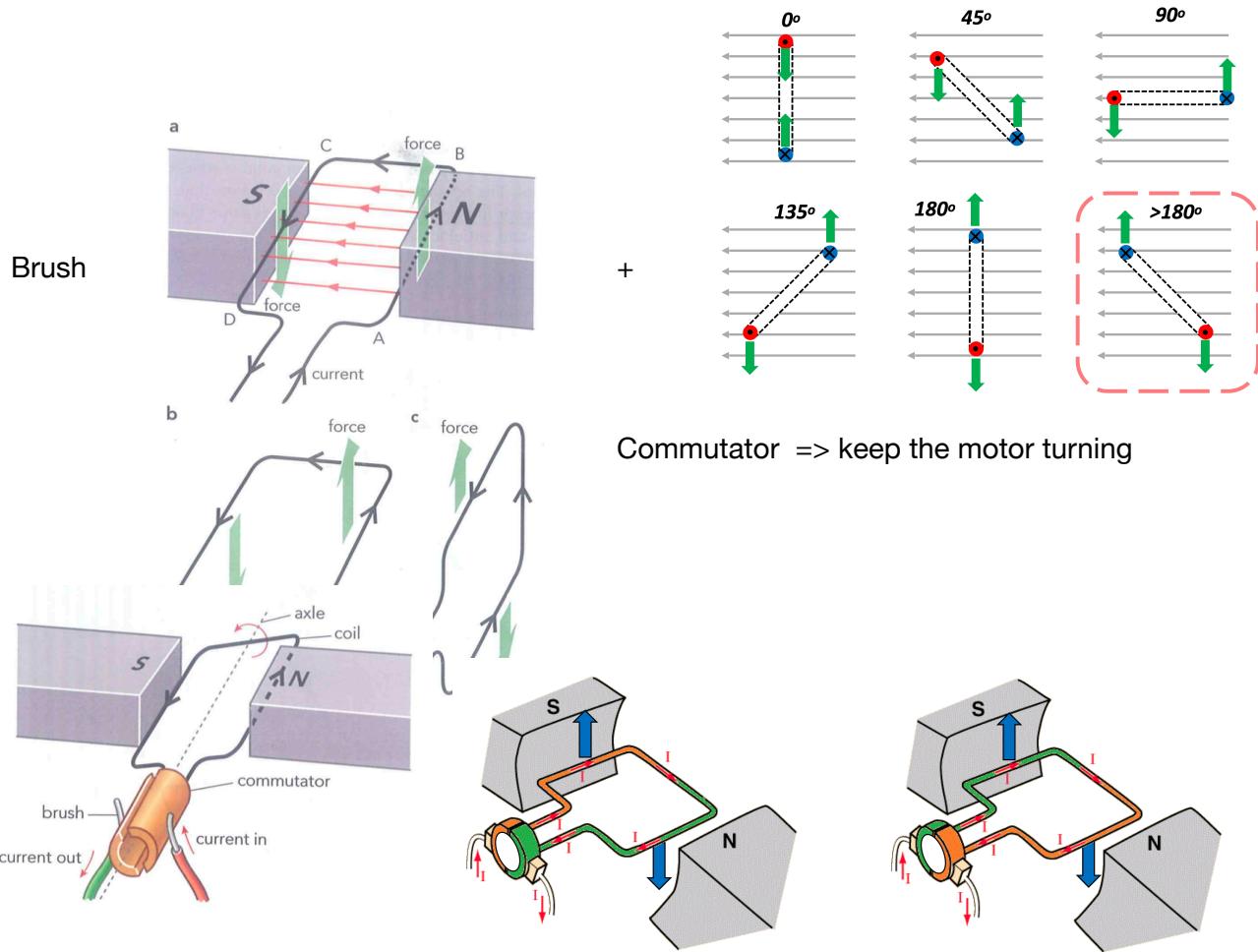
Can you use what you just learned to explain why two wires carrying same/opposite direction of current will appear attractive/repulsive to each other?



20.3 Electric Motors (d.c. motor)



How motor works?



How to increase turning effect?

Exercise:

Describe the energy transfers that happen in
A an electric motor
B a loudspeaker

Describe the motion that would be seen if the coil in a motor was attached directly to a d.c. power supply without a commutator/

20.4 Beams of charged particles and magnetic fields

Cathode-ray tube

Electron beam in cathode-ray tube

Particle accelerator in CERN