Chapter 20. Electromagnetic Forces

Contents:

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

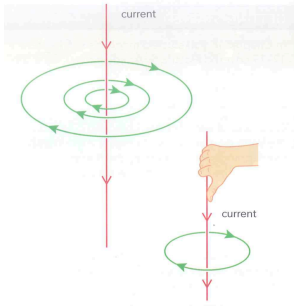
Core

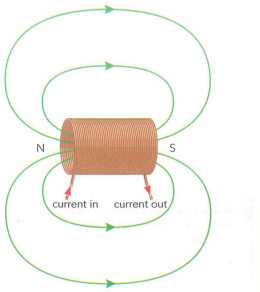
1 Know that a current-carrying coil in a magnetic field may experience a turning effect and that the turning effect is increased by increasing:
   (a) the number of turns on the coil
   (b) the current
   (c) the strength of the magnetic field

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 20.1:

Complete the following sentences

There is a magnetic field around a conductor when it carries _____

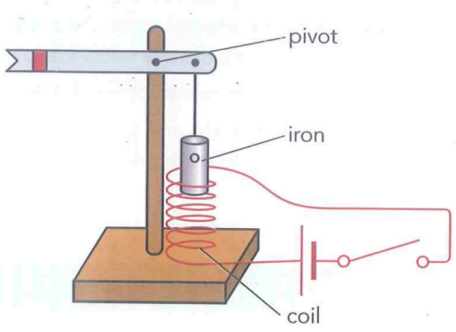
The field lines around a straight wire are _____

The direction of these field lines cam be found using _____

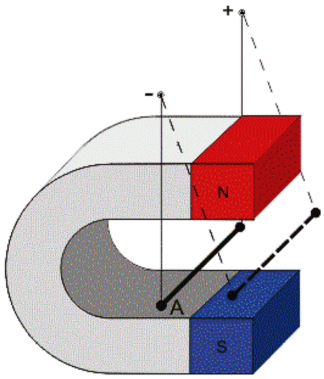
The field around a solenoid is the same as that around a _____

Exercise 20.2:

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



20.2 Force on a Current - Carrying conductor

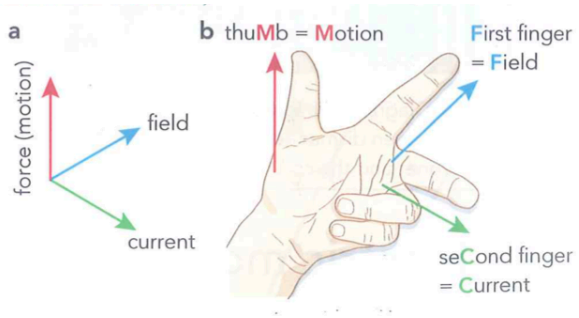


Motor effect:

Basic requirements for motor effect:

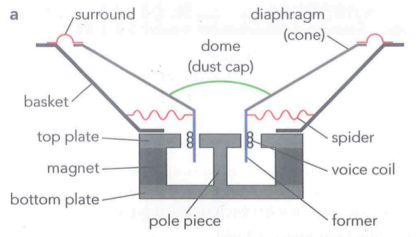
The direction of force can be reversed by:

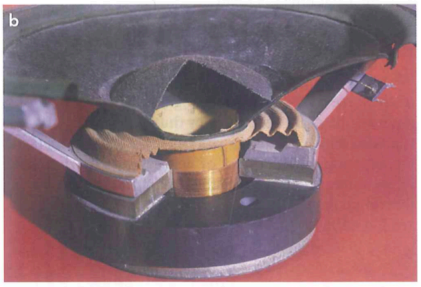
How do we determine the direction of force (Ampere's force)? =>



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

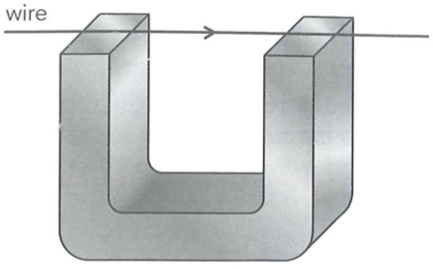
Motor effect application





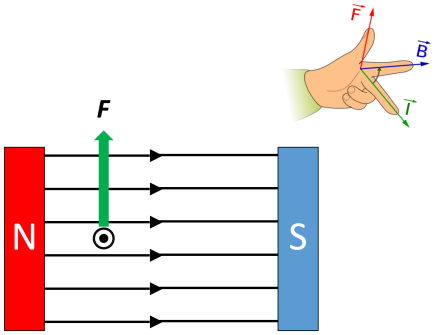
Exercise 20.3:

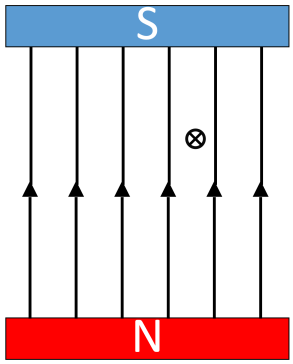
Explain why the wire will not move

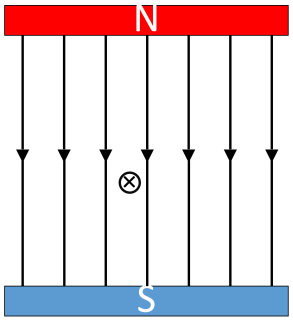


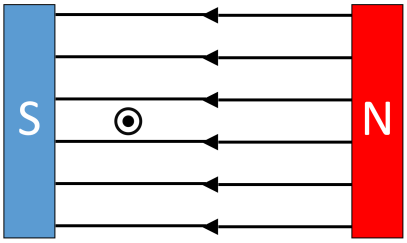
Exercise 20.4:

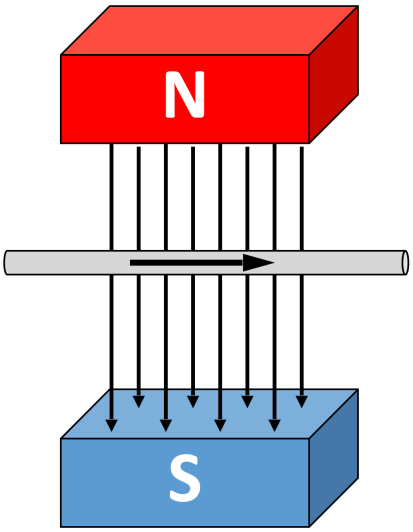
Can you determine the direction of force that the wire experience in the following settings? First one is done for you as an example.

