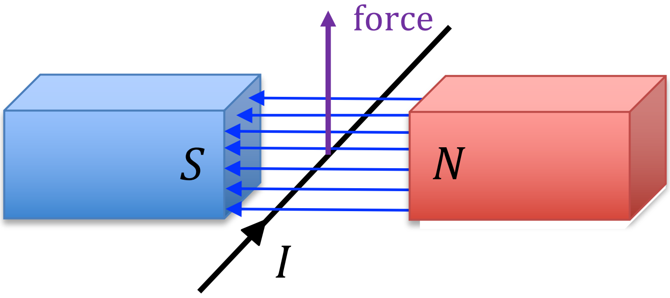
7.3.1 The motor effect

videos

If we pass a current (I) through a wire that is in a magnetic field (B), it experiences a force (F).



If the wire is at right angles to the magnetic field, the size of the force on a length (l) of wire in the magnetic field is given by:

$$F = BIl$$

where B=magnetic flux density (in Tesla), I=current (in amperes), and l=length of wire in magnetic field (in metres)

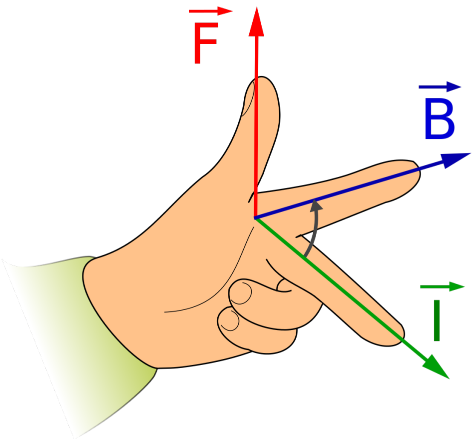
(1)✐What happens to the size of the force if the length of wire in the field is doubled?

(2)✐What happens to the size of the force if the current is halved and the magnetic flux density is doubled?

(3)✐Calculate the force on a 0.02m length of wire, carrying a current of 1.5A in a magnetic field of 0.05T.

When a current is passed through a wire, it generates a magnetic field around the wire. This magnetic field interacts with the magnetic field from the permanent magnet. This results in a force on the wire.

(4)✐The permanent magnet also experiences a force. How does the direction and size of this force compare to the force on the wire? (Hint: Look up Newton's third law.)



The direction of the force on the wire depends on the direction of the magnetic field and the direction of the current. The force is always at right angles to both of these. We use Fleming's Left Hand Rule to work out the direction.

As shown (left), the first finger points in the direction of the magnetic field (N to S), the second finger points in the direction of the current (flowing from positive to negative), and the force direction is the direction the thumb points. One way to remember these is to think of "FBI" as in the Federal Bureau of Investigation.

(5) What direction is the force in the following situations?