MAGNETISM AND MATTER

THE BAR MAGNET

The Bar Magnet

We all have played with magnets in our childhood. All of us had a Bar Magnet as our favorite toy! It was quite surprising to wonder how a tiny piece of the magnet could attract so many iron scraps. We basked in the magic when one magnet repelled another! It was indeed a glorious time! Well, today it is time to decode the theory of magnets!

Introduction

In this chapter, we will discuss all magnets, particularly bar magnets. We will look at their properties and other related terms. Let us start with the types of magnets. Let us look at the types of magnets in brief:

- Natural Magnets: They occur in nature and have a weak magnetic field. Examples include lodestones.
- Artificial magnets: They are produced by man-made means and have a stronger magnetic field. You can shape them as required. When shaped in form of a bar, they are called bar magnets.

Bar Magnet

A bar magnet is a rectangular piece of the object. It is made up of iron, steel or any other ferromagnetic substance or ferromagnetic composite, having permanent magnetic properties. The magnet has two poles: a north and a south pole. When you suspend it freely, the magnet aligns itself so that the north pole points towards the magnetic north pole of the earth.

Properties of Bar Magnet

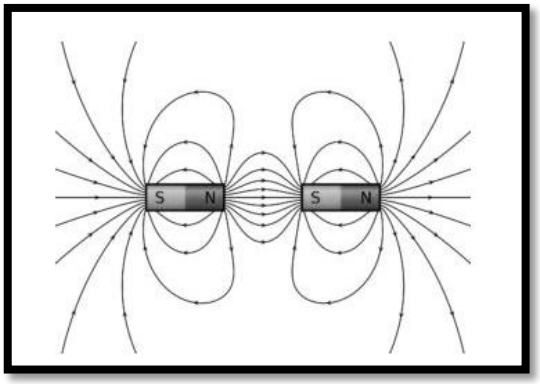
A bar magnet's properties are similar to those of permanent magnets. Let us look at them in the below section. The bar magnet has a north pole and a south pole at two ends. Even if you break a bar magnet from the middle, both the pieces will still have a north pole and a south pole, no matter how many pieces you break it in.

The magnetic force of it is the strongest at the pole. When the magnet is suspended freely in the air with a thread, it will not come to rest until the poles are aligned in a north-south position. A Mariner's Compass uses this property to determine direction.

When you place two bar magnets close to each other, their unlike poles will attract and like poles will repel each other. A bar magnet will attract all ferromagnetic materials such as iron, nickel, and cobalt.

Magnetic Field Lines

Let us understand the concept of magnetic field lines using the activity described below. Let us sprinkle iron filings on a sheet of paper and a bar magnet in between. When we tap the paper, we notice that the fillings get aligned in the form of many lines. The patterns of the filings show us the magnetic field lines that surround this bar magnet.



The magnetic field lines can be defined as imaginary lines that can be drawn along the magnetic field that is acting around any magnetic substance. The magnetic field lines possess certain properties. They are mentioned below.

- The magnetic field lines of a magnet form continuous closed loops.
- The tangent to the field line at any point represents the direction of the net magnetic field B at that point.

- Larger the number of field lines crossing per unit area, the stronger is the magnitude of the magnetic field B..
- The magnetic field lines do not intersect.

Pole Strength

The Pole strength of a bar magnet can be measured by moving it along an 'infinite' wire and carefully measuring the amount of current that is created. The formula for calculating the pole strength is:

Where p = the Strength of the magnetic pole, W = the work-done while moving the magnet around the wire, I = the electric current in the wire.

Alnico and Neodymium Bar Magnet

It will be incomplete to talk about bar magnets and not mention Alnico bar magnet and neodymium bar magnet. The primary components of Alnico magnets are aluminum, nickel, cobalt, and iron.

These magnets produce a strong magnetic field and retain their magnetic property even under extreme heat. Neodymium bar magnets are made with a mixture of neodymium, boron, and iron. These are both extremely powerful magnets but very brittle.

Q: Assertion: It is not necessary that every magnet has one North Pole and one South Pole.

Reason: It is a basic fact that magnetic poles occur in pairs.

A. Both the statements are true and the reason is a correct explanation of the assertion.

B. The statements are true but the reason is not the correct explanation of the assertion.

C. Assertion is true but the reason is wrong.

D. The reason is true but the assertion is wrong.

Sol: D) As you move on in Physics, you will be able to show that magnetic monopoles i.e. the isolated North Pole or the isolated South Pole of a magnet can't exist. But a magnet may have more than one pole when it is called the multipole. Therefore the answer is D.

Q: Why are some magnets shaped like a horseshoe?

Sol: Some magnets are shaped like a horseshoe because of the high magnetic flux at the end. The lifting power of a horseshoe is more than that of a simple rectangular bar magnet. Thus, having a horseshoe shape makes them powerful.