

Vigyan Pratibha Learning Unit (Teacher Version)

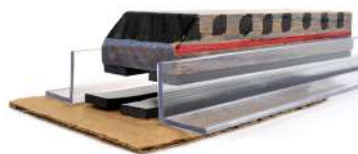
Force between magnets

Motivation:

Many of you must have had memorable experiences with magnets and magnetic materials. Magnetic materials are generally encountered around the home, often holding small objects on the kitchen fridge.

The vast majority of magnets we encounter (e.g. fridge magnets, door catches and magnetic toys) are manufactured from materials which are based on mixtures of iron, nickel or cobalt. Stronger magnets can be made with these and the addition of rare earth elements.

You know that like magnetic poles repel and unlike magnetic poles attract each other. Infact one of our favourite science exhibition topics is the magnetic levitating train in which a train (with magnets attached at the bottom) floats over a magnetic track.



? But have you ever wondered about how much weight magnets in repulsive mode can lift? In other words, if a magnet is floating (levitating) on top of other magnet, how much force it must be exerting on the bottom magnet?

Lets try to find it out.

Learnings:

In this activity we will investigate the force of repulsion between two magnets.

Prerequisites:

Like poles repel and unlike poles attract. (VI std. NCERT Science textbook, Page 131)

Precautions:

Discuss safe use of magnets with the class. Magnets should be handled carefully. If they are banged against the table or broken they lose their magnetic force.

Materials/facilities required:

2 ferrite magnets, Two 15 cm plastic rulers, Weighing scale (Maximum weighing limit - 1 kg), card board, punching machine, Permanent Glue, retort stand.

Learning unit type:

Group of 4 students. Unit is in two parts. Part I is the design part and part II is the measurement of force of repulsion between two levitating magnets.

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Learning unit I: Designing the levitation assembly

1. Take two ferrite magnets (40 mm × 25 mm × 10 mm), which have their poles on surfaces. Check for their like poles. Make a mark to identify them using a marker.
2. Paste small paper strips along the long edges of the magnets using the permanent glue.
3. Paste the 15 cm rulers on these paper strips for one of the magnets using the permanent glue.



4. Take a 1 inch wide and 30 cm long satin ribbon.



5. Paste another magnet at the center of this ribbon.



6. Join and paste both ends of the ribbon (with the glue) with a small square piece of cardboard sandwiched between ribbon ends.



7. Punch a hole at the center of the cardboard square.



8. Mount the assembly on the retort stand as shown. Hold the weighing scale firmly in the clamp.



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Discussion:

1. Why do you think the paper strips are needed?

If the plastic rulers are pasted directly on the bottom magnet then the top magnet will experience friction with the ruler wall when pressed down. For smooth movement of the top magnet it is necessary to keep some gap between the edges of the top magnet and ruler wall.

2. Is it necessary to use ferrite magnets?

No. One can use any other type of magnets. The only change will be in the construction of the walls for the movement of top magnet. Walls are necessary to restrict the top magnet to move in straight line.

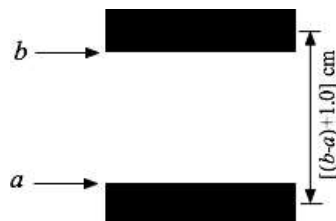
3. Is it necessary to choose thicker ferrite magnets?

Thicker the magnets lesser will be the chance of flipping during levitation.

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Learning unit II: Measuring the force of repulsion between magnets

1. Observe the weighing scale reading when the top magnet (pasted with bolt) is just floating.
2. Also note down the ruler readings of top magnet and bottom magnet. For convenience, you may note down the lower edge of top magnet (b) and upper edge of the bottom magnet (a).
3. Hold both the rulers and pull them down such that top magnet moves down with surfaces of both magnets remaining parallel to each other.
4. Change b in steps of 0.2 cm. Note down the corresponding weighing scale reading.
5. Repeat step 4, twice.
6. Plot a graph between the weighing pan reading (Y-axis) and the distance between the magnets (X-axis).