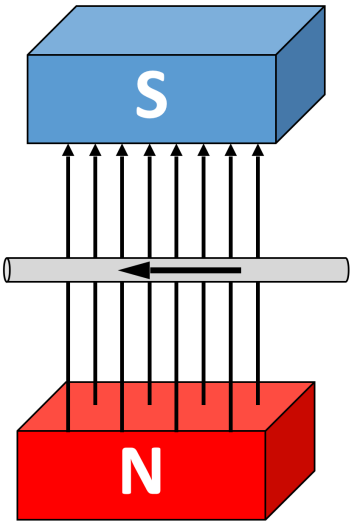


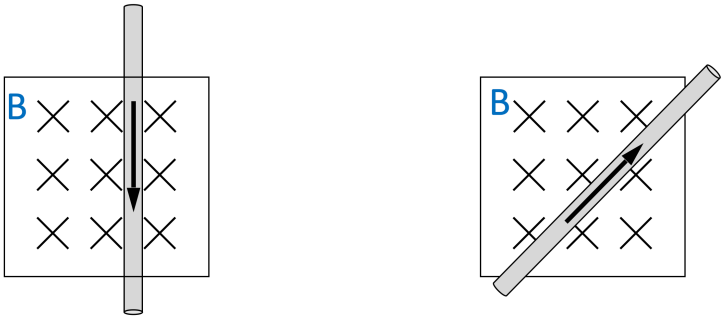


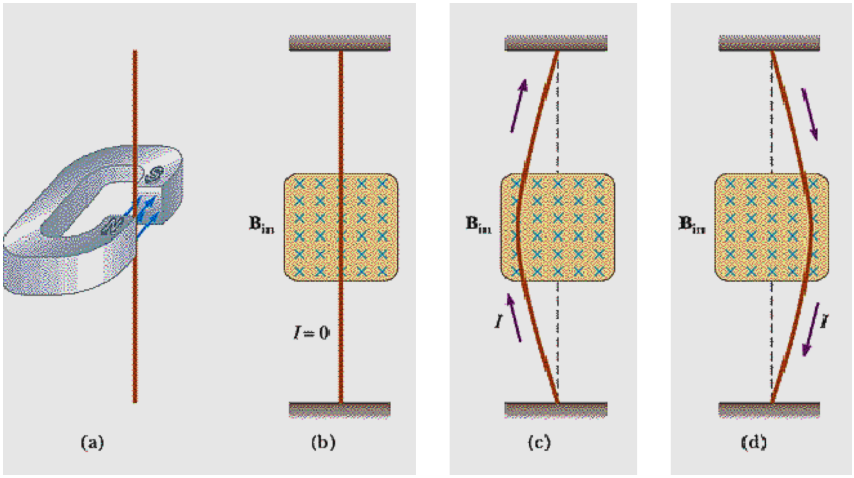






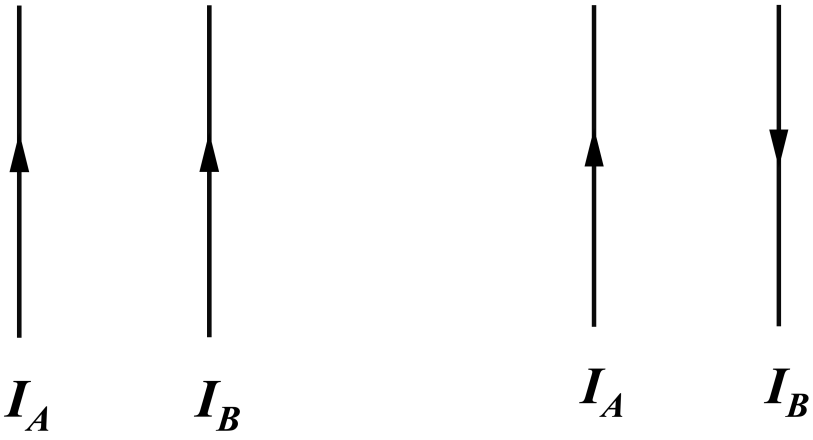




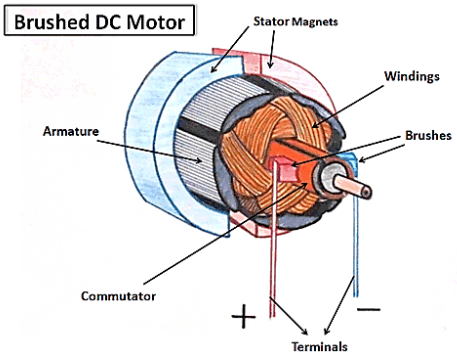


Exercise 20.5:

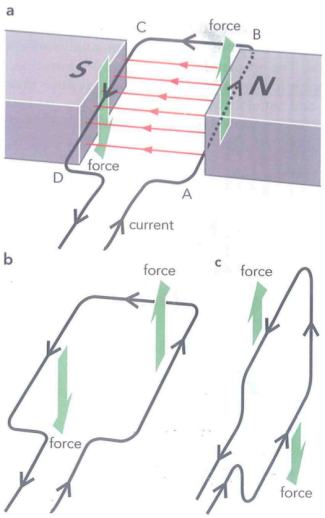
Can you use what you just learned to explain why two wires carrying same/opposite direction of current will appear attractive/repulsive to each other?