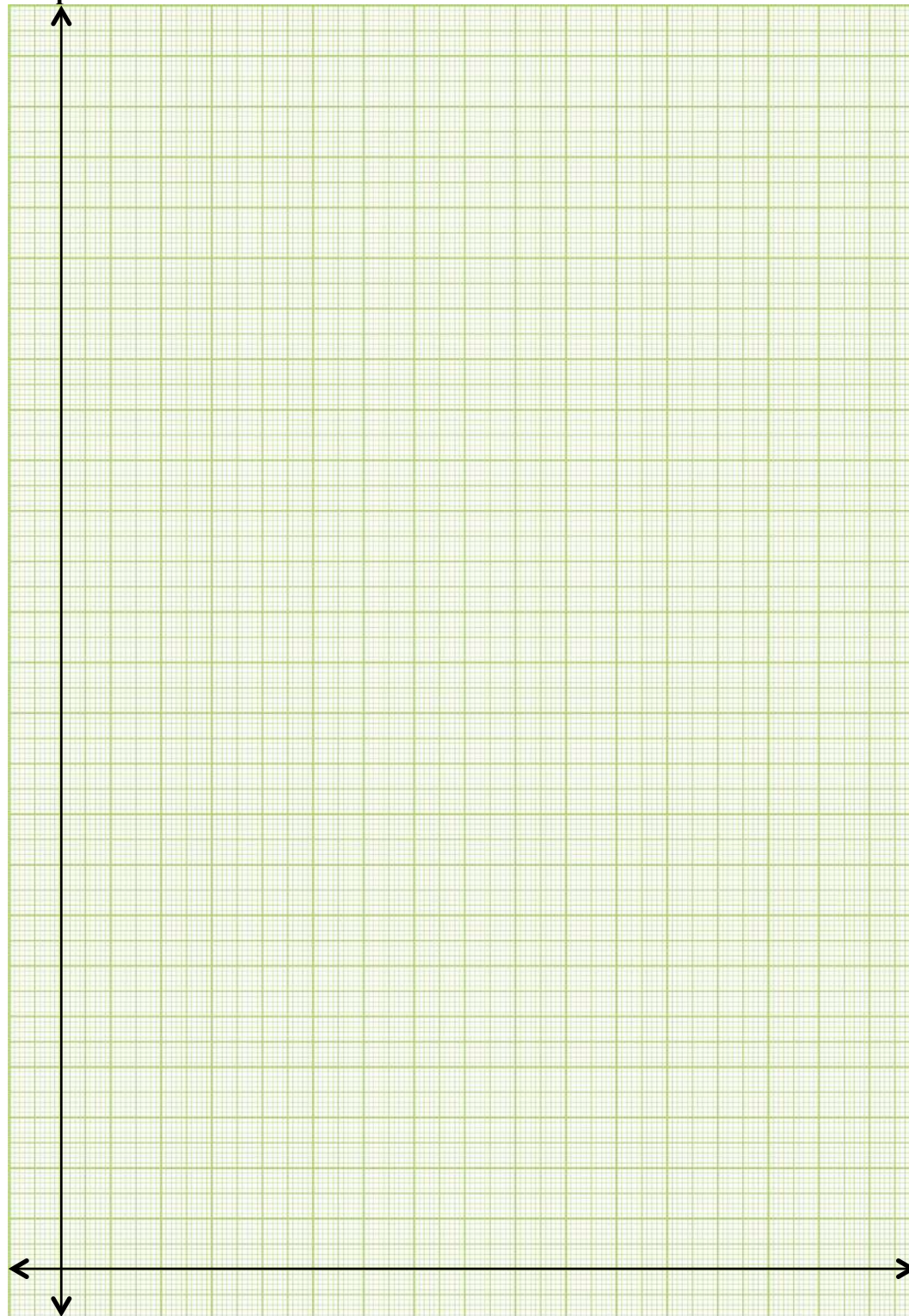
Observation table:

Ruler reading of the upper edge of the bottom magnet = $a =$ _____ cm

No.	Ruler reading of the lower edge of the top magnet, (b) /cm	Distance between magnets $[(b - a) + 1.0]$ /cm	Weighing scale reading /g			
			m_1	m_2	m_3	Mean m
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

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Graph:



Discussion:

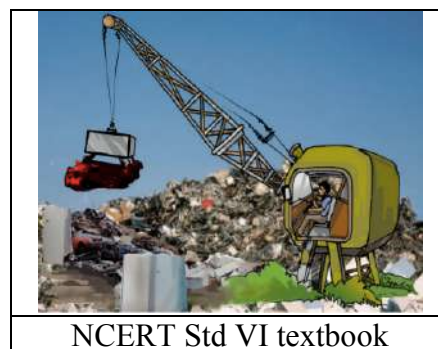
1. Does the force of repulsion linearly increase or decrease?

The force does not vary linearly. With decreasing distance it increases quite rapidly.

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For Teachers:

- Since students at 6th standard may not have an idea of what force is, they can be explained that weight is a force caused by gravity. The more mass the object has the greater its weight will be. Weight is a force, so it's measured in newtons.
- Students will explore, the magnitude of weight, a levitating magnet can lift. But this activity has a further potential to understand the relationship between the force of repulsion between two magnets.
- It can be shown that the force between the magnets is proportional to the inverse of fourth power of distance between the magnets.
- Instead of regular bar magnets or ferrite magnets, it can be interesting to explore rare-earth magnets, which are much stronger. Rare-earth magnets are cheaper than these magnets. Some online websites provide these magnets.
- This force-distance relationship can also be explored for a solenoid (electromagnet) – magnet assembly. Students can also be explained that the role of huge solenoids used in junkyards.



NCERT Std VI textbook