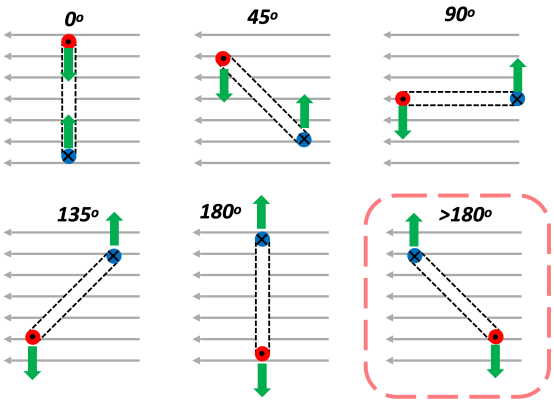


20.3 Electric Motors (d.c. motor)

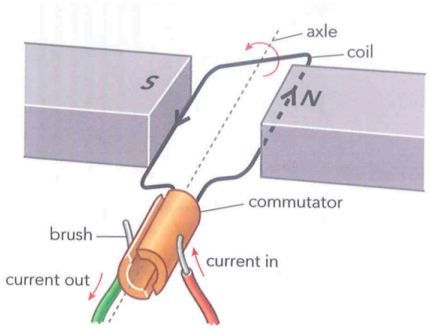


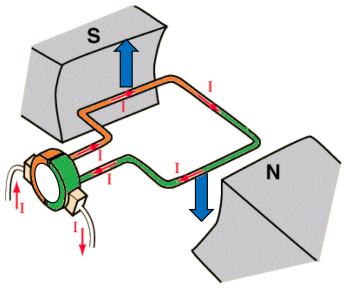
How motor works?

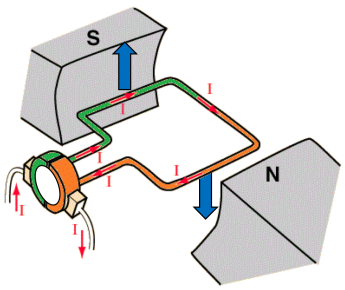


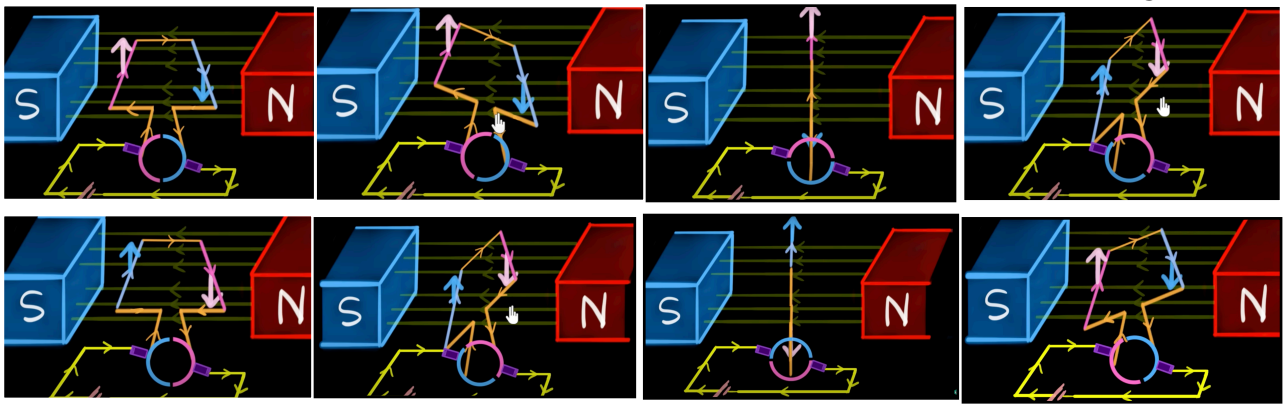


keep the motor turning? => Brush + Commutator









How to increase turning effect?

Exercise 20.6:

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

Exercise 20.7:

